MERSEYSIDE RECYCLING & WASTE AUTHORITY

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Merseyside and Halton Waste Composition Study 2015/16

Final Project Report

July 2016

Amec Foster Wheeler Environment
& Infrastructure UK Limited

Report for

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Document revisions

No.	Details	Date
1	Draft Final Project Report 16173i1	May-2016
2	Final Report 16173i2	June-2016
3	Final Report 16173i3	June 2016
4	Final Report 16173i4	July 2016

Executive summary

Purpose of this report

This report has been produced for the purpose of identifying the main waste materials arising from the Local Authority areas in the Merseyside and Halton Waste Partnership (MHWP)[1] in the following waste streams:

- Kerbside collected household waste (residual, dry recycling and organics); and,
- Household Waste Recycling Centre (HWRC) residual waste.

The composition data for these waste streams will then be used by MHWP with operational data to inform the Joint Recycling and Waste Management Strategy review.

The aims of the project are to:

- Identify the composition (% weight) of household waste collected or recycled or composted or delivered for disposal in the Liverpool City Region through physical waste sampling;
- Estimate general household waste composition through combining composition and arisings data;
- Identify the proportion of the sample waste which could have been repaired or reused but are currently being sent for recycling or disposal; and,
- Estimate the biodegradable content and net calorific value (CV) of the kerbside and HWRC residual waste streams.

Table E.1 presents the kerbside waste composition results for MHWP.

Key results include:

- The high proportion of food waste in the residual stream at 39.1% (approximately 140,000 tonnes) of which 63.9% (approx. 90,000 tonnes) was "avoidable"[2]. WRAP (2014) *Household food and drink waste: A product focus* found that approximately 15% of all food and drink waste was thrown away in its packaging with around 4% thrown away in packaging which was not opened;
- Approximately 63% (approx. 225,000 tonnes) of the residual waste stream was potentially recyclable. The majority of the potentially recyclable material was food waste (approx. 140,000 tonnes) followed by recyclable paper (approx. 18,000 tonnes) and textiles (approx. 17,000 tonnes); and,
- 4.6% (approx. 25,000 tonnes) of the total kerbside waste was potentially reusable. The potentially reusable materials in the total kerbside waste were predominantly textiles at 3.4% (approx. 18,000 tonnes) followed by WEEE at 0.6% (approx. 3,000 tonnes).

Figure E.1 shows the study average kerbside residual waste composition result.

[1] Halton Borough Council, Knowsley Metropolitan Borough Council, Liverpool City Council, Merseyside Recycling and Waste Authority (MRWA), St Helens Metropolitan Borough Council, Sefton Metropolitan Borough Council and Wirral Metropolitan Borough Council..

[2] Food and drink waste that was, at some point prior to disposal, edible.

Table E.1 Kerbside waste composition results (% wt.) – MHWP

	Dry recycling	Food waste	Garden	Residual	Kerbside waste
Paper	28.1%	0.3%	0.2%	9.8%	12.2%
Card	18.5%	0.0%	0.1%	5.1%	7.1%
Plastic	13.0%	0.8%	0.2%	13.9%	11.9%
Glass	27.7%	0.0%	0.0%	3.4%	7.9%
Metals	6.0%	0.0%	0.1%	3.7%	3.7%
Textiles	0.9%	0.0%	0.6%	4.7%	3.4%
WEEE	0.3%	0.0%	0.2%	0.8%	0.6%
Food	2.1%	95.7%	0.8%	39.1%	27.2%
Garden	0.1%	0.7%	95.4%	2.5%	13.7%
Other organics	0.2%	2.5%	0.1%	2.1%	1.5%
Hazardous	0.2%	0.0%	0.0%	0.6%	0.4%
Sanitary	0.5%	0.0%	0.0%	3.5%	2.4%
Misc. combustibles	1.1%	0.0%	0.3%	3.7%	2.7%
Misc. non-combustible	0.6%	0.0%	2.1%	2.7%	2.2%
<20 mm fines	0.7%	0.0%	0.0%	4.4%	3.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability				66.2%	64.7%
Potentially recyclable*				62.9%	70.3%
Potentially reusable	2.4%			6.1%	4.6%
Non-target	15.8%	4.3%	24.0%**		

*Based on materials currently collected at the kerbside. For the Partnership we have used the broadest definition of recyclable and included all textiles and food waste.
**The majority of the non-target material in the garden waste stream was composed of soil.

Figure E.1 Kerbside residual waste result – MHWP

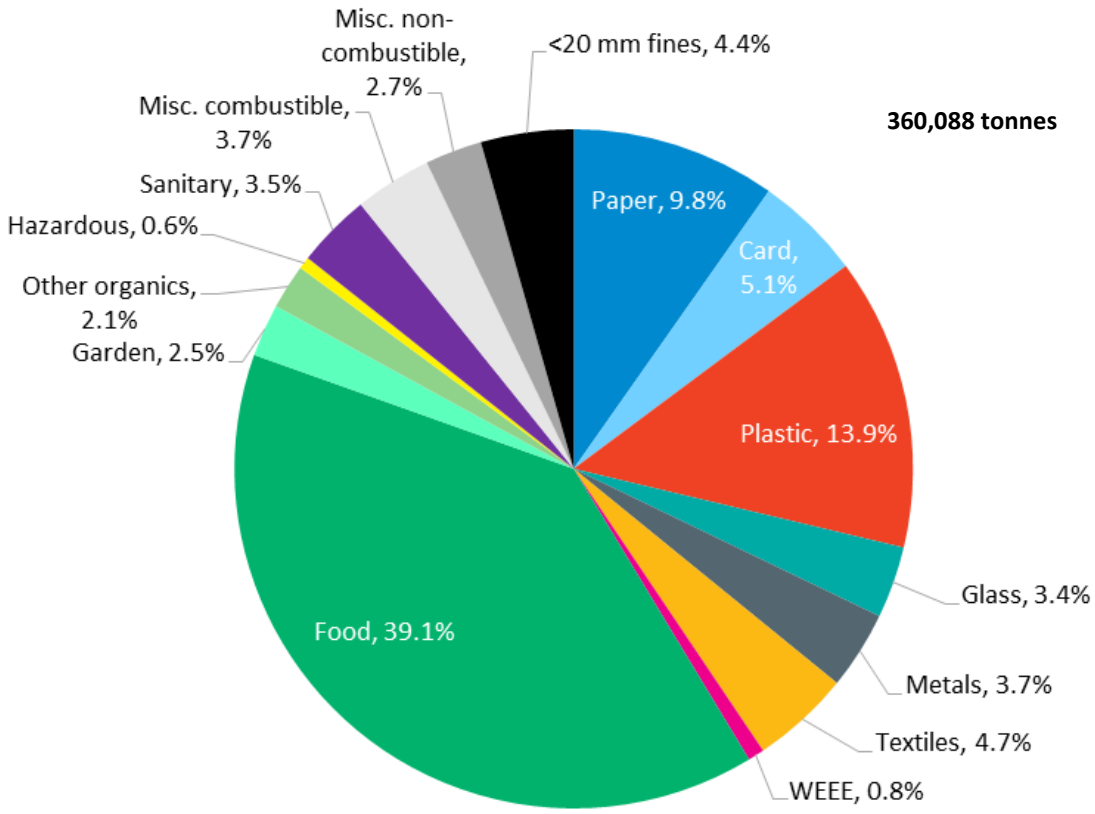


Table E.2 and Figure E.2 present the HWRC residual waste composition results.

Key results include:

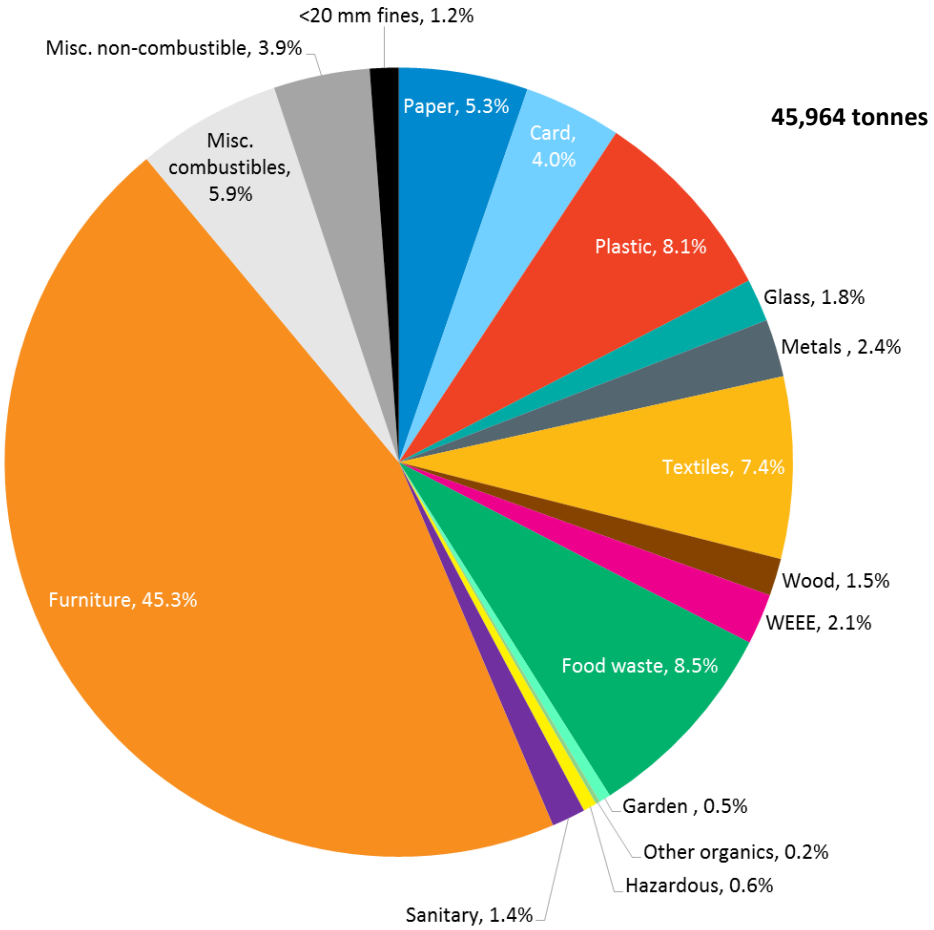
- The high proportion of furniture in the residual stream at 45.3% (approx. 21,000 tonnes). Over 97% of the furniture was “soft furniture” including sofas and their furnishings;
- The second largest material category was food waste at 8.5% (approx. 4,000 tonnes) followed by plastic at 8.1% (approx. 4,000 tonnes). Plastic bottles comprised 1.0% and Pots, Tubs and Trays (PTTs) 0.7% of the HWRC residual waste; and,
- The proportion of sample material categorised as potentially reusable was 45.5% (approx. 21,000 tonnes).

Table E.2 HWRC residual waste composition results (% wt.)

	Huyton	Otterspool/ Old Swan	South Sefton	Ravenhead	Bidston	Picow Farm	Average
Paper	3.7%	5.8%	6.0%	6.9%	3.4%	6.2%	5.3%
Card	4.0%	4.2%	2.7%	3.3%	6.5%	2.7%	4.0%
Plastic	7.1%	11.3%	7.9%	8.1%	6.4%	6.7%	8.1%
Glass	1.7%	1.1%	3.6%	2.0%	0.9%	1.1%	1.7%
Metals	2.5%	4.2%	1.7%	2.7%	1.6%	1.1%	2.4%
Textiles	6.5%	9.6%	5.1%	6.0%	8.1%	8.9%	7.5%
Wood	1.2%	2.7%	1.3%	1.9%	0.8%	0.9%	1.5%
WEEE	2.0%	1.6%	2.8%	1.3%	3.5%	0.7%	2.1%
Food waste	6.2%	7.2%	9.1%	9.5%	10.2%	8.6%	8.5%
Garden	1.0%	0.1%	0.1%	0.3%	1.0%	0.1%	0.5%
Organics	0.0%	0.6%	0.0%	0.1%	0.1%	0.1%	0.2%
Hazardous	1.2%	0.1%	0.6%	0.3%	0.1%	1.0%	0.6%
Sanitary	1.3%	0.7%	1.1%	1.9%	2.1%	1.4%	1.4%
Furniture	52.6%	39.7%	41.2%	41.0%	48.3%	51.6%	45.3%
Misc. combustibles	6.1%	5.6%	7.3%	9.6%	3.4%	4.7%	5.9%
Misc. non-combustible	2.0%	3.8%	8.3%	3.6%	2.6%	2.8%	3.9%
<20 mm fines	0.7%	1.6%	1.0%	1.4%	1.1%	1.3%	1.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability	48.5%	49.1%	47.1%	51.6%	52.9%	52.2%	50.1%
Potentially recyclable or reusable*	79.1%	77.3%	73.8%	69.3%	79.3%	81.3%	76.7%
Potentially reusable**	46.4%	45.5%	46.7%	49.5%	49.6%	39.7%	45.5%

*Based on materials currently collected at HWRCs.
**Based on categorisation during physical sort.

Figure E.2 Average composition (% wt.) of HRWC residual waste



The differences between the HWRC residual waste composition estimates for 2015/16 study compared with previous studies is substantial. Furniture has increased from around 10% in 2010 to over 45% of the HWRC residual waste stream in 2015/16. Applying the HWRC residual waste tonnages used in each study to the associated composition result suggests that the quantity of furniture disposed of in HWRCs in Merseyside and Halton has increased from approximately 9,000 tonnes in 2010 to over 21,000 tonnes in 2015/16. After accounting for housing growth[3] the quantity of furniture disposed of at HWRCs more than doubles from 14 kg/hh/yr in 2010 to 31 kg/hh/yr in 2015/16. This may reflect temporary impacts (e.g. the Ikea effect[4]) or be a function of the sampling approach and the bias that may have been introduced by requesting HWRC user permission.

It is clear that furniture, specifically soft furniture (e.g. sofas) is becoming a more important component of the HWRC residual waste stream, however it is possible that the furniture composition may have been over-estimated as a consequence of the methodology adopted. The HWRC residual waste composition result and the proportion of furniture estimated to be present is unusual and requires further investigation.

[3] Household numbers from the ACORN database have been used. In the 2009 ACORN database the number of households in Merseyside and Halton was 641,843. In the 2015 ACORN database the number of households in Merseyside and Halton was 664,544.

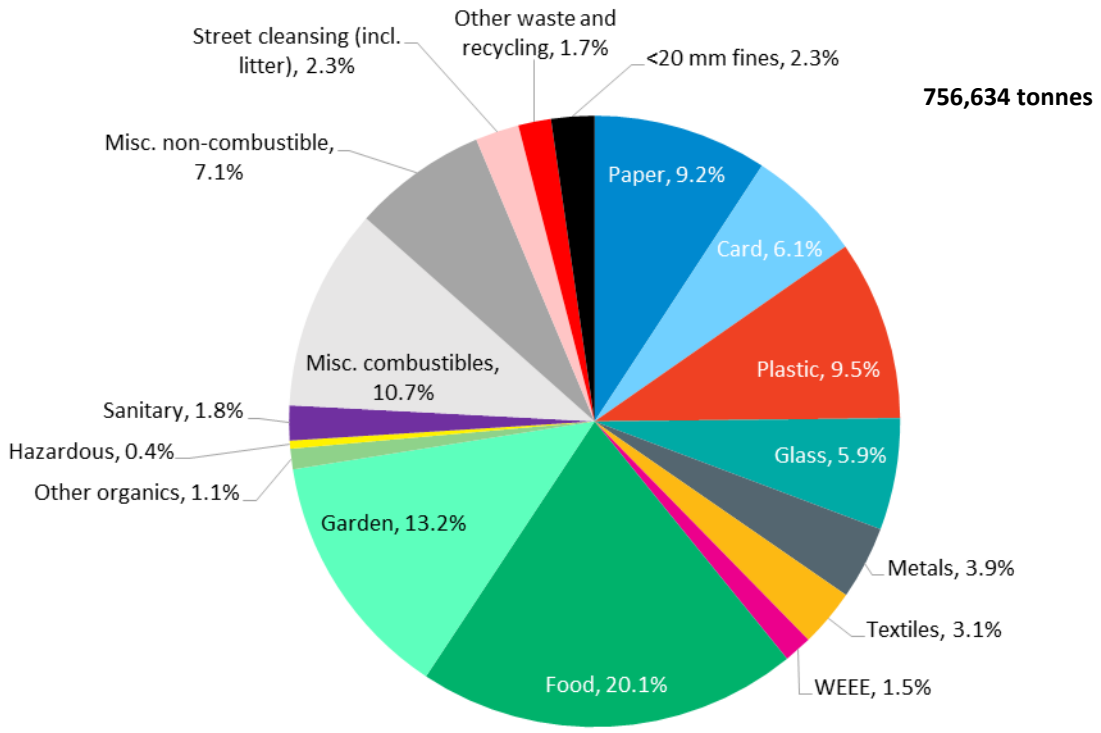
[4] Resource Futures/Defra (2009) WR0121 – Understanding Waste Growth at Local Authority Level describes a case where the introduction of a series of new budget furniture stores within the area which led to a temporary influx of furniture / office equipment being thrown out by local residents.

The authorities in the Partnership collect and manage more than just kerbside household waste and HWRC residual waste. Other local authority collected waste streams include:

- HWRC recycling, composting and reuse;
- Street cleansing and litter; and,
- Other household waste streams (such as bring banks, fly-tipped waste and clinical waste).

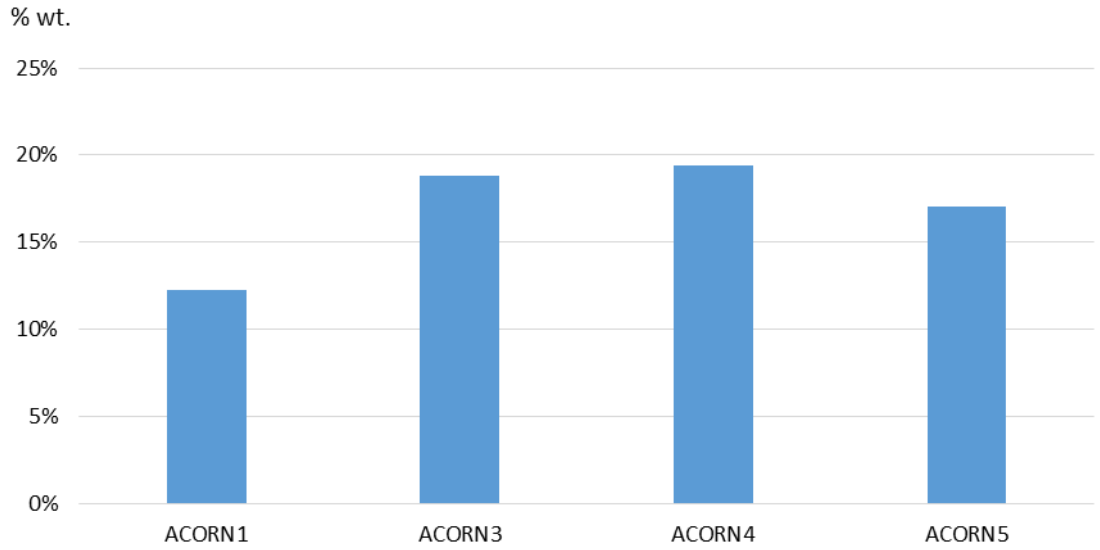
Figure E.3 shows the composition of local authority collected waste. The predominant materials are food waste at 20.1% (approx. 150,000 tonnes), garden waste at 13.2% (approx. 100,000 tonnes) and miscellaneous combustibles at 10.7% (approx. 80,000 tonnes). Local authority collected waste is discussed in Section 3.4 of the report.

Figure E.3 MHWP Local Authority Collected Waste



An exploratory data analysis was undertaken to see what the sample data can reveal about the waste produced by households from different ACORN[5] categories. The analysis showed that the levels of contamination in the dry recycling stream vary by ACORN category[6] (Figure E.4). The analysis also identified potential differences in the residual waste and dry recyclables produced by households from different ACORN categories are primarily associated with materials used for packaging such as paper, card, plastic, glass and metals. The ACORN categories associated with more affluent households appeared to produce a higher proportion of paper and glass. In contrast, ACORN categories associated with less affluent households appeared to generate a higher proportion of plastic in their waste. Similar differences have also been found in other studies undertaken by Amec Foster Wheeler and others[7].

Figure E.4 Average dry recycling contamination levels by ACORN category



[5] 'A Classification of Residential Neighbourhoods (ACORN)' is a recognised socio-demographic tool used in the majority of household waste composition survey projects. The tool classifies each postcode area within the authority and assigns it to a Category, a Group and a Type. There are 6 categories, 18 groups and 62 types. The database is widely used across disciplines and is owned and managed by CACI Ltd. Further details about the ACORN classifications are included in Section 4.2.

[6] ACORN 2 was not included in the study as less than 3% of the households in Merseyside and Halton are assigned to this category. The ACORN 6 category contains predominantly communal establishments, and those that do not contain residential populations.

[7] Warren Spring and Aspinwall (1993) The National Household Waste Analysis Programme Phase Two - Results Report, Volume One - Category Analysis and Weight Data. However it should be noted ACORN classification have changed over time making direct comparisons difficult.

Based on the findings of this study our recommendations for the MHWP are:

1. Approximately 64% of the kerbside residual waste in the MHWP was potentially recyclable. The main component of the potentially recyclable material was food waste which was estimated to comprise 39.1% ±2.1% of the kerbside residual waste (between 130,000 and 150,000 tonnes). The introduction of separate food waste collections has the potential to significantly reduce the quantity of residual waste requiring treatment and disposal and improve recycling performance. The "whole system costs" (i.e. from collection through to treatment/disposal) would need to be considered to fully assess the economic viability of separate food waste collections;

2. Approximately 24% (approx. 86,000 tones) of the residual waste was comprised of materials which are currently collected at the kerbside for recycling by at least one of the Districts. Recyclable materials present in the kerbside residual waste include recyclable paper (approx. 18,000 tonnes), textiles (approx. 17.000 tonnes), recyclable card including books and telephone directories (approx. 16,000 tonnes), glass (approx. 11,000 tonnes), metal packaging (approx. 9,000 tonnes) and plastic bottles (approx. 8,000 tonnes). There was also an estimated 7,000 tonnes of garden waste present in the kerbside residual waste stream. The Partnership should target these materials to divert them from the residual waste stream into the dry recycling or garden waste streams;

3. Approximately 16% (approx.18, 000 tonnes) of the dry recycling stream was comprised of materials which are not targeted for recycling. Communication and education initiatives which reduce the level of contamination in the kerbside dry recycling would improve the quality of recyclable materials collected by the Partnership. This could have benefits in terms of the prices achieved for dry recyclables; and,

4. Almost 45% (approximately 21,000 tonnes) of the HWRC residual waste stream was estimated to be composed of furniture. This is an unusual result which requires further investigation to confirm the contribution of furniture to this waste stream and identify ways in which furniture can be managed more sustainably. Furniture was also one of the main components contributing to the estimate that 45.5% of the HWRC residual waste was potentially reusable indicating that there is an opportunity to divert large quantities of material from disposal to reuse. At a minimum, if it is assumed the quantity of furniture arising at HWRCs has not changed between 2010 and 2015/16 approximately 9,000 tonnes (20%) of the HWRC residual waste stream would be furniture which could be potentially reusable.

Contents

1. Introduction

This section describes the context for the work undertaken, project background, project aims and objectives, project overview and the structure of the report.

1.1 Context

The Merseyside and Halton Waste Partnership (MHWP) is comprised of six Councils (Halton Borough Council, Knowsley Metropolitan Borough Council, Liverpool City Council, St Helens Metropolitan Borough Council, Sefton Metropolitan Borough Council and Wirral Metropolitan Borough Council) and the Merseyside Recycling and Waste Authority (MRWA). The administrative areas of the partner authorities (the Liverpool City Region) generated approximately 725,000 tonnes of household waste[8] in 2015/16, a small increase on 2014/15 (approx. 700,000 tonnes). The Partnership is currently achieving a combined recycling and composting rate of approximately 43%. The target for 2020 is a Partnership recycling rate of 50%.

MRWA has a long-term Waste Management and Recycling Contract with Veolia. Veolia also manage and operate a Materials Recovery Facility (MRF), four Waste Transfer Stations, transfer waste to landfill and manage the Household Waste Recycling Centres (HWRC) across the region.

The MHWP have an award winning waste prevention programme, is heavily involved in the Love Food Hate Waste campaign was an early signatory to the Courtauld 2025 voluntary agreement and have adopted a waste Re-use Strategy to support resource efficiency in the City Region.

1.2 Project Background

Together the MHWP provide domestic waste collection and disposal services to over 650,000 households, so understanding the disposal habits of residents is essential to maintaining waste management services that are fit for purpose into the future. One element of this is an understanding of the composition of the waste that is collected.

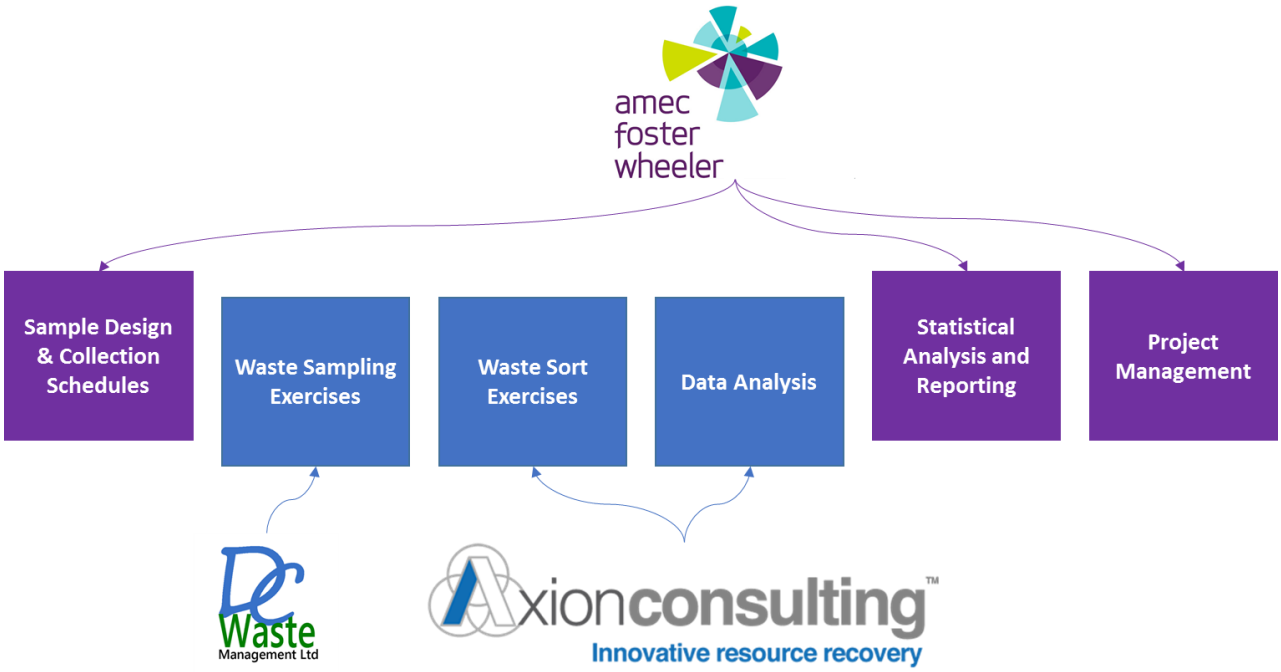
The Partnership commissioned Amec Foster Wheeler E&I UK Ltd (Amec Foster Wheeler) to undertake a Household Waste Composition Analysis to identify the main waste materials arising by weight within the Liverpool City Region. The results of the analysis will be used as part of ongoing waste growth and composition forecasting and to inform the review of “RESOURCES Merseyside 2011-41: The Joint Recycling and Waste Management Strategy for Merseyside” and Halton’s aligned sustainable waste management strategy.

The comprehensive analysis of waste is an important asset for local authorities. By determining the composition of the waste being collected, it is possible to target materials remaining in residual waste streams in order to enhance existing kerbside recycling schemes. Furthermore, information on waste types and amounts may be used to identify wider ranging service improvements and efficiencies. Waste composition analyses also complement other elements of monitoring undertaken by local authorities including scheme participation, contamination levels in recyclable material collections and socio-economic factors. For example, the waste composition study results may be used to help inform MRWA’s Re-use Strategy and behavioural change engagement plan.

Amec Foster Wheeler (formerly Entec) successfully delivered Merseyside and Halton’s last waste composition analysis in 2010. MRWA appointed Amec Foster Wheeler and their partners Axion Consulting Ltd (Axion) via a competitive tendering process in 2015. The roles and responsibilities of Amec Foster Wheeler and Axion for this project are defined in Figure 1.1. Axion sub-contracted DC Waste Management Ltd to undertake the sampling activities.

[8] Kerbside and HWRC waste streams only.

Figure 1.1 Amec Foster Wheeler and Axion - Roles and Responsibilities



1.3 Project Purpose and Aims

The primary purpose of the project is to identify the main waste materials (by weight) arising within the Local Authority areas of the Liverpool City Region in the following waste streams:

- Kerbside collected household waste (residual, dry recycling and organics); and,
- Household Waste Recycling Centre (HWRC) residual waste.

The composition data of these waste streams will then be used by MHWP with operational data to directly inform the Joint Recycling and Waste Management Strategy for Merseyside (JRWMS) review.

The aims of the project were to:

- Identify the composition of household waste collected, or recycled, or composted, or delivered for disposal in the Liverpool City Region through physical waste sampling;
- Estimate general household waste composition through combining composition and arisings data; and,
- Identify the proportion of the waste which could have been repaired or reused but are currently being sent for recycling or disposal.

The achievement of these aims will contribute to the following positive outcomes:

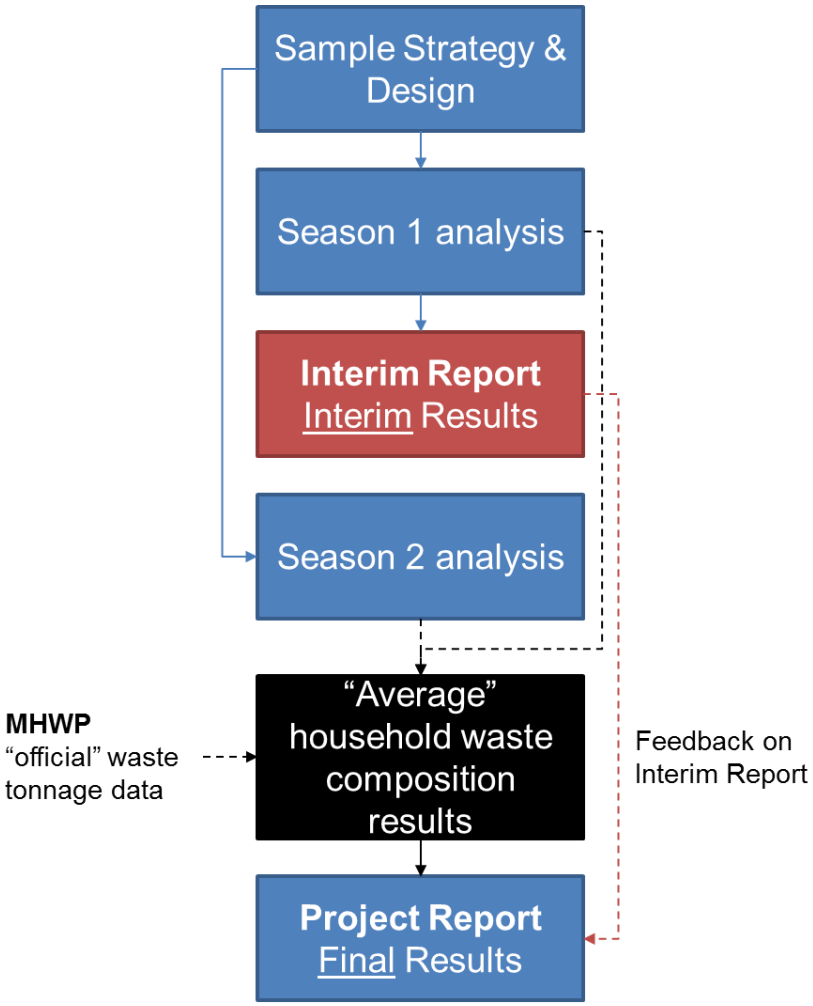
- Provision of essential baseline data to assist in the review of the JRWMS in 2016/17;
- Support MHWP in improving and optimising the existing recycling and composting services;
- Support MHWP in developing waste prevention, reduction, re-use and recycling action plans which will move waste management up the waste hierarchy, improve quality and yields, and reduce contamination;
- Assist progress across the Liverpool City Region in reducing carbon emissions and increasing resource efficiency to benefit the developing Circular Economy; and,

- Improve the understanding of the links between household waste generation, season and socio-economic characteristics of local communities in the Liverpool City Region.

1.4 Project Overview

Figure 1.2 presents an overview of the project. It is designed to show how each task informs the results and the production of final project report. Please note this Project Report supersedes the Interim Report previously submitted to the MHWP.

Figure 1.2 Project Overview



1.5 Project Report Structure

The Project Report is structured as follows:

- Executive Summary;
- Introduction;
- Methodology;
- Study results for the Partnership and partner authorities;
- Statistical analysis and comparisons with other waste composition studies; and
- Recommendations.

2. Methodology

This section provides a summary of the methodologies used to undertake the seasonal waste analyses in November 2015 (Season 1) and February/March 2016 (Season 2).

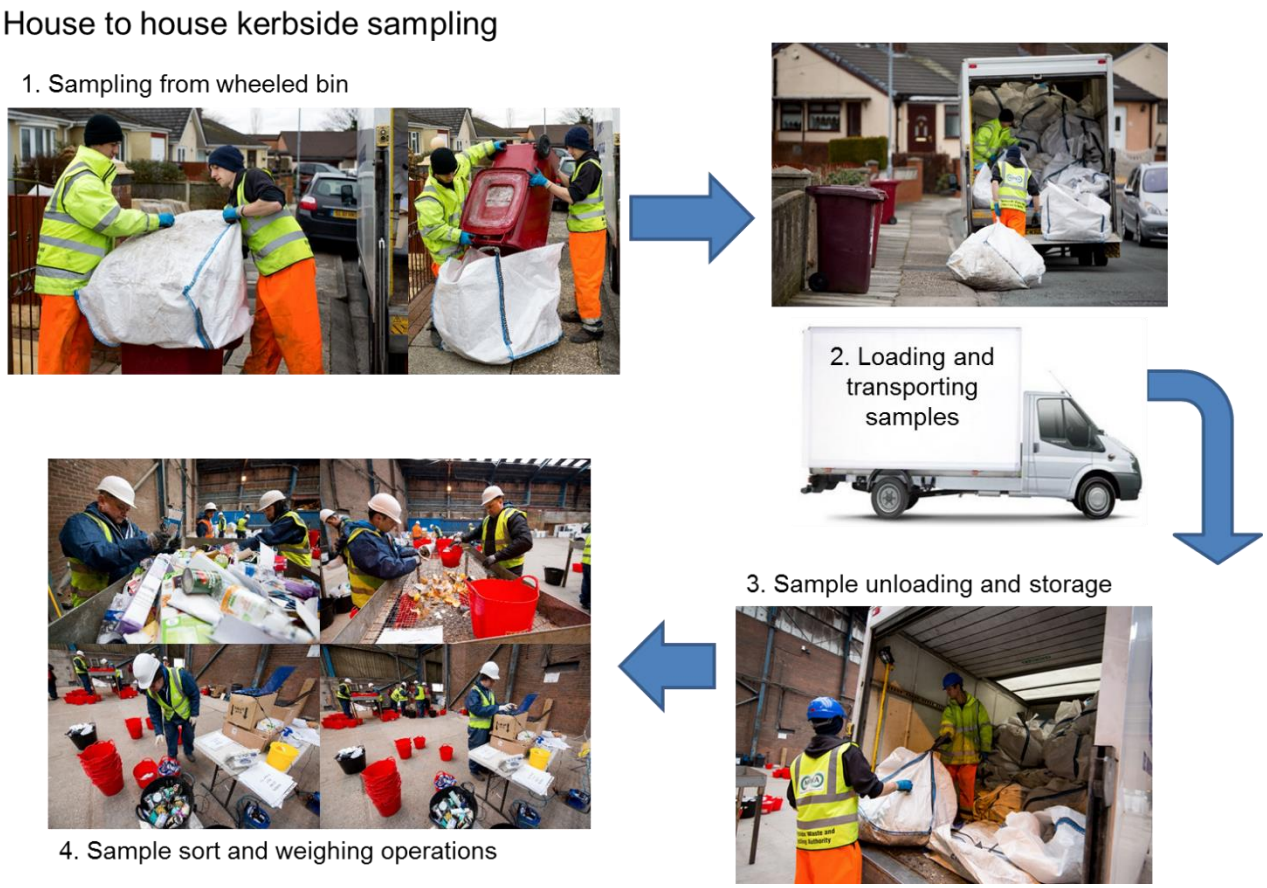
2.1 Kerbside Waste Analysis

Approach

Amec Foster Wheeler and Axion adopted a house by house analysis approach for the kerbside waste streams (Figure 2.1). This approach provides waste composition data for individual households, allowing for more detailed statistical analysis and interpretation of the results.

The residual waste and the materials presented for recycling and organic treatment by individual households were sampled. The individual waste streams were sampled separately. Each sample was labelled to identify the area (but not the household) that the sample originated from. Samples were then transported to the designated site for sorting. Please see Appendix A for the waste sort categories used in the kerbside waste analysis.

Figure 2.1 Kerbside approach



Sample Strategy

Several factors are recognised as having an influence on the amount and type of waste generated by households, these factors include: the age profile, income and size of individual households. For planning and predictive modelling it is important to use waste composition information that reflects the waste produced by the residents of Merseyside and Halton. This implies that average waste composition data is required to be determined from samples of waste which are representative of the waste produced within the MHWP.

Amec Foster Wheeler's approach to designing a robust sample of households to represent each of the participating Districts was based on systematic random sampling of different strata of the population. We used the socio-demographic tool 'A Classification Of Residential Neighbourhoods (ACORN)' [9] to stratify and profile the six Districts within the Partnership. .

There are five primary ACORN categories, the sample strategy was to collect waste from the main ACORN categories in each District (i.e. the categories of households that are the most common, and which will generate the majority of waste arising in each District). This recognises that there are likely to be differences in the waste generation habits between the different categories of household. These individual categories were sampled, rather than the whole population, reducing the overall burden of sampling. Table 2.1 below provides ACORN profiles for each District and MHWP in 2015. The samples collected from the coloured ACORN category/District combinations shown in Table 2.1 represented more than 90% of the households within each District and the Partnership.

Table 2.1 2015 ACORN Profile

ACORN Category	Knowsley	Liverpool	Sefton	St. Helens	Wirral	Halton	MHWP
1	10.9%	13.6%	35.1%	17.4%	32.0%	17.6%	21.9%
2	2.2%	5.2%	0.6%	2.7%	1.5%	3.1%	2.8%
3	26.2%	14.1%	27.7%	28.1%	24.8%	22.3%	22.2%
4	26.4%	25.5%	16.8%	26.9%	18.9%	27.0%	22.9%
5	34.1%	41.4%	19.4%	24.8%	22.5%	29.8%	29.9%
U	0.1%	0.1%	0.5%	0.1%	0.3%	0.2%	0.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Representation	97.6%	94.6%	99.0%	97.2%	98.2%	96.8%	96.9%

The sample areas, represented by the coloured cells in Table 2.1, as far as practicable, mirrored the sample areas used in the 2010 study to facilitate comparison between the studies. These areas included approximately 50 households of the same ACORN category, as identified by postcode. Samples were collected from households in four sample areas (representing different ACORN categories) in each District.

The number of samples that were collected from each sample area was proportionate to the ACORN socio-demographic profile and, because the quantity produced will also vary by area, weighted by the relative set out of different waste streams by ACORN category from the 2010 study. This created unique sample profiles for each waste stream in each District.

[9] ACORN is a recognised socio-demographic tool used in the majority of household waste composition survey projects. The tool classifies each postcode area within the authority and assigns it to a Category, a Group and a Type. The database is widely used across disciplines and is owned and managed by CACI Ltd. The database was licenced to MRWA with Amec Foster Wheeler and Axion as named consultants

The number of samples collected for the different waste streams was informed by the expected level of variability between the samples of different waste streams. As the variance between the compositions of kerbside residual waste samples was likely to be relatively high, between 75 and 100 samples of this waste stream were collected and sorted each season. In contrast, the variance between the composition of garden waste and food waste samples was likely to be relatively low – therefore just 40 samples of each of these waste streams were targeted for collection and sorting during each season. This strategy was selected in order to achieve indicative confidence intervals of at least ±10% at a 95% confidence level for the primary waste categories.

Sample Design

As far as practicable, the same sample areas that were used in the 2010 study were also used in the 2015/16 study. We accessed the ACORN database to confirm that the sample areas were still in the same ACORN category as in 2010. Where the ACORN category had changed or the collection dates or timings were incompatible with the study, Amec Foster Wheeler identified alternative sample areas of approximately 50 households which corresponded to the correct ACORN category. Kerbside waste and recycling collection information (day and estimated time of collection) for the selected sample areas was used to create a collection schedule that was reviewed and agreed with the Partnership.

To collect the full complement of waste streams, kerbside waste samples were collected over two weeks to reflect the fortnightly services carried out by most of the Districts. With the exception of one area which changed collection days between the seasonal exercises, the same sample areas were used during both seasonal exercises.

Sample Collection

A sampling team comprised of a supervisor and an operative used a 3.5 tonne box lorry to undertake sample collection[10]. In general, the sample teams arrived on site at each sample area prior to the normal collection crews and proceeded to collect all the waste streams presented for collection by households. In some cases where it was not possible to arrive at the samples areas before the normal collection crews a mitigation strategy was agreed with the relevant District. These strategies involved, for example, the regular collection crews being requested to alter their usual route and stay away from the sample area until a specified time.

Samples were collected at random from the households in the sample area. The waste presented for collection by a household was placed into a bulk carrying sack. Each waste stream was collected separately and no side waste was collected. The sacks were then labelled to give discrete samples that could be associated with individual households for each waste stream from each sample area. A coding system was used to provide anonymity for all households included in the sampling. Collected material was then loaded onto the sample collection vehicle and transported to the sort site.

The sampling supervisor oversaw the sampling operation to ensure that samples were appropriately collected, labelled, stored, and details recorded. All collection staff wore appropriate PPE including safety boots, overalls, hi-viz and gloves.

[10] Sample collection was undertaken by DC Waste Management Limited.

Figure 2.2 Sample collection

Notes: Sample collection (top left photograph); loading sample (bottom left); and, labelling sample (right).

Sample Sorting

The waste sorting took place at the licensed waste facility in Huyton provided by MRWA and operated by Veolia. The waste sorting team included three supervisors and a six operatives and hand sorted the kerbside waste samples.

Individual household waste samples were stored separately in individual labelled bulk carry sacks. Prior to sorting the weight of the sample was recorded. Sample sorting involved the screening of each sample to remove fines (material <20mm), this material was collected, weighed and recorded as 'fines'. No further analysis of the fines fraction was undertaken. The remaining material was hand sorted into the material categories in Appendix A. The importance of treating material arising in the waste as confidential was emphasised during waste sort operative induction and training. Following completion of the material classification, each category was weighed using calibrated scales and the weight recorded on an Excel spreadsheet. The sort supervisors were responsible for the weighing operation and quality checking the sorting process for each sample.

Figure 2.3 Waste Sorting

Figure 2.4 Quality Checks

Figure 2.5 Weighing Process

2.2 HWRC Residual Waste

Approach

Amec Foster Wheeler and Axion adopted an on-site HWRC user sampling approach for the HWRC residual waste stream. A mobile sample team visited each selected HWRC according to a collection schedule to collect relatively small, but numerous, samples from selected HWRCs. This approach allowed for the collection of a relatively high number of samples and hence more detailed statistical analysis and interpretation of the results. The sample team was also able to control the types sample material collected and avoid sampling potentially hazardous wastes.

Figure 2.6 HWRC approach

Sample Strategy

The sample strategy for the HWRC residual waste stream was based on the ASTM International Standard Test Method for the Determination of the Composition of Unprocessed Municipal Solid Waste D5231 – 92 (Reapproved 2008). The standard includes a calculation method to determine the number of samples required based on the desired level of confidence and precision. The formula was used to estimate that the collection of 15 HWRC samples of approximately 150kg would generate results with indicative confidence intervals of ±15% (or better) at confidence level of 95% for the primary material categories.

Sample Design

We worked with MRWA to select one HWRC for analysis in each of the Districts (a total of six HWRCs). This allowed for the collection of 3 samples from three of the HWRCs and 2 samples from the remaining three HWRCs. Three HWRC samples were collected per day over a 5 day period including a Saturday and a Sunday in each season.

Table 2.2 HWRC sample sites

	District	Season 1	Season 2
HWRC 1	Knowsley	Huyton	Huyton
HWRC 2	Liverpool	Otterspool	Old Swan*
HWRC 3	Sefton	South Sefton	South Sefton
HWRC 4	St. Helens	Ravenhead	Ravenhead
HWRC 5	Wirral	Bidston	Bidston
HWRC 6	Halton	Picow Farm	Picow Farm

Note (*): Old Swan HWRC was opened in December 2015 and was included to collect information on the residual waste deposited at this new site.

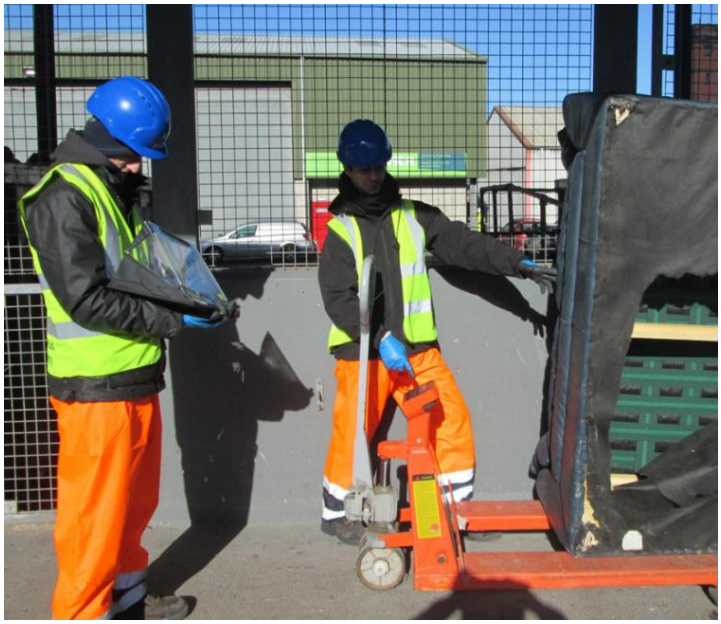
Sample Collection

A sample team was comprised of a supervisor and an operative with a 3.5t box lorry.

The supervisor worked with the site "meet and greet" staff to ask users when they entered the HWRC if they would be willing to let their residual waste be included in the study. It was explained to the HWRC user that their waste would be mixed with waste from other users to maintain anonymity and that no personal information was required. HWRC users who agreed to allow their waste to be sampled were directed to visit the sample team to deposit their residual waste.

In the sample area, we confirmed with the user that they intended to dispose of all the material presented in the residual waste. Next, bulky items, such as furniture or large appliances, were weighed on the pallet truck weight scales and the data recorded as part of the sample (Figure 2.7). Bulky items were then loaded into the box lorry for on-site disposal by the sample team. Non-bulky items, such as bagged waste or loose mixed waste, was deposited into bulk carry sacks. Potentially hazardous or dangerous waste was identified, segregated and managed according to the protocols of the host site. A minimum of five HWRC user's waste was included in each sample. The supervisor was responsible for ensuring samples were appropriately labelled, recording weight of bulky wastes and weight of non-bulky waste samples.

Figure 2.7 Weighing and recording "bulky" waste data



Sample Sorting

The non-bulky HWRC residual waste samples were taken to the sort site and sorted in the same manner as described for the kerbside waste samples in Section 2.1. An expanded material classification was used for the HWRC residual waste as shown in Appendix A.

The sampling supervisor provided the sort supervisor with the data on the bulky waste associated with each sample. The sort supervisor combined the data from the bulky and non-bulky waste sorts into a single result for each sample.

2.3 Data Analysis

Kerbside Waste

The first step in the analysis of kerbside waste data was to compare the target sample profile with the profile of the sample which was collected for each waste stream in each District. In some cases, where samples were not collected, it was necessary to include some data substitutions to improve the representativeness of the results in each District. Representation and data substitutions are discussed in detail in Appendix B.

The analysis of the sample data included weighting the individual samples according to the quantity (kg) sampled to produce an average composition for each waste stream in each District. The composition results for each waste stream were then applied to the tonnage of the waste stream collected in each District in each season. Combined kerbside waste composition estimates for each District were then calculated by summing the tonnages collected in each waste stream. Partnership results for kerbside waste streams were then estimated by summing the tonnages collected in each waste stream in each District.

Table 2.3 presents the kerbside waste tonnages collected by each District in 2015/16[11]. This data was assigned to the seasonal waste composition results (Season 1 and Season 2). The Season 1 data has been applied to the tonnages collected between September and February which includes the period in which the Season 1 analysis took place (e.g. November). The Season 2 data has been applied to the tonnages collected between March and August which includes the period in which the Season 2 analysis took place (e.g. March). This means that the Season 1 composition result was applied to monthly tonnage data which predominantly corresponds to the autumn and winter months (September to February) and the Season 2 composition result was applied to monthly tonnage data which predominantly corresponds to the spring and summer months (March to August).

[11] Please note that at the time of writing not all the 2015/16 waste tonnages had been validated. In addition, where tonnage data for some months for waste streams such as bring banks and fly-tipped waste was not present the corresponding tonnage data from 2014/15 was used.

Table 2.3 Kerbside waste tonnages, 2015/16

	Waste stream	Season 1 (Sept – Feb, Autumn/Winter) (tonnes)	Season 2 (Mar – Aug, Spring/Summer) (tonnes)	Total, 2015/16 (tonnes)
Halton	**Residual**	13,757	14,333	28,090
	Dry recycling	4,970	4,347	9,317
	Garden waste	1,112	3,293	4,405
Knowsley	**Residual**	17,865	17,872	35,737
	Dry recycling	6,087	6,196	12,283
	Garden waste	1,839	5,491	7,330
Liverpool	**Residual**	60,628	60,063	120,691
	Dry recycling	14,654	13,981	28,635
	Garden waste	4,844	11,534	16,378
Sefton	**Residual**	31,525	31,960	63,485
	Paper, glass and metals	6,909	6,744	13,653
	Plastic and card	4,133	3,882	8,014
	Garden waste	6,551	11,945	18,496
	Food waste	983	970	1,953
St Helens	**Residual**	20,367	19,776	40,143
	Dry recycling	5,939	5,419	11,358
	Garden waste	2,983	6,748	9,731
	Food waste	1,616	1,544	3,160
Wirral	**Residual**	35,614	36,327	71,941
	Dry recycling	14,445	14,161	28,606
	Garden waste	4,693	7,645	12,338

Source: Merseyside Recycling and Waste Authority.

HWRC Residual Waste

Seasonal HWRC residual waste compositional results have been reported as a simple average. Study average results have been estimated by applying the seasonal HWRC residual waste composition results to the tonnage of HWRC residual waste collected in each season. HWRC residual waste tonnages for 2015/16 are shown in Table 2.4.

Table 2.4 HWRC residual waste tonnages, 2015/16

	Waste stream	Season 1 (Sept – Feb, Autumn/Winter)	Season 2 (Apr – Aug, Mar, Spring/Summer)	Total, 2015/16
HWRC	Residual	21,816	24,148	45,964

Source: Merseyside Recycling and Waste Authority.

Potentially Recyclable and Non-target Material

The proportion of potentially recyclable and non-target material present in different waste streams have been estimated by defining whether a material category is a target material for recycling in the kerbside or HWRC services. Please see Appendix A for details on target and non-target materials.

Potentially Reusable Material

The proportion of potentially reusable material present in kerbside waste has been estimated by assigning a material category as potentially reusable. Material categories classified as potentially reusable include: books; WEEE; textiles and shoes; paint, furniture and mineral oils.

The proportion of potentially reusable material present in HWRC residual waste was estimated as part of the sampling and sorting exercise. Potentially reusable materials were visually assessed by the sample team (bulky waste) and sort team (non-bulky waste). Items which were categorised as potentially reusable were weighed and the data was recorded.

Please see Appendix A for details on materials categorised as potentially reusable.

Note, both these methods result in a broad definition of "potentially reusable". Hence it should be recognised that some of the items categorised as potentially reusable may not be economically viable to repair or refurnish.

Biodegradability

The biodegradability of the waste streams was calculated based on the biodegradability content factors used in Defra/Resource Futures (2012) WR1003 Biodegradability of municipal solid waste.

Calorific Value (CV)

Gross calorific value is the quantity of heat released when all combustible material is fully burnt, the theoretical maximum energy available, determined using a bomb calorimeter. In practical situations energy recovery facilities cannot recover all of the energy implied by a gross calorific value. There are two main reasons for this: water produced by the oxidation of hydrogen in the fuel is not condensed, but escapes from the system in the stack gas as steam, and other residues leave the system at a higher temperature than they enter, so removing heat. Net calorific value is viewed as a useful parameter for estimating the energy input to combustion processes, since it takes into account these potential losses.

The results of the waste composition exercise have been used to estimate the net CV for the residual waste streams[12] using an Amec Foster Wheeler model developed for this purpose. The model uses reference values for the waste constituents. The reference values used are derived from the UK National Household Waste Composition Study conducted in 1994. These are the reference values used in 'WRATE' the waste management lifecycle modelling tool originally developed for the Environment Agency and now owned and supported by Golders Associates (UK) Ltd.

The reference data were determined by laboratory analysis of materials extracted from waste bins. As may be anticipated, these materials would have been contaminated with other waste constituents while in the bin. Hence adsorbent materials such as paper, card and textiles would have adsorbed moisture from wet materials such as kitchen and garden waste, and become contaminated. Likewise, kitchen and garden waste would have lost moisture. Values for each of the key constituents of the waste materials are also provided in the reference data (Ash, Water, Hydrogen, Carbon, Nitrogen, Oxygen, Sulphur and Chlorine). These reference values were determined by destructive testing of waste materials.

[12] The CV model was designed for kerbside waste. It can be also used to estimate CV of HWRC residual waste but, as not all HWRC waste categories are present in the model, it can only be considered indicative of the actual CV.

Statistical Analysis

Statistical analysis of the sample data revealed that most of the composition and arisings data was not normally distributed. Therefore the non-parametric[13] Mann-Whitney U test[14] has been used to test for significance.

Indicative confidence intervals at the 95% confidence level have been estimated for the kerbside waste to illustrate the level of uncertainty associated with the results for the primary material categories. Please see Appendix C for more information on confidence levels and intervals.

District kerbside waste and all Partnership level composition results have been estimated by summing the materials estimated to be present in each kerbside waste stream (residual, dry recycling, garden waste and food waste). Confidence intervals for these results have been estimated using the square root sum square (RSS) or root mean square (RMS) methods.

Note the confidence intervals are an estimate of sampling error only (i.e. the error that arises in a data collection process as a result of taking a sample from a population rather than using the whole population). There is also the potential for non-sampling errors (e.g. data input errors) which are not included in the confidence intervals. Therefore the confidence intervals presented may be an underestimate.

2.4 Project Limitations

It should be noted that any study of this type, regardless of the sample strategy or design, is a snapshot in time of waste composition and that other local and national factors, such as changes to collection policies through to legislative changes, could lead to significant differences in compositional make-up over time.

Any small discrepancies in totals and sub-totals within the data are due to cumulative rounding errors in Microsoft Excel as multiple spreadsheet calculations are used and rounded down to 1 or 2 decimal places as appropriate in the reporting process.

[13] Non-parametric methods are those which do not rely on assumptions that the data are drawn from a given probability distribution such as a normal distribution.

[14] https://en.wikipedia.org/wiki/Mann%E2%80%93Whitney_U_test

3. Results

This section reports the seasonal and study average kerbside waste composition results for the Merseyside and Halton Waste Partnership, Halton, Knowsley, Liverpool, Sefton, St. Helens and Wirral. It also includes the seasonal and study average results for the HWRC residual waste and an estimate of the composition of Local Authority Collected Waste.

3.1 Kerbside waste results

Summary statistics and key findings are reported for the Partnership, each District and the HWRC residual waste below.

Detailed seasonal and study average composition results have been provided separately to the Partnership in Microsoft Excel format.

In each section on the District and the Partnership results an infographic that provides an overview of the study and its findings on the kerbside waste is included. Each infographic is split into four sections which show the following:

- The top section provides information on the local authority including an ACORN socio-demographic profile (which was fundamental in the study design) and a housing type profile;
- The second section shows the collection system employed by the District and the number of samples collected and sorted during the study;
- The third section includes charts showing the composition of each waste stream and their relative contribution (not to scale) to the composition of household kerbside waste in the District; and,
- The fourth section shows the proportion of the main recyclable materials, food waste and garden waste which is captured in the dry recycling or garden waste streams or disposed of in the residual waste stream.

Merseyside and Halton Waste Partnership

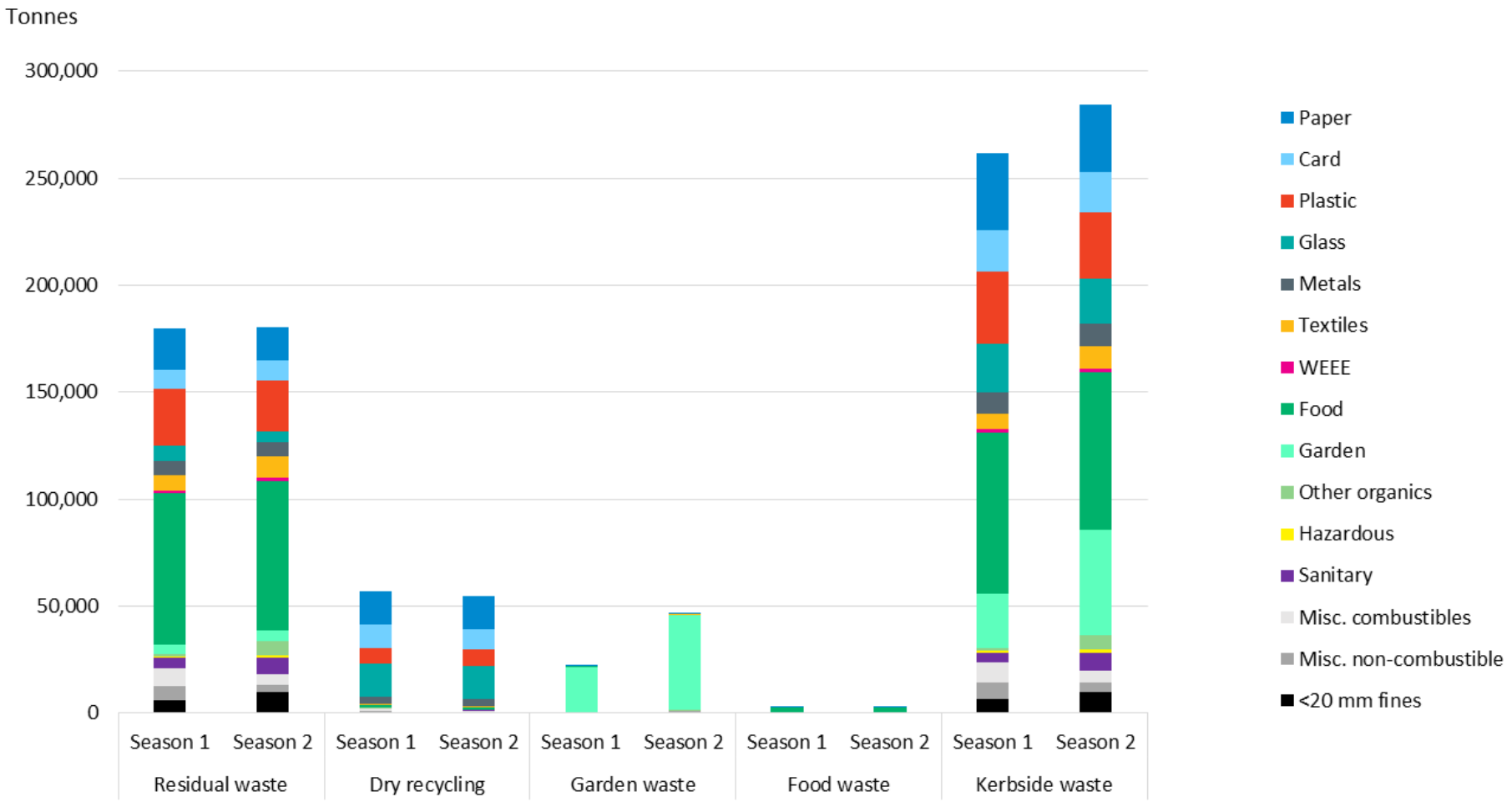
Seasonal kerbside waste composition results

In Figure 3.1 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the Merseyside Recycling and Waste Authority (MRWA) to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons was the quantity of garden waste generated. There was an increase in garden waste arisings in Season 2. Garden waste comprised 17.3% (approx. 49,000 tonnes) of the kerbside waste in Season 2 compared to 9.7% (approx. 25,000 tonnes) in Season 1.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.1 Seasonal kerbside waste composition results – MHWP



Kerbside waste composition study average results

Table 3.1 presents the average kerbside waste composition results for the MHWP. Key results include:

- The high proportion of food waste in the residual stream at 39.1% (approximately 140,000 tonnes) of which 63.9% (approx. 90,000 tonnes) was "avoidable" (i.e. was, at some point prior to disposal, edible). WRAP (2014) *Household food and drink waste: A product focus* found that approximately 15% of all food and drink waste was thrown away in its packaging with around 4% thrown away in packaging which was not opened;
- Approximately 63% (approx. 225,000 tonnes) of the residual waste stream was potentially recyclable. The majority of the recyclable material was food waste (approx. 140,000 tonnes) followed by recyclable paper (approx. 18,000 tonnes) and textiles (approx. 17,000 tonnes); and,
- 4.6% (25,000 tonnes) of the total kerbside waste was potentially reusable. The potentially reusable materials in the total kerbside waste were predominantly textiles at 3.4% (approx. 18,000 tonnes) followed by WEEE at 0.6% (approx. 3,000 tonnes).

Table 3.1 Kerbside waste stream composition results (% wt.) – MHWP

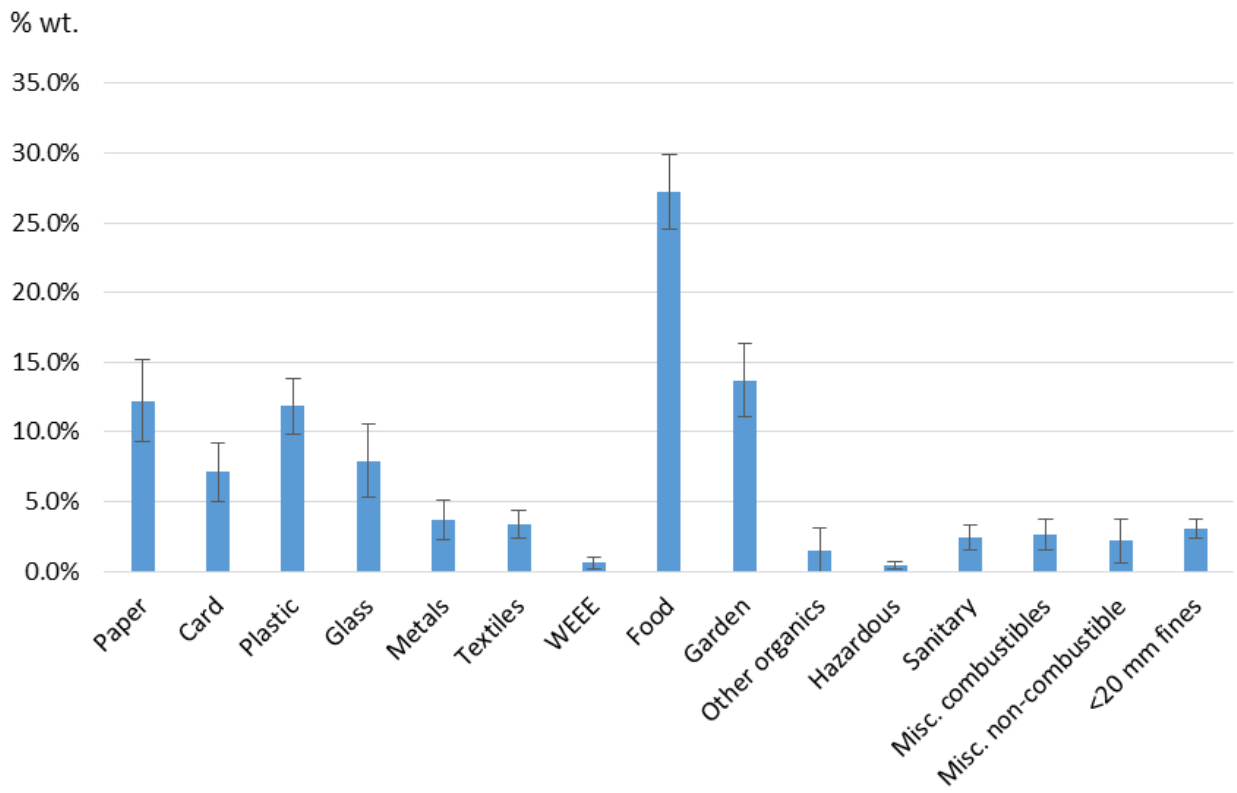
	Dry recycling	Food waste	Garden	Residual	Kerbside waste
Paper	28.1%	0.3%	0.2%	9.8%	12.2%
Card	18.5%	0.0%	0.1%	5.1%	7.1%
Plastic	13.0%	0.8%	0.2%	13.9%	11.9%
Glass	27.7%	0.0%	0.0%	3.4%	7.9%
Metals	6.0%	0.0%	0.1%	3.7%	3.7%
Textiles	0.9%	0.0%	0.6%	4.7%	3.4%
WEEE	0.3%	0.0%	0.2%	0.8%	0.6%
Food	2.1%	95.7%	0.8%	39.1%	27.2%
Garden	0.1%	0.7%	95.4%	2.5%	13.7%
Other organics	0.2%	2.5%	0.1%	2.1%	1.5%
Hazardous	0.2%	0.0%	0.0%	0.6%	0.4%
Sanitary	0.5%	0.0%	0.0%	3.5%	2.4%
Misc. combustibles	1.1%	0.0%	0.3%	3.7%	2.7%
Misc. non-combustible	0.6%	0.0%	2.1%	2.7%	2.2%
<20 mm fines	0.7%	0.0%	0.0%	4.4%	3.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability				66.2%	64.7%
Potentially recyclable*				62.9%	70.3%
Potentially reusable	2.4%			6.1%	4.6%
Non-target	15.8%	4.3%	24.0%**		

*Based on materials currently collected at the kerbside. For the Partnership we have used the broadest definition of recyclable and included all textiles and food waste.
**The non-target material in the garden waste stream was predominantly composed of "soil".

Confidence

Figure 3.2 shows the kerbside waste composition average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[15]. For example, food waste is estimated to comprise 27.2% ±2.7% of the kerbside waste. This means that food waste is estimated to comprise between 24.5% and 29.9% of the kerbside waste or between 134,000 and 163,000 tonnes.

Figure 3.2 Kerbside waste composition result with 95% confidence intervals – MHWP



[15] See Appendix C.

recycle for Merseyside and Halton

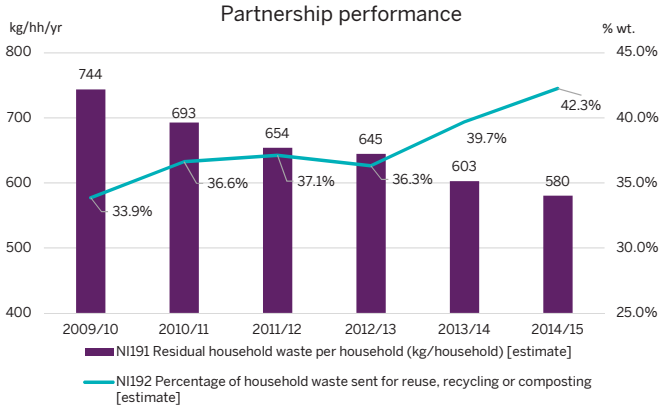
Merseyside and Halton Waste Partnership

Number of households
660,934 (2011)

13 % 38 % 31 % 17 %

Acorn 1 Acorn 3 Acorn 4 Acorn 5

Partnership performance



Sample Information

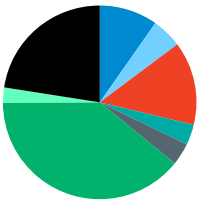
Res.	962 samples	14.3t
Rec.	878 samples	7.1t
Garden	231 samples	3.5t
Food	134 samples	0.5t
	14 samples	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other

Dry recycling = 111,865 t

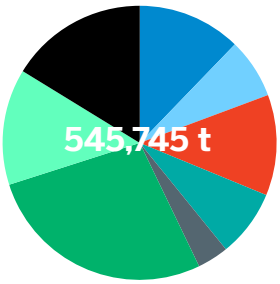
Food waste = 5,114 t

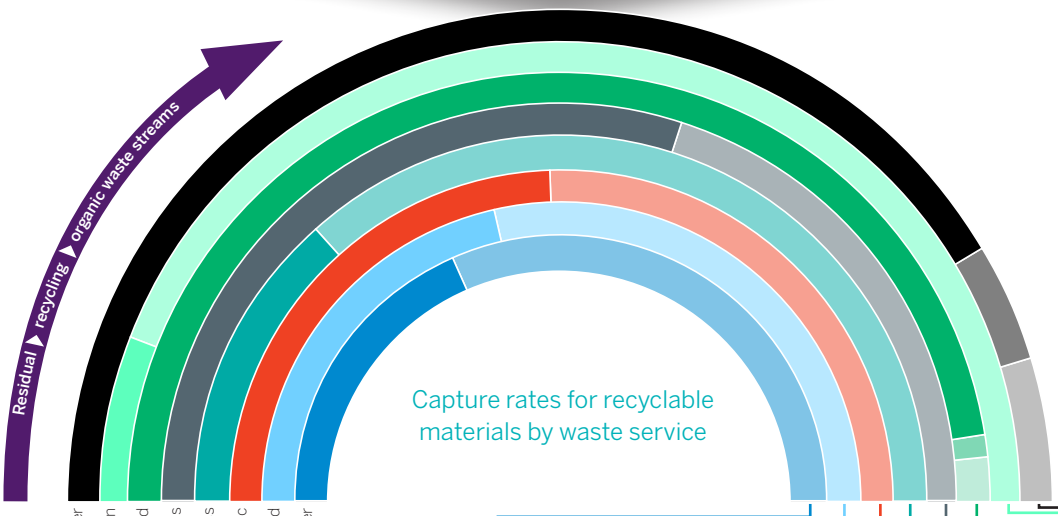
Garden waste = 68,678 t



Residual waste = 360,088 t

All kerbside waste





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	38%	43%	49%	27%	60%	95%	12%	83%
Dry	62%	57%	51%	73%	40%	2%	0%	8%
Garden	0%	0%	0%	0%	0%	0%	88%	9%
Food	0%	0%	0%	0%	0%	3%	0%	0%

amec foster wheeler

Halton BC

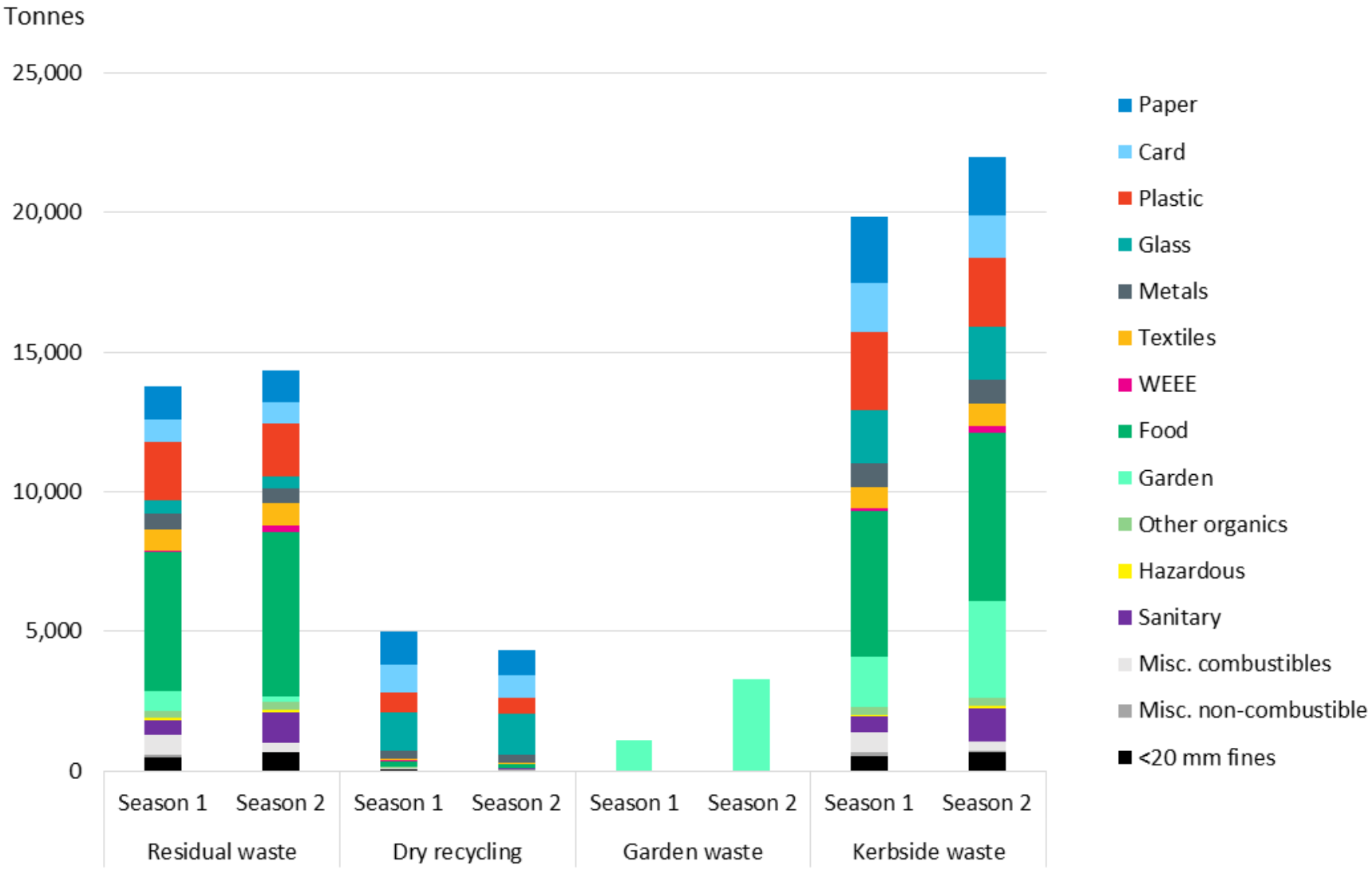
Seasonal kerbside waste composition results

In Figure 3.3 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2. This is also accompanied by a reduction in the quantity of garden waste in the residual waste stream.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.3 Seasonal kerbside waste composition results – Halton



Kerbside waste composition study average results

Table 3.2 presents the kerbside waste composition average results for Halton. Key results include:

- The high proportion of food waste in the residual waste stream at 38.7% (approx. 11,000 tonnes);
- 19.1% (approx. 5,000 tonnes) of the residual waste stream was potentially recyclable. If food waste was classified as recyclable, then 57.8% (approx. 16,000 tonnes) of the residual waste would be potentially recyclable;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 1.9% (<1,000 tonnes) of the kerbside waste; and,
- 5.2% (approx. 2,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 3.8% followed by WEEE at 0.8%.

Table 3.2 Kerbside waste stream composition results (% wt.) – Halton

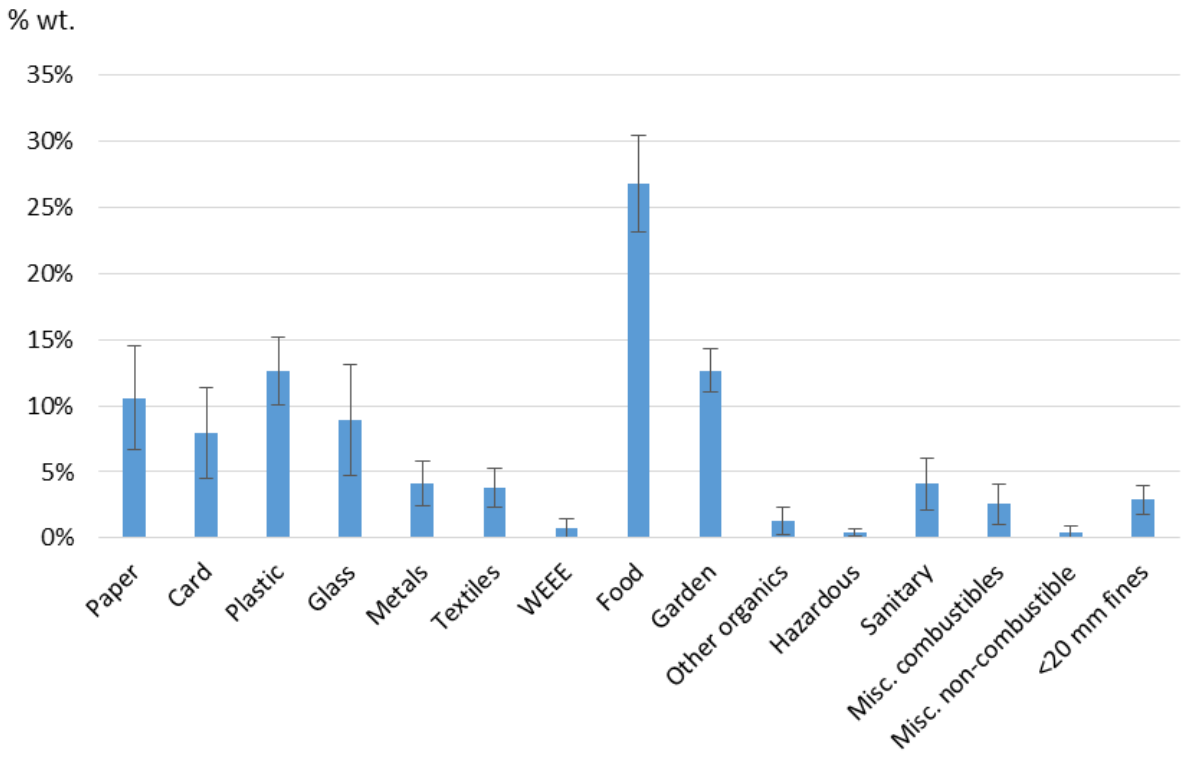
	Dry recycling	Garden	Residual	Kerbside waste
Paper	22.8%	0.0%	8.2%	10.6%
Card	18.7%	0.0%	5.6%	7.9%
Plastic	14.1%	0.0%	14.2%	12.7%
Glass	30.3%	0.0%	3.2%	8.9%
Metals	6.5%	0.0%	4.0%	4.1%
Textiles	0.7%	0.0%	5.4%	3.8%
WEEE	0.3%	0.0%	1.1%	0.8%
Food	3.8%	0.0%	38.7%	26.8%
Garden	0.1%	99.8%	3.2%	12.7%
Other organics	0.3%	0.0%	1.8%	1.3%
Hazardous	0.2%	0.0%	0.6%	0.4%
Sanitary	0.7%	0.0%	5.9%	4.1%
Misc. combustibles	0.5%	0.2%	3.7%	2.6%
Misc. non-combustible	0.3%	0.0%	0.5%	0.4%
<20 mm fines	0.8%	0.0%	4.0%	2.9%
Total	100.0%	100.0%	100.0%	100.0%
Biodegradability			66.8%	63.7%
Potentially recyclable*			19.1%	39.6%
Potentially reusable	2.7%		6.8%	5.2%
Non-target	19.1%	20.5%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

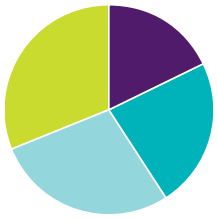
Figure 3.4 shows the kerbside waste composition study average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[16].

Figure 3.4 Kerbside waste composition result with 95% confidence intervals – Halton



[16] See Appendix C.

Halton Borough Council



Number of households
53,312 (2011)

	Dry recycling	Garden waste	Residual waste
Waste service			
Collection frequency	Fortnightly	Fortnightly	Fortnightly
Materials collected	newspapers & magazines; food tins & drink cans; plastic bottles; cardboard; mixed glass bottles & jars; cartons	garden waste (Charged service)	household waste

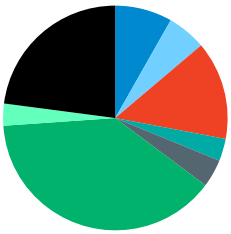
Sample Information

Res.	145 samples	2.2 t
Rec.	134 samples	1.3 t
Garden	48 samples	0.9t
	2 samples	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other

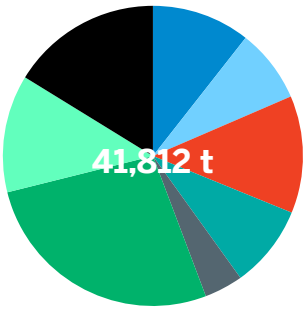
Dry recycling
= 9,317 t

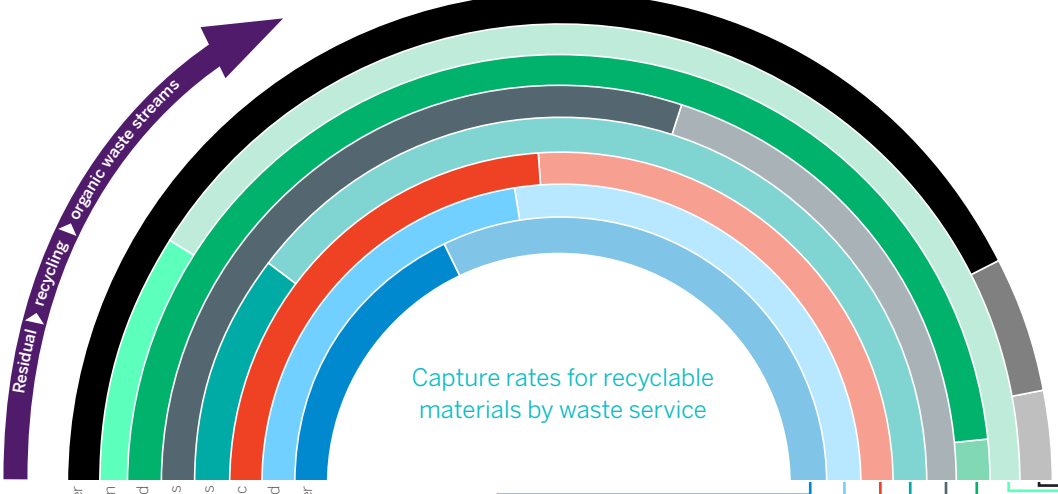
Garden waste
= 4,405 t



Residual waste
= 28,090 t

All kerbside waste





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	36%	45%	48%	21%	60%	97%	18%	85%
Dry	64%	55%	52%	79%	40%	3%	0%	9%
Garden	0%	0%	0%	0%	0%	0%	82%	6%

amec foster wheeler

Knowsley MBC

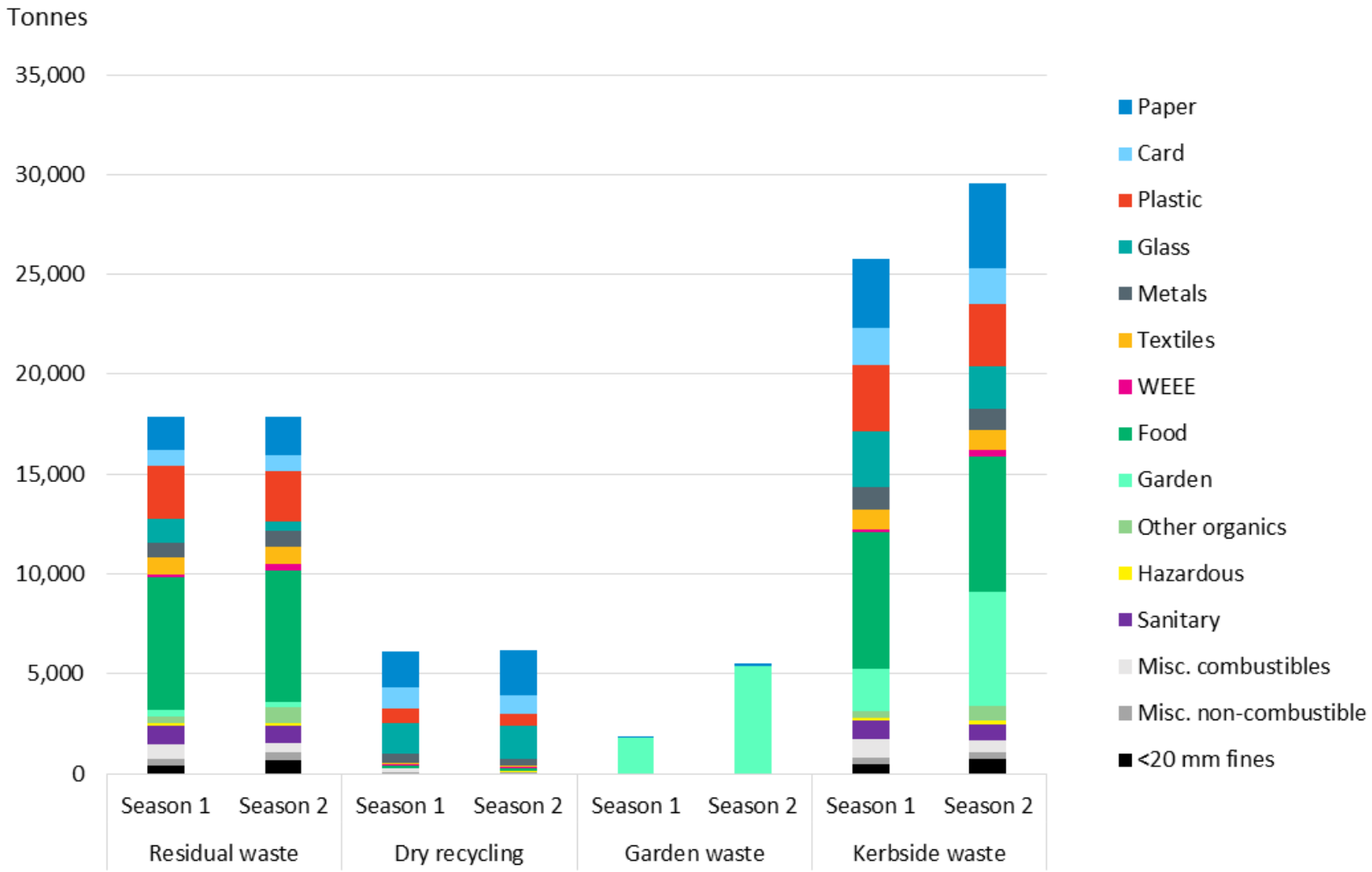
Seasonal kerbside waste composition results

In Figure 3.5 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.5 Seasonal kerbside waste composition results – Knowsley



Kerbside waste composition study average results

Table 3.3 presents the kerbside waste composition average results for Knowsley MBC. Key results include:

- The high proportion of food waste in the residual waste stream at 37.0% (approx. 13,000 tonnes);
- 19.7% (approx. 7,000 tonnes) of the residual waste stream was potentially recyclable. If food waste was classified as recyclable, then 56.8% (approx. 20,000 tonnes) of the residual waste would be potentially recyclable;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 1.6% (<1,000 tonnes) of the kerbside waste; and,
- 5.3% (approx. 3,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 3.5% followed by WEEE at 0.9%.

Table 3.3 Kerbside waste stream composition results (% wt.) – Knowsley

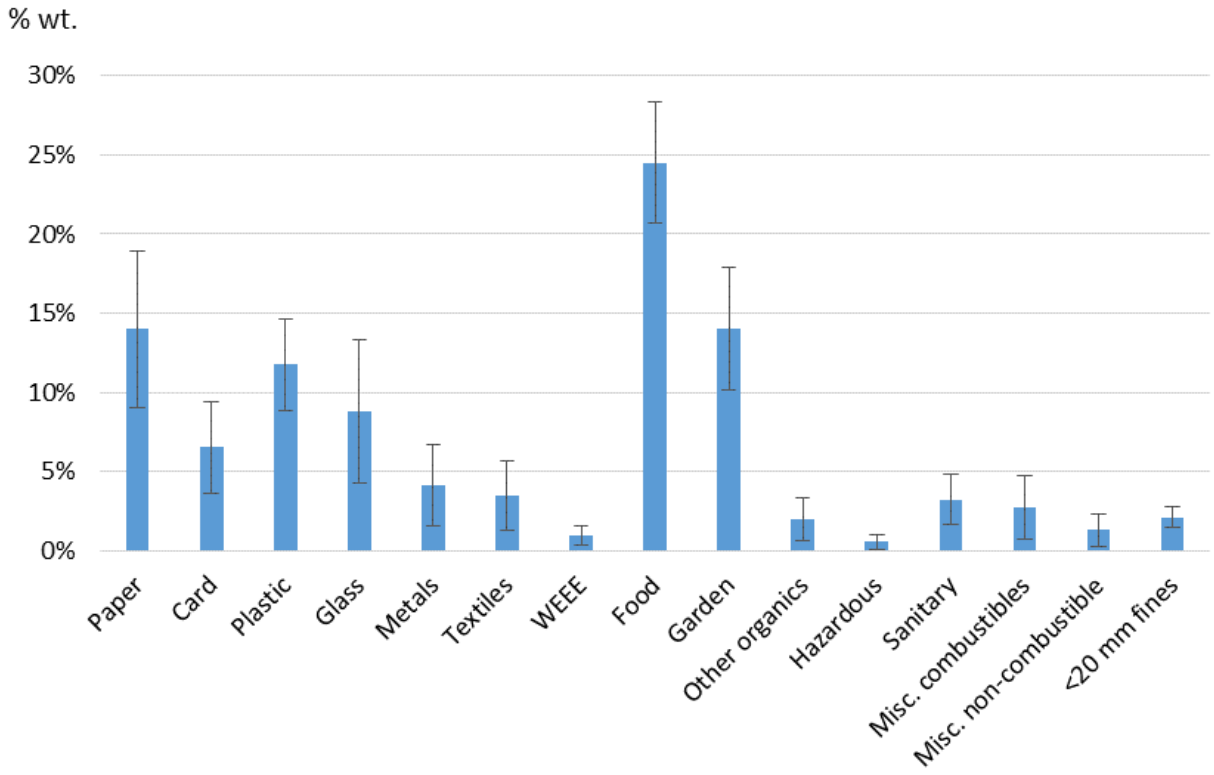
	Dry recycling	Garden	Residual	Kerbside
Paper	32.8%	1.3%	10.1%	14.0%
Card	16.4%	0.0%	4.5%	6.5%
Plastic	10.7%	0.0%	14.5%	11.7%
Glass	25.9%	0.0%	4.7%	8.8%
Metals	6.7%	0.0%	4.0%	4.1%
Textiles	1.3%	0.1%	4.9%	3.5%
WEEE	0.4%	0.0%	1.3%	0.9%
Food	2.7%	0.2%	37.0%	24.5%
Garden	0.0%	98.2%	1.6%	14.1%
Other organics	0.0%	0.0%	3.1%	2.0%
Hazardous	0.1%	0.0%	0.8%	0.6%
Sanitary	0.2%	0.0%	4.9%	3.2%
Misc. combustibles	1.8%	0.0%	3.6%	2.7%
Misc. non-combustible	0.5%	0.1%	1.8%	1.3%
<20 mm fines	0.6%	0.0%	3.0%	2.1%
Total	100.0%	100.0%	100.0%	100.0%
Biodegradability			64.0%	65.7%
Potentially recyclable*			19.7%	44.2%
Potentially reusable	3.1%		7.1%	5.3%
Non-target	15.7%	7.6%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

Figure 3.6 shows the kerbside waste composition study average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[17].

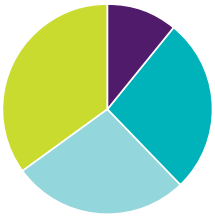
Figure 3.6 Kerbside waste result with 95% confidence intervals - Knowsley



[17] See Appendix C.

Knowsley Council

Knowsley Metropolitan Borough Council



Number of households
61,323 (2011)

13 % 41 % 35 % 10 %

Acorn 1 Acorn 3 Acorn 4 Acorn 5

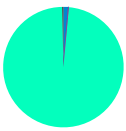
	Dry recycling	Garden waste	Residual waste
Waste service			
Collection frequency	Fortnightly	Fortnightly	Fortnightly
Materials collected	newspapers & magazines; food tins & drink cans; plastic bottles; cardboard; mixed glass bottles & jars; cartons	garden waste; No collection Dec - Feb	household waste

Sample Information

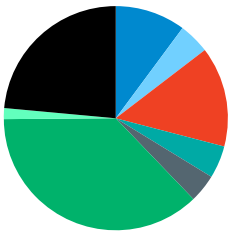
Res.	183 samples	2.8 t
Rec.	135 samples	0.8 t
Garden	43 samples	0.5 t
	2 samples	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other

Dry recycling
= 12,283 t



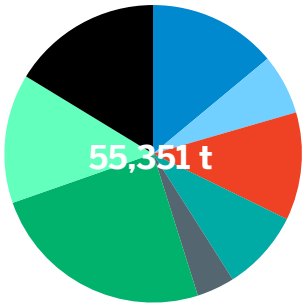
Garden waste
= 7,330 t

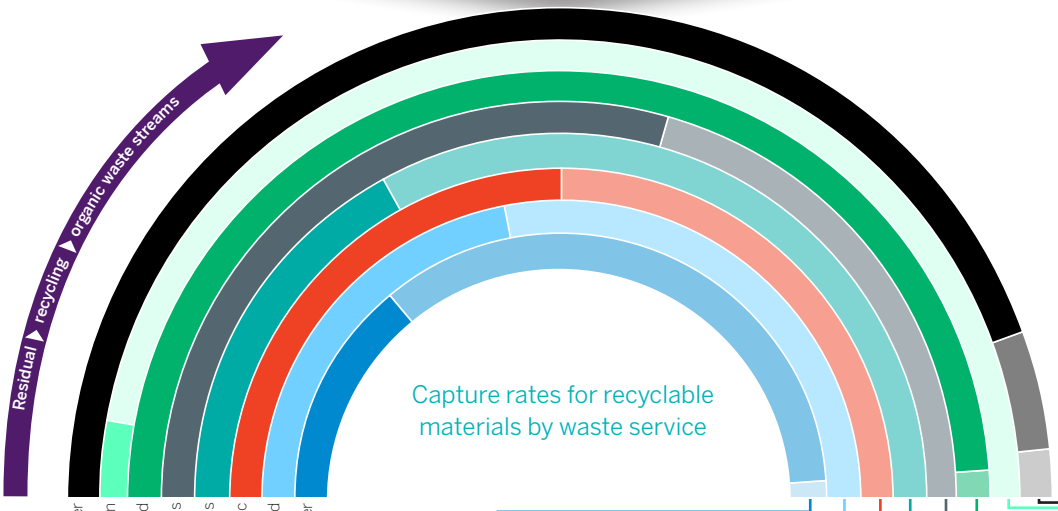


Residual waste
= 35,737 t

=

All kerbside waste





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	28%	44%	62%	34%	59%	98%	6%	89%
Dry	70%	56%	38%	66%	41%	2%	0%	8%
Garden	2%	0%	0%	0%	0%	0%	94%	3%

amec foster wheeler

Liverpool City Council

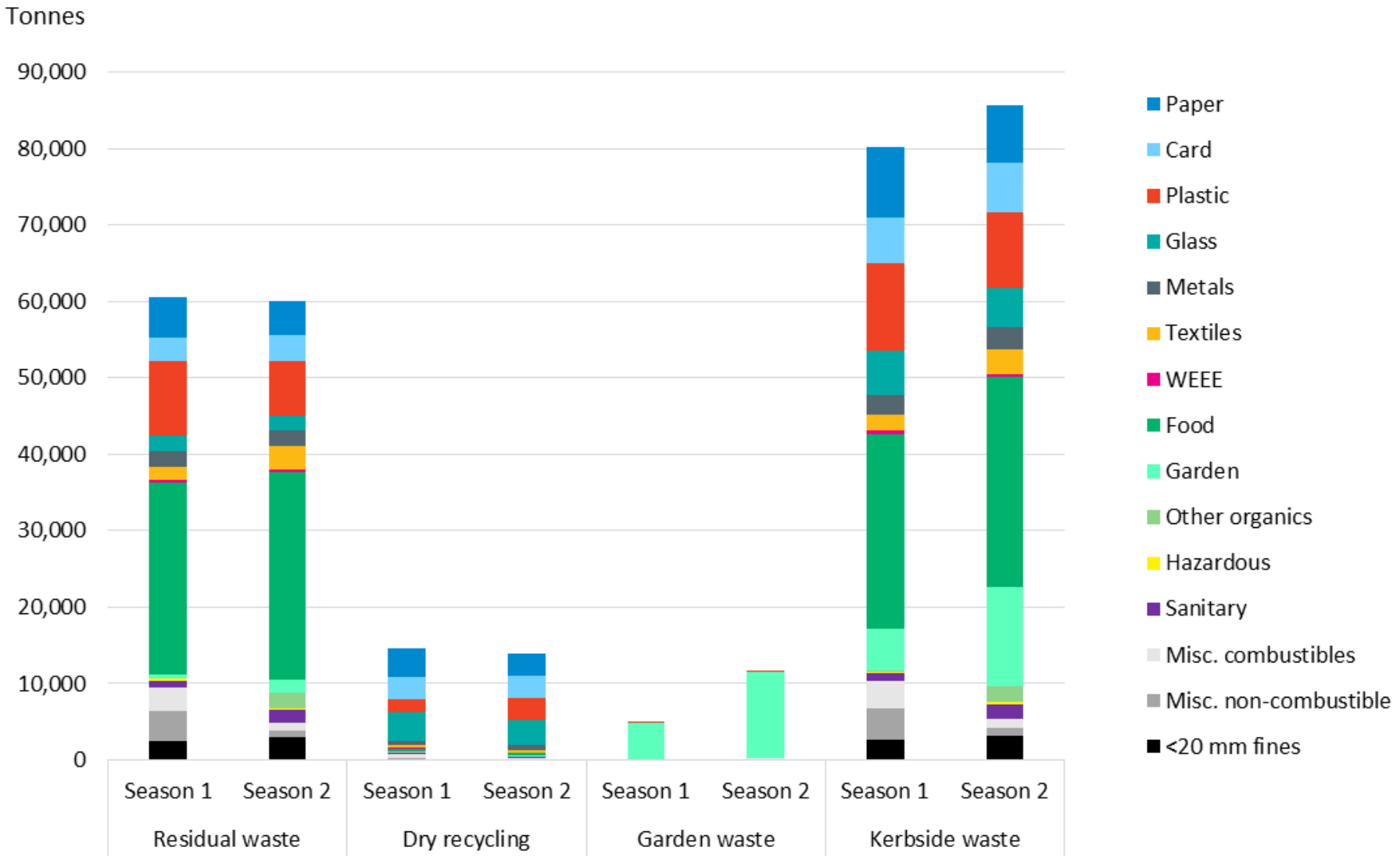
Seasonal kerbside waste composition results

In Figure 3.7 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.7 Seasonal kerbside waste composition results – Liverpool



Kerbside waste composition study average results

Table 3.4 presents the kerbside waste composition average results for Liverpool. Key results include:

- The high proportion of food waste in the residual waste stream at 43.4% (approx. 52,000 tonnes);
- 17.2% (approx. 21,000 tonnes) of the residual waste stream was potentially recyclable. If food waste was classified as recyclable, then 60.6% (approx. 73,000 tonnes) of the residual waste would be potentially recyclable;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 2.1% (approx. 3,000 tonnes) of the kerbside waste; and,
- 4.1% (approx. 7,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 3.2% followed by WEEE at 0.5%.

Table 3.4 Kerbside waste composition results (% wt.) – Liverpool

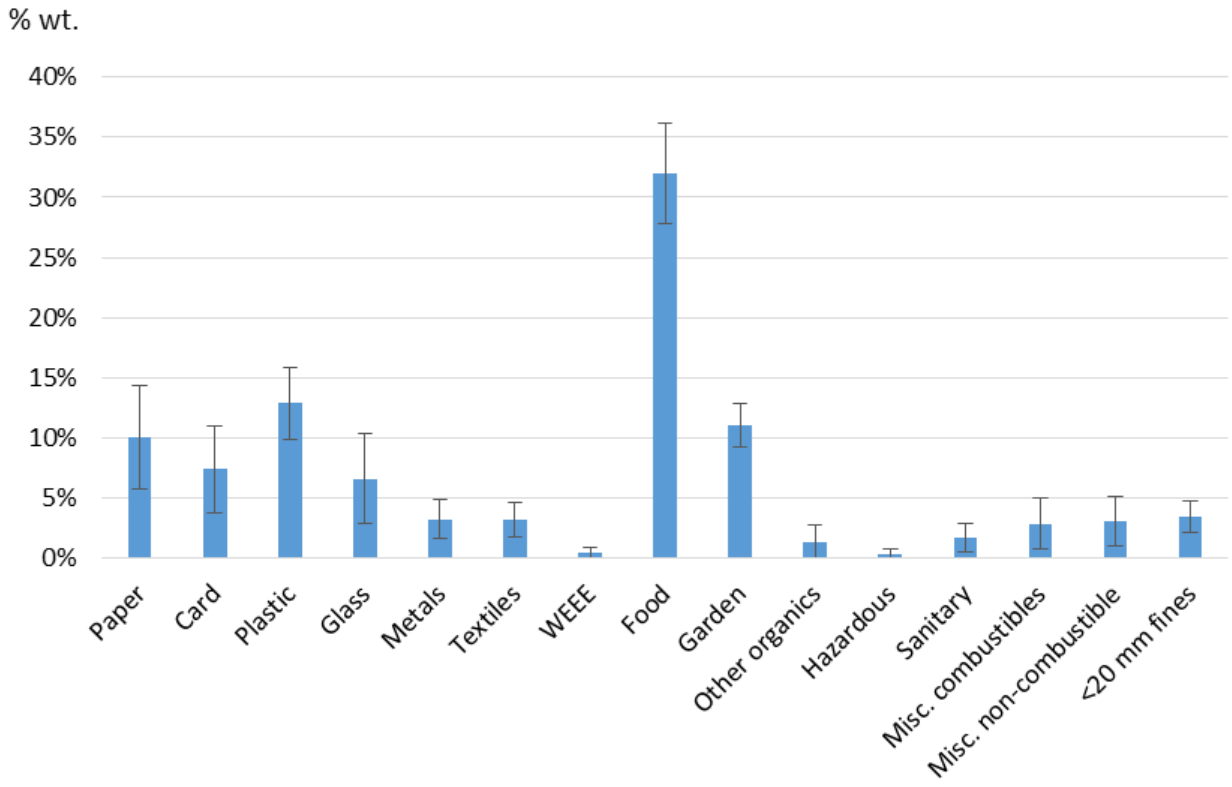
	Dry recycling	Garden	Residual	Kerbside waste
Paper	23.9%	0.0%	8.2%	10.1%
Card	20.0%	0.0%	5.5%	7.4%
Plastic	16.1%	0.1%	13.9%	12.9%
Glass	24.4%	0.0%	3.3%	6.6%
Metals	4.6%	0.0%	3.4%	3.3%
Textiles	2.1%	0.0%	3.9%	3.2%
WEEE	0.7%	0.0%	0.5%	0.5%
Food	2.3%	0.0%	43.4%	32.0%
Garden	0.2%	97.9%	1.8%	11.0%
Other organics	0.5%	0.0%	1.8%	1.4%
Hazardous	0.3%	0.0%	0.4%	0.3%
Sanitary	1.1%	0.0%	2.2%	1.8%
Misc. combustibles	2.1%	0.9%	3.3%	2.9%
Misc. non-combustible	0.6%	1.0%	4.0%	3.1%
<20 mm fines	0.9%	0.0%	4.5%	3.5%
Total	100.0%	100.0%	100.0%	100.0%
Biodegradability			67.2%	64.7%
Potentially recyclable*			17.2%	33.1%
Potentially reusable	3.6%		4.7%	4.1%
Non-target	22.8%	28.6%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

Figure 3.8 shows the kerbside waste composition study average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[18].

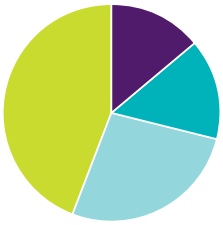
Figure 3.8 Kerbside waste result with 95% confidence intervals - Liverpool



[18] See Appendix C.

The City of Liverpool

Liverpool City Council



Number of households
206,515 (2011)

7 % 28 % 41 % 23 %

Acorn 1 Acorn 3 Acorn 4 Acorn 5

	Dry recycling	Garden waste	Residual waste
Waste service			
Collection frequency	Fortnightly	Fortnightly	Fortnightly
Materials collected	newspapers & magazines; food tins & drink cans; plastic bottles; cardboard; mixed glass bottles & jars; cartons	garden waste	household waste

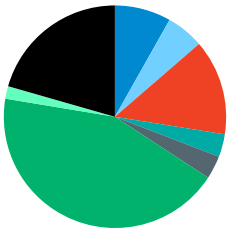
Sample Information

Res.	159 samples	2.4 t
Rec.	124 samples	1.4 t
Garden	27 samples	0.4 t
	3 samples	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other

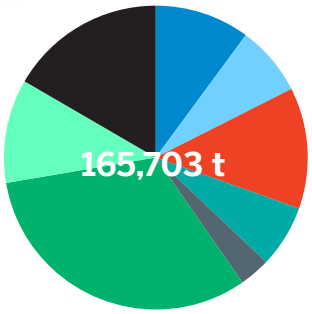
Dry recycling = 28,635 t

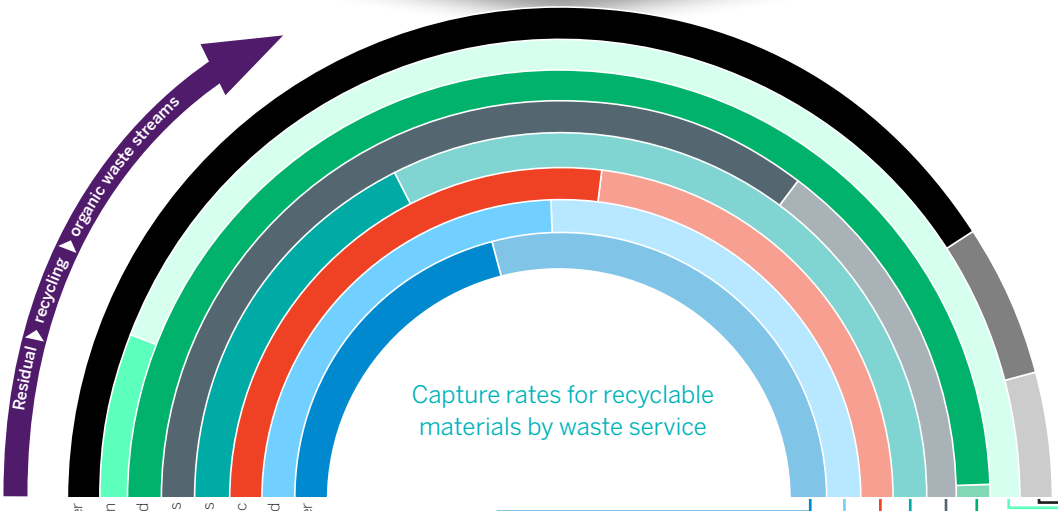
Garden waste = 16,378 t



Residual waste = 120,691 t

All kerbside waste





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	42%	49%	54%	35%	71%	99%	12%	82%
Dry	58%	51%	46%	65%	29%	1%	0%	10%
Garden	0%	0%	0%	0%	0%	0%	88%	8%

amec foster wheeler

Sefton MBC

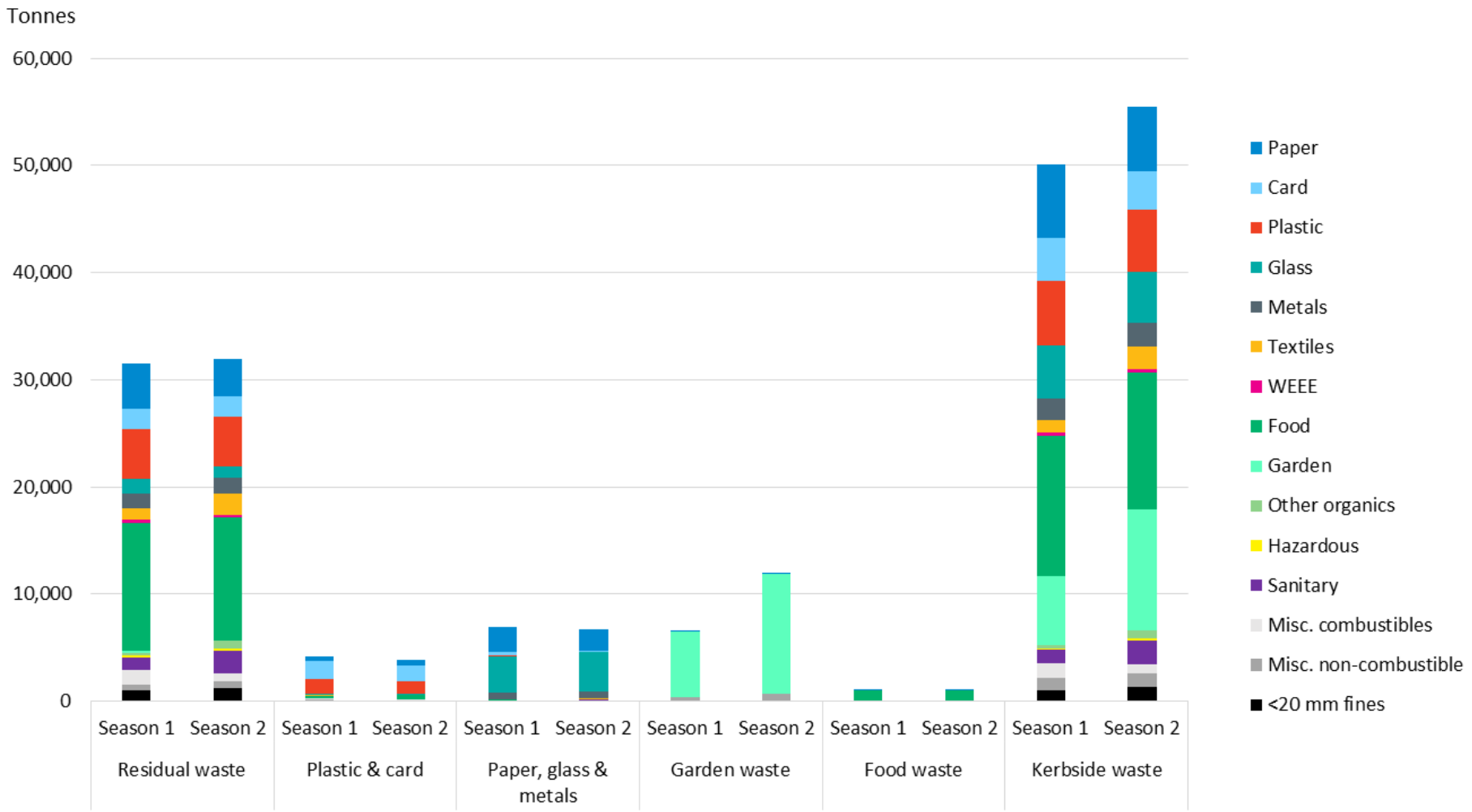
Seasonal kerbside waste composition results

In Figure 3.9 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.9 Seasonal kerbside waste composition results – Sefton



Kerbside waste composition study average results

Table 3.5 presents the kerbside waste composition average results for Sefton. Key results include:

- The high proportion of non-target material in the plastic and card stream at 39.4% (approx. 3,000 tonnes). Non-target materials in the plastic and card stream include paper at 10.6% and food waste at 7.5%;
- The high proportion of food waste in the residual waste stream at 36.9% (approx. 23,000 tonnes);
- 64.6% (approx. 41,000 tonnes) of the residual waste stream was potentially recyclable;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 1.4% (approx. 2,000 tonnes) of the kerbside waste; and,
- 4.2% (approx. 4,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 3.1% followed by WEEE at 0.5%.

Table 3.5 Kerbside waste composition results (% wt.) – Sefton

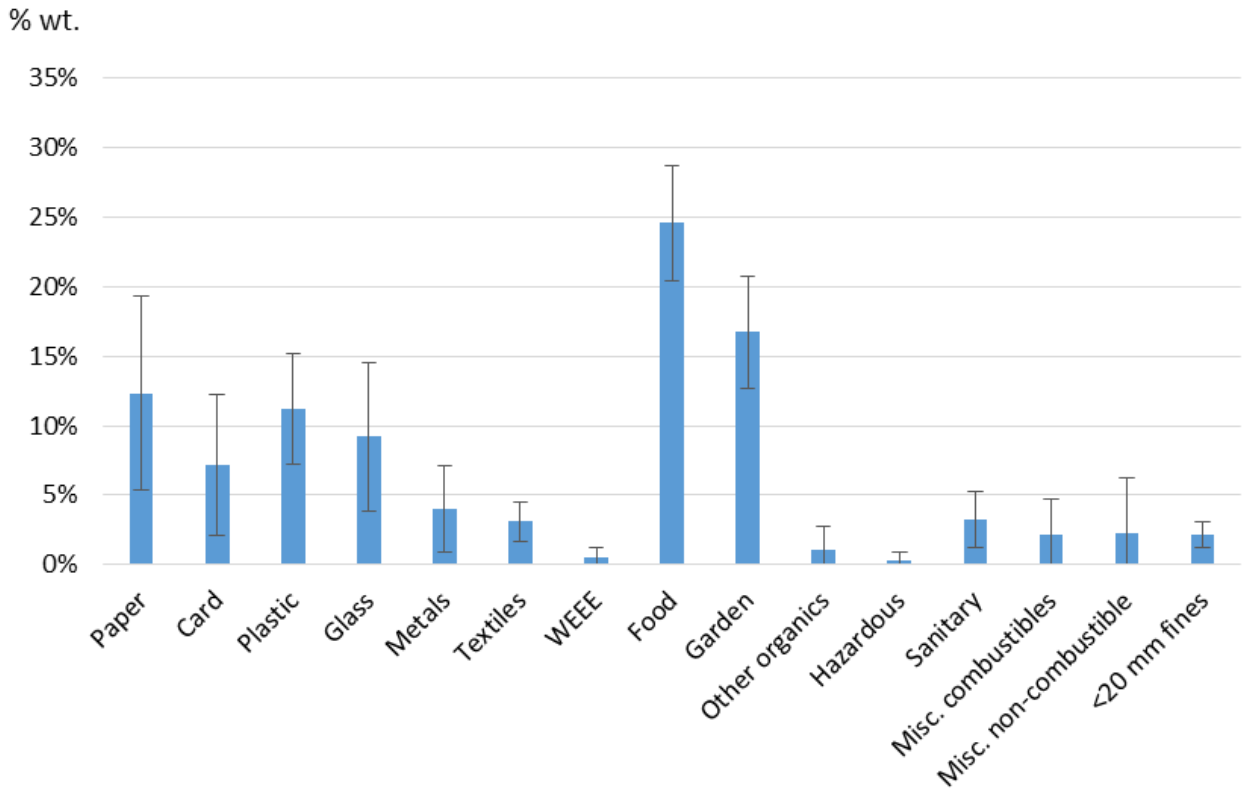
	Paper, glass & metals	Plastic & card	Food	Garden	Residual	Kerbside waste
Paper	31.7%	10.6%	0.6%	0.2%	12.2%	12.3%
Card	3.1%	40.9%	0.0%	0.0%	6.0%	7.1%
Plastic	0.9%	31.5%	0.2%	0.0%	14.5%	11.2%
Glass	52.1%	1.9%	0.0%	0.0%	3.9%	9.2%
Metals	9.5%	1.6%	0.0%	0.0%	4.4%	4.0%
Textiles	0.4%	0.5%	0.0%	0.0%	5.0%	3.1%
WEEE	0.0%	0.0%	0.0%	0.0%	0.8%	0.5%
Food	0.6%	7.5%	95.5%	0.0%	36.9%	24.6%
Garden	0.1%	0.0%	0.0%	94.3%	0.3%	16.7%
Other organics	0.0%	0.4%	3.6%	0.0%	1.6%	1.1%
Hazardous	0.0%	0.1%	0.0%	0.0%	0.5%	0.3%
Sanitary	0.5%	0.4%	0.0%	0.0%	5.2%	3.2%
Misc. combustibles	0.0%	2.6%	0.0%	0.1%	3.2%	2.1%
Misc. non-combustible	1.0%	1.3%	0.0%	5.3%	1.9%	2.3%
<20 mm fines	0.1%	0.6%	0.0%	0.0%	3.5%	2.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability					65.2%	63.1%
Potentially recyclable*					64.6%	71.8%
Potentially reusable	1.1%	0.7%			6.6%	4.2%
Non-target	6.6%	39.4%	4.5%	27.8%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

Figure 3.10 shows the kerbside waste composition study average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[19].

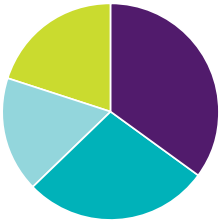
Figure 3.10 Kerbside waste result with 95% confidence intervals - Sefton



[19] See Appendix C.

Sefton Council

Metropolitan Borough of Sefton



Number of households
117,930 (2011)

16 % 47 % 19 % 18 %

	Dry recycling	Food waste	Garden waste	Residual waste
Waste service				
Collection frequency	**Weekly** (box/bags) **Fortnightly** (bin)	**Weekly**	**3 Weekly**	**Fortnightly**
Materials collected	newspapers & magazines; food tins & drink cans; plastic bottles; cartons; cardboard; mixed glass bottles & jars; textiles	food waste	garden waste	household waste
		Opt in	No collection Nov - Feb	

Sample Information

Res.	173samples	2.5t
Rec.	274 samples	1.7t
Garden	76 samples	1.1t
Food	45 samples	0.1t
	4 samples	failed QA check

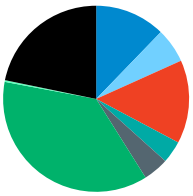
Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other

Paper, glass & metal = 13,653 t

Plastic & card = 8,014 t

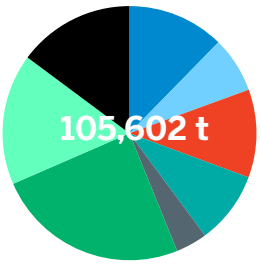
Food waste = 1,953 t

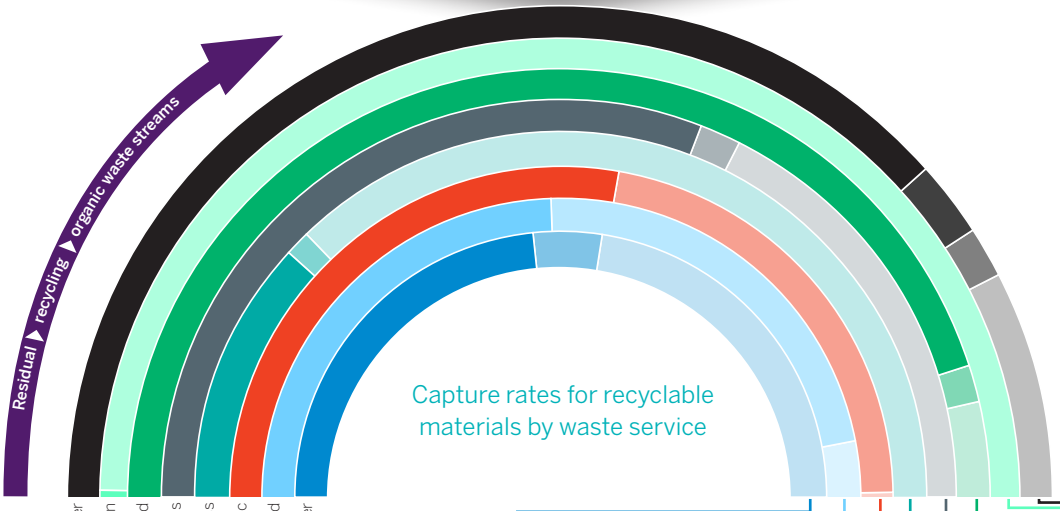
Garden waste = 18,496 t



Residual waste = 63,485 t

All kerbside waste





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	47%	49%	56%	24%	62%	90%	1%	77%
Plastic & card	8%	45%	44%	2%	3%	2%	0%	5%
Paper, glass & metal	45%	6%	1%	75%	34%	0%	0%	2%
Garden	0%	0%	0%	0%	0%	0%	99%	15%
Food	0%	0%	0%	0%	0%	7%	0%	0%

amec foster wheeler

St. Helens MBC

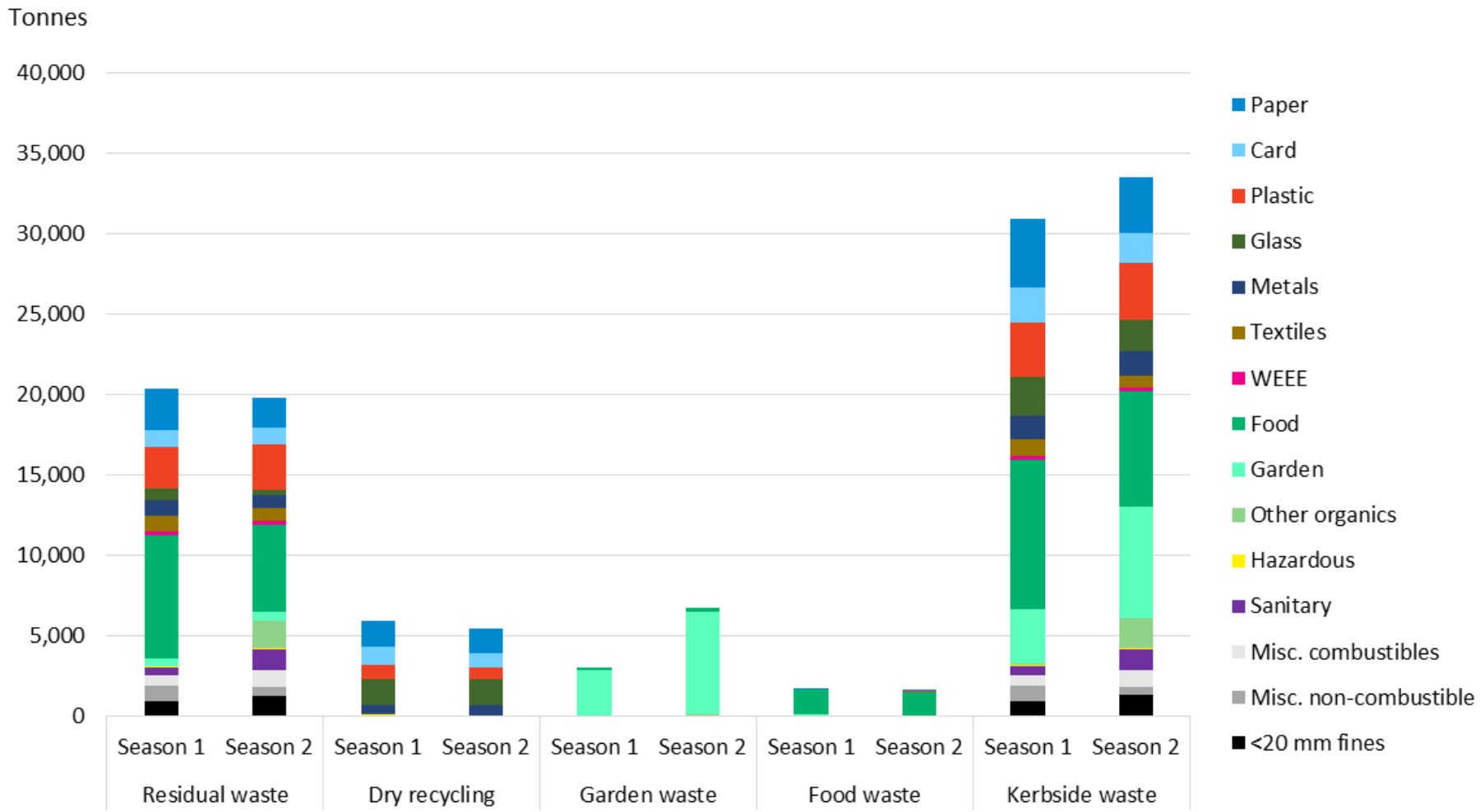
Seasonal kerbside waste composition results

In Figure 3.11 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.11 Seasonal kerbside waste composition results – St Helens



Kerbside waste composition study average results

Table 3.6 presents the kerbside waste composition average results for St Helens. Key results include:

- The high proportion of food waste in the residual waste stream at 32.7% (approx. 13,000 tonnes);
- 52.1% (approx. 21,000 tonnes) of the residual waste stream was potentially recyclable;
- St Helens operate an on-demand textiles service. Although the service was not included in the sampling, the on-demand textiles services does not appear to have had an observable effect on the composition of the kerbside waste streams. For example, textiles comprised 4.4% of the residual waste stream which is comparable to the other Districts where textiles composed 4 – 6% of the residual waste stream;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 1.4% (<1,000 tonnes) of the kerbside waste; and,
- 4.0% (approx. 3,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 2.8% and WEEE at 0.7%.

Table 3.6 Kerbside waste composition results (% wt.) – St. Helens

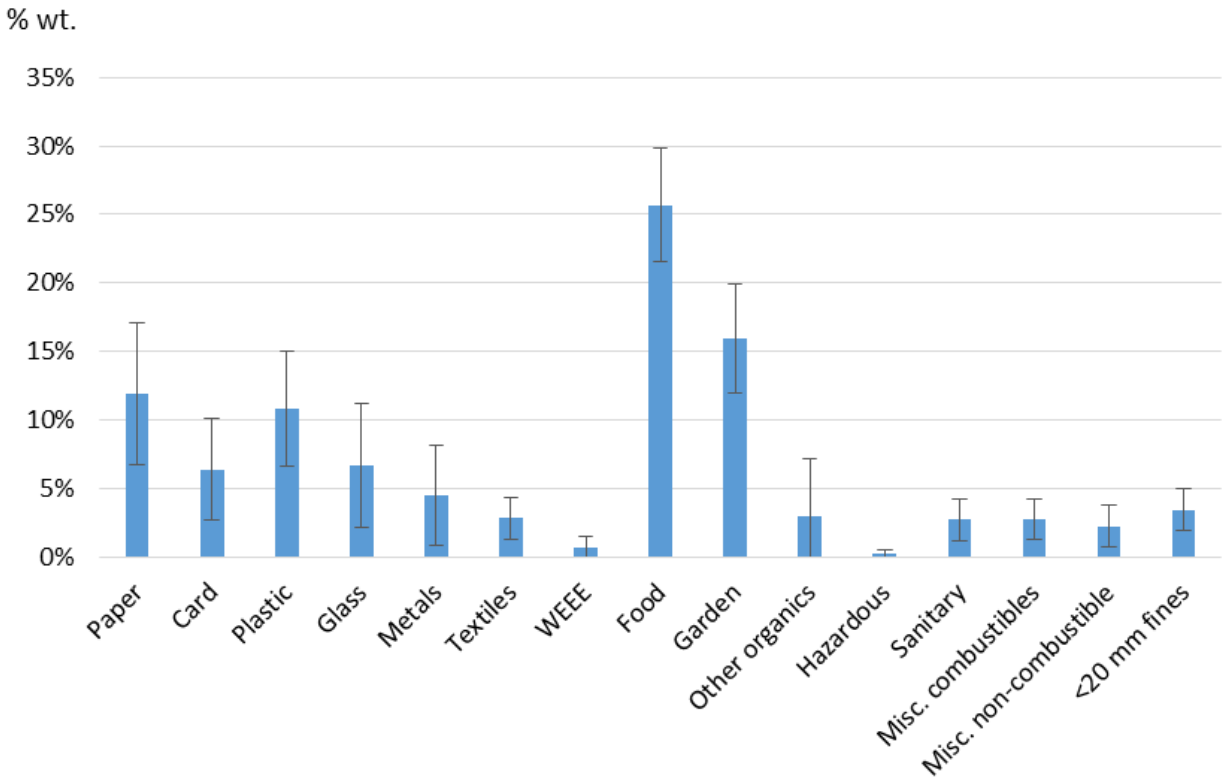
	Dry recycling	Food	Garden	Residual	Kerbside waste
Paper	28.1%	0.1%	0.0%	11.1%	11.9%
Card	18.0%	0.0%	0.0%	5.2%	6.4%
Plastic	13.4%	1.1%	0.0%	13.5%	10.8%
Glass	28.6%	0.0%	0.0%	2.7%	6.7%
Metals	10.1%	0.1%	0.0%	4.4%	4.5%
Textiles	0.3%	0.0%	0.0%	4.4%	2.8%
WEEE	0.0%	0.0%	0.0%	1.1%	0.7%
Food	0.3%	95.9%	3.6%	32.7%	25.7%
Garden	0.0%	1.0%	95.2%	2.5%	16.0%
Other organics	0.0%	1.9%	1.0%	4.4%	3.0%
Hazardous	0.4%	0.0%	0.0%	0.3%	0.2%
Sanitary	0.2%	0.0%	0.0%	4.3%	2.7%
Misc. combustibles	0.0%	0.0%	0.1%	4.4%	2.8%
Misc. non-combustible	0.1%	0.0%	0.0%	3.6%	2.2%
<20 mm fines	0.3%	0.0%	0.0%	5.4%	3.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability				64.4%	66.2%
Potentially recyclable*				52.1%	66.2%
Potentially reusable	1.8%			5.9%	4.0%
Non-target	10.0%	4.1%	18.3%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

Figure 3.12 shows the kerbside waste composition study average result with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[20].

Figure 3.12 Kerbside waste result with 95% confidence intervals – St Helens



[20] See Appendix C.

St.Helens Council

St. Helens Metropolitan Borough Council

Number of households
75,736 (2011)

17 % 42 % 25 % 16 %

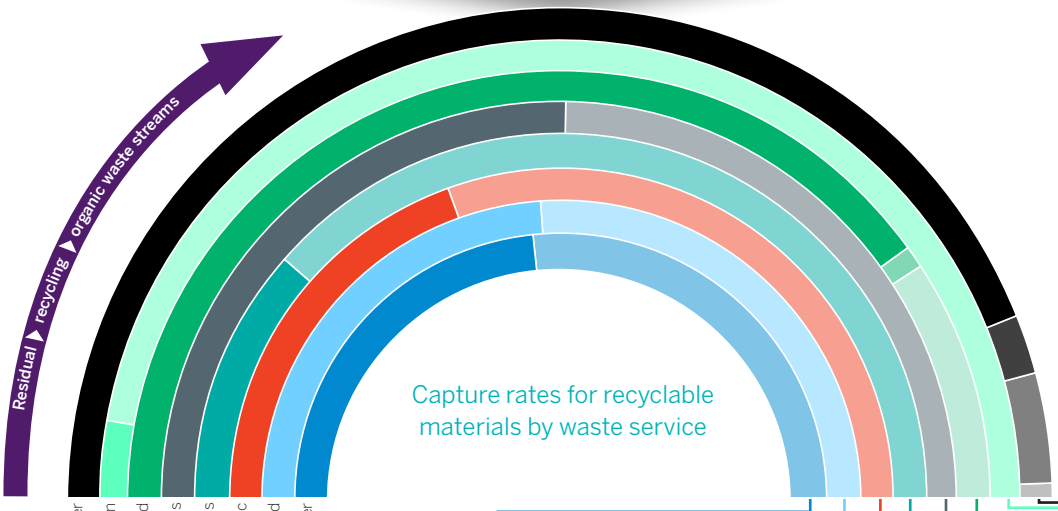
Acorn 1 Acorn 3 Acorn 4 Acorn 5

	Dry recycling	Food waste	Garden waste	Residual waste
Waste service				
Collection frequency	Weekly	Weekly	Fortnightly	Fortnightly
Materials collected	newspapers & magazines, food tins & drink cans, plastic bottles, cardboard, mixed glass bottles & jars, cartons	food waste	garden waste	household waste
			4 weekly in winter	

Sample Information

Res.	151 samples	2.4 t
Rec.	127 samples	0.6 t
Garden	14 samples	0.2
Food	71 samples	0.3 t
	1 sample	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other



Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	47%	48%	39%	23%	51%	79%	6%	88%
Dry	53%	52%	61%	77%	49%	0%	0%	4%
Garden	0%	0%	0%	0%	0%	2%	94%	7%
Food	0%	0%	0%	0%	0%	18%	0%	1%

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Wirral MBC

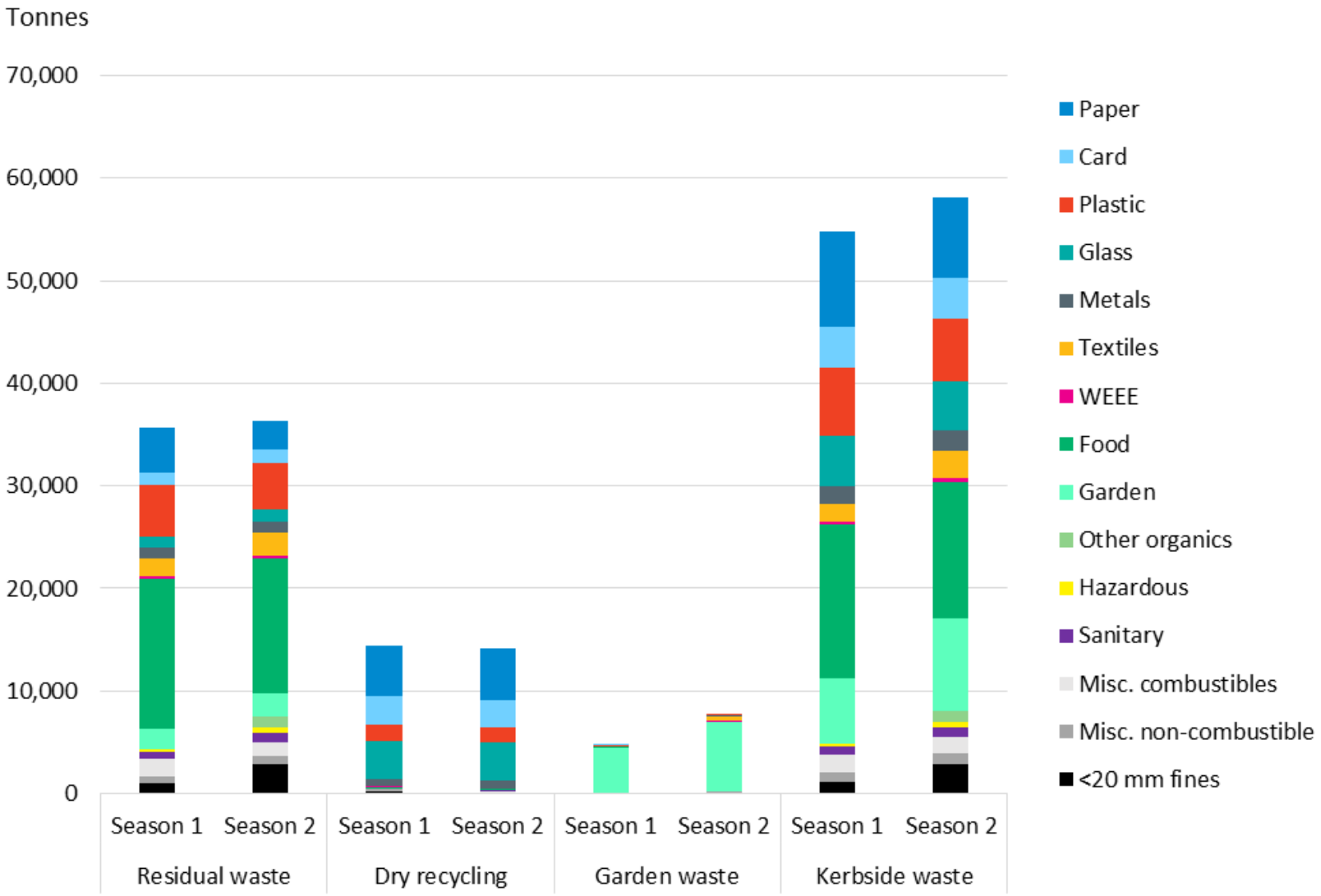
Seasonal kerbside waste composition results

In Figure 3.13 the seasonal kerbside waste composition results have been applied to the waste arisings data supplied by the MRWA to illustrate how kerbside waste varies at different times of the year.

The main difference between the seasons is the quantity of material collected in the garden waste stream in Season 2.

Please note, large variations in material categories such as sanitary waste, other organics and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from home improvements).

Figure 3.13 Seasonal kerbside waste composition results – Wirral



Kerbside waste composition study average results

Table 3.7 presents the kerbside waste composition average results for Wirral. Key results include:

- The high proportion of food waste in the residual waste stream at 38.7% (approx. 28,000 tonnes);
- 18.8% (approx. 14,000 tonnes) of the residual waste stream was potentially recyclable. If food waste was classified as recyclable, then 57.4% (41,000 tonnes) of the residual waste would be potentially recyclable;
- Pots, tubs and trays (PTTs) excluding black plastics comprised 1.7% (approx. 2,000 tonnes) of the kerbside waste; and,
- 5.5% (approx. 6,000 tonnes) of the kerbside waste was potentially reusable. The potentially reusable materials in the kerbside waste were predominantly textiles at 3.9% followed by WEEE at 0.6%.

Table 3.7 Kerbside waste composition results (% wt.) – Wirral

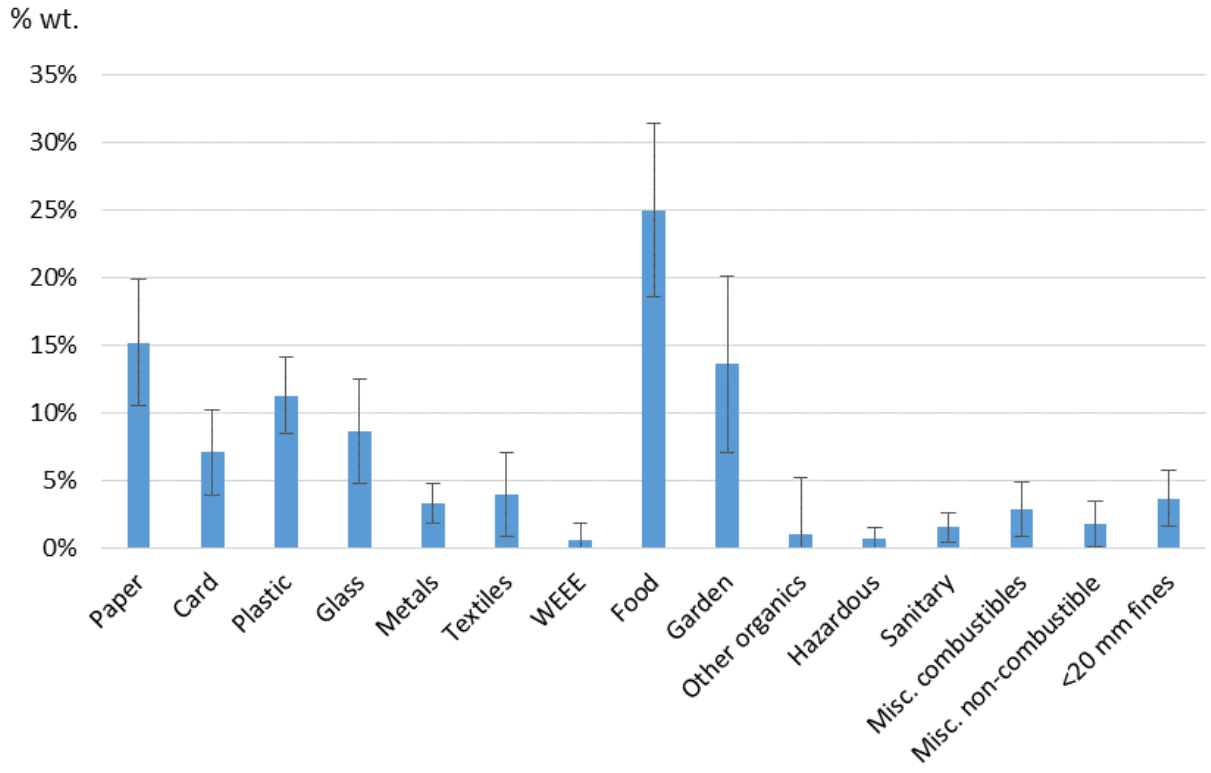
	Dry recycling	Garden	Residual	Kerbside waste
Paper	35.0%	0.0%	9.9%	15.2%
Card	18.9%	0.3%	3.5%	7.1%
Plastic	10.8%	0.7%	13.3%	11.3%
Glass	26.2%	0.1%	3.0%	8.6%
Metals	5.0%	0.6%	3.0%	3.3%
Textiles	0.2%	3.1%	5.5%	3.9%
WEEE	0.1%	1.3%	0.7%	0.6%
Food	0.9%	1.3%	38.7%	25.0%
Garden	0.1%	90.5%	5.8%	13.6%
Other organics	0.0%	0.0%	1.6%	1.0%
Hazardous	0.1%	0.0%	1.0%	0.7%
Sanitary	0.2%	0.0%	2.3%	1.5%
Misc. combustibles	0.6%	0.1%	4.3%	2.9%
Misc. non-combustible	0.7%	2.0%	2.1%	1.7%
<20 mm fines	1.1%	0.0%	5.3%	3.7%
Total	100.0%	100.0%	100.0%	100.0%
Biodegradability			67.4%	65.4%
Potentially recyclable*			18.8%	42.9%
Potentially reusable	2.1%		7.1%	5.5%
Non-target	11.4%	27.7%**		

*Based on materials currently collected at the kerbside.
**The non-target material in the garden waste stream was predominantly composed of “soil”.

Confidence

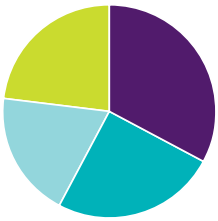
Figure 3.14 shows the study average kerbside waste composition results with indicative 95% confidence intervals to illustrate the level of uncertainty associated with the results for the primary material categories[21].

Figure 3.14 Study average kerbside waste results with 95% confidence intervals – Wirral



[21] See Appendix C.

Wirral Metropolitan Borough Council



Number of households
146,118 (2011)

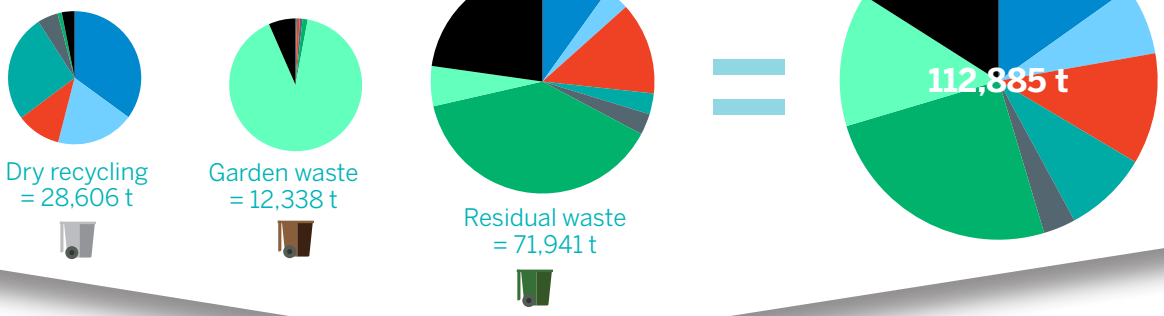
15 % 47 % 30 % 8 %

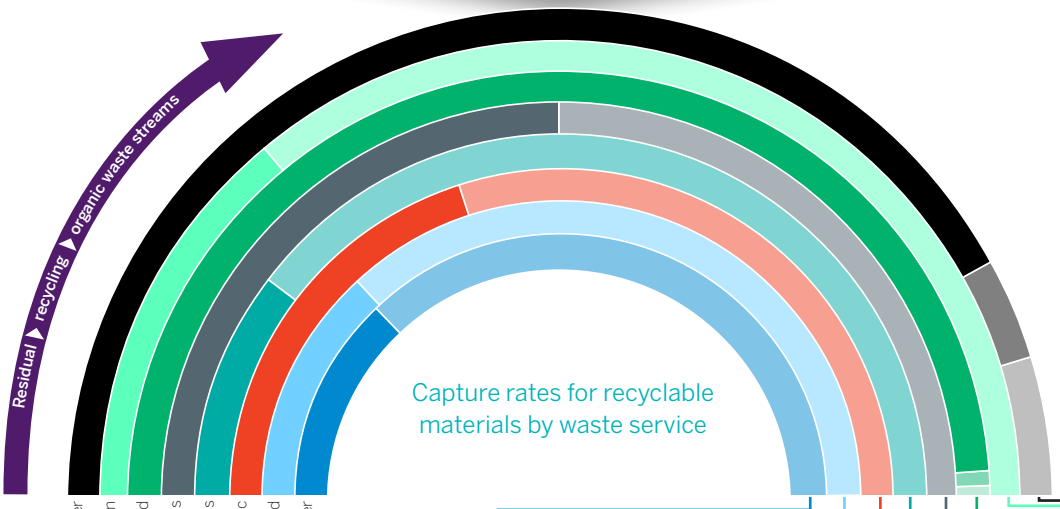
	Dry recycling	Garden waste	Residual waste
Waste service			
Collection frequency	Fortnightly	Fortnightly	Fortnightly
Materials collected	newspapers & magazines; food tins & drink cans; plastic bottles; cardboard; mixed glass bottles & jars; cartons	garden waste	household waste
		Charged service No collection 21st Dec – 21st Jan	

Sample Information

Res.	151 samples	1.9t
Rec.	128 samples	1.3t
Garden	23 samples	0.3t
	2 samples	failed QA check

Key
Paper
Card
Plastic
Glass
Metals
Food
Garden
Other





Capture rates for recyclable materials by waste service

Key	Recyclable paper	Recyclable card	Recyclable plastic	Recyclable glass	Recyclable metals	Food	Garden	Other
Residual	26%	27%	40%	21%	50%	98%	28%	84%
Dry	74%	73%	60%	79%	50%	1%	0%	7%
Garden	0%	0%	0%	0%	0%	1%	72%	9%

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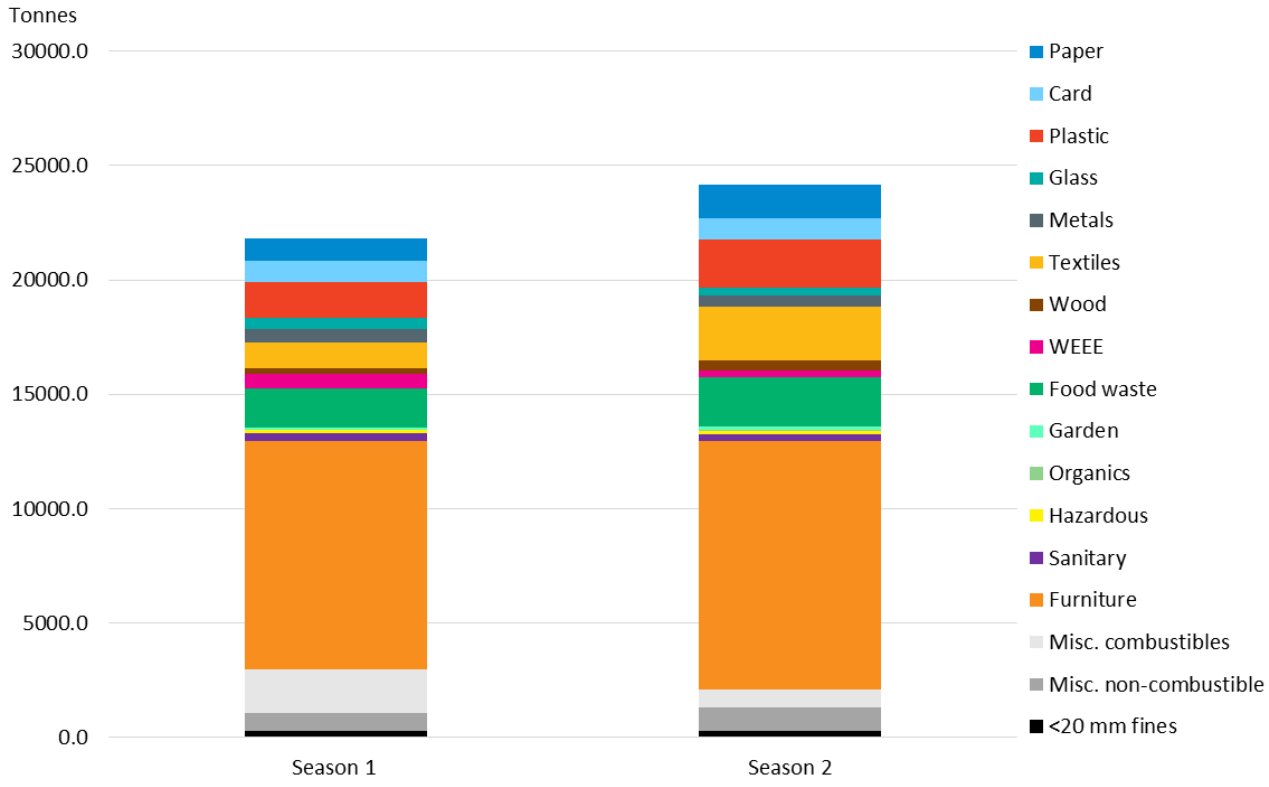
3.2 Household Waste Recycling Centres (HWRCs) Residual Waste Results

Seasonal HWRC residual waste composition results

In Figure 3.15 the seasonal HWRC residual waste composition results have been applied to waste arisings data supplied by the MRWA to provide a comparative summary of the Season1 and Season 2results. The composition of HWRC residual waste was relatively consistent between Season 1 and 2 however larger quantities of waste were disposed of during the period that the Season 2 results have been applied to (Mar – Aug 2015/16). HWRCs tend to be busier during the summer months and also tend to be open longer. HWRC opening times in Merseyside and Halton at the time of the study were 8am to 5pm (Oct – Mar) and 8am to 8pm (Apr – Sept).

Please note, large variations in material categories such as miscellaneous combustibles and miscellaneous non-combustibles are common because although they are produced by most households they are produced infrequently (e.g. miscellaneous non-combustibles from home improvements or house clearances).

Figure 3.15 Seasonal results – HWRCs



HWRC residual waste composition study average results

Table 3.8 presents the HWRC residual waste composition average results. Key results include:

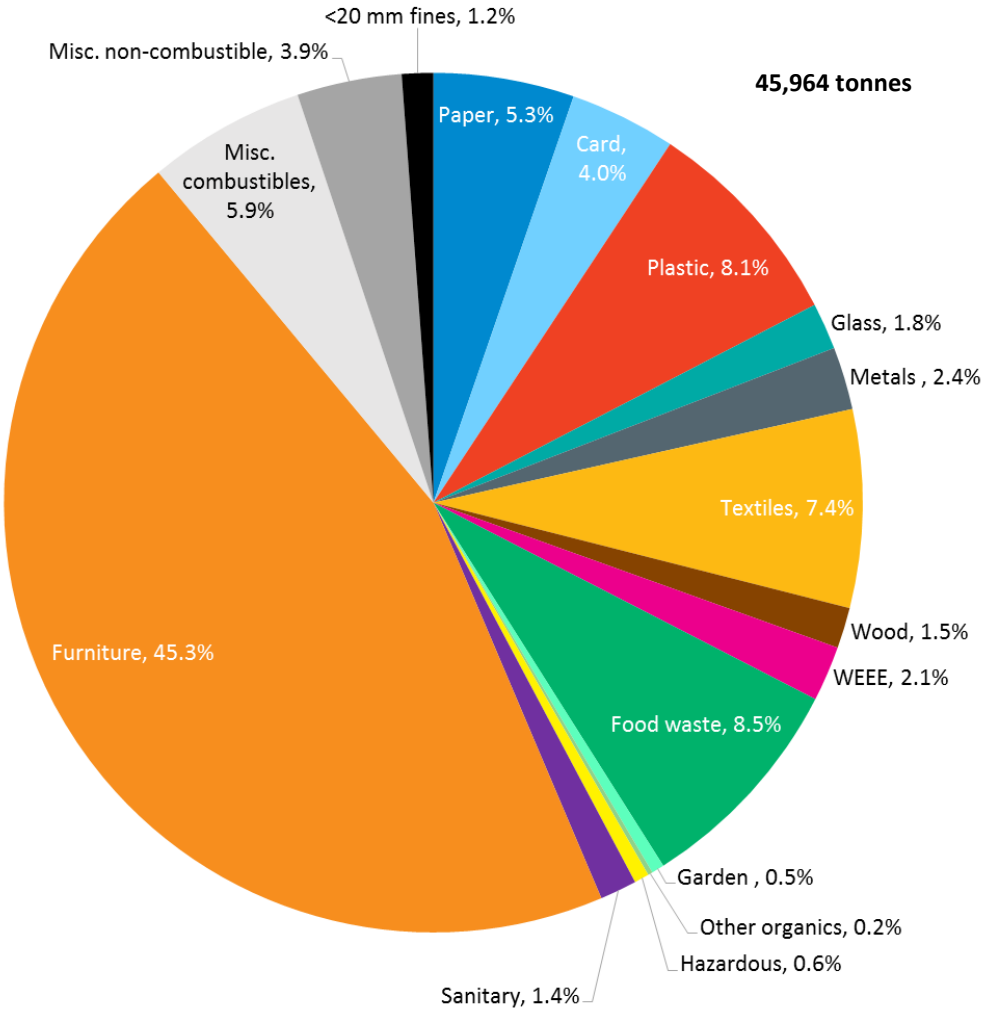
- The high proportion of furniture in the residual stream at 45.3% (approx. 21,000 tonnes). Over 97% of the furniture was "soft furniture" including sofas and their furnishings. These results are discussed in more depth in Section 4.3;
- The second largest material category was food waste at 8.5% (approx. 4,000 tonnes) followed by plastic at 8.1% (approx. 4,000 tonnes). Plastic bottles comprised 1.0% and Pots, Tubs and Trays (PTTs) 0.7% of the HWRC residual waste; and,
- The proportion of sample material categorised as potentially reusable was 45.5% (approx. 21,000 tonnes). There is no observable difference between sites with reuse shops (such as South Sefton) and sites without reuse shops.

Table 3.8 HWRC residual waste composition results (% wt.)

	Huyton	Otterspool/ Old Swan	South Sefton	Ravenhead	Bidston	Picow Farm	Average
Paper	3.7%	5.8%	6.0%	6.9%	3.4%	6.2%	5.3%
Card	4.0%	4.2%	2.7%	3.3%	6.5%	2.7%	4.0%
Plastic	7.1%	11.3%	7.9%	8.1%	6.4%	6.7%	8.1%
Glass	1.7%	1.1%	3.6%	2.0%	0.9%	1.1%	1.7%
Metals	2.5%	4.2%	1.7%	2.7%	1.6%	1.1%	2.4%
Textiles	6.5%	9.6%	5.1%	6.0%	8.1%	8.9%	7.5%
Wood	1.2%	2.7%	1.3%	1.9%	0.8%	0.9%	1.5%
WEEE	2.0%	1.6%	2.8%	1.3%	3.5%	0.7%	2.1%
Food waste	6.2%	7.2%	9.1%	9.5%	10.2%	8.6%	8.5%
Garden	1.0%	0.1%	0.1%	0.3%	1.0%	0.1%	0.5%
Organics	0.0%	0.6%	0.0%	0.1%	0.1%	0.1%	0.2%
Hazardous	1.2%	0.1%	0.6%	0.3%	0.1%	1.0%	0.6%
Sanitary	1.3%	0.7%	1.1%	1.9%	2.1%	1.4%	1.4%
Furniture	52.6%	39.7%	41.2%	41.0%	48.3%	51.6%	45.3%
Misc. combustibles	6.1%	5.6%	7.3%	9.6%	3.4%	4.7%	5.9%
Misc. non-combustible	2.0%	3.8%	8.3%	3.6%	2.6%	2.8%	3.9%
<20 mm fines	0.7%	1.6%	1.0%	1.4%	1.1%	1.3%	1.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Biodegradability	48.5%	49.1%	47.1%	51.6%	52.9%	52.2%	50.1%
Potentially recyclable or reusable*	79.1%	77.3%	73.8%	69.3%	79.3%	81.3%	76.7%
Potentially reusable**	46.4%	45.5%	46.7%	49.5%	49.6%	39.7%	45.5%

*Based on materials currently collected at HWRCs.
**Based on categorisation during physical sort.

Figure 3.16 Average composition (% wt.) of HRWC residual waste



As shown in Figure 3.16, the key finding from the HWRC residual waste analysis is the proportion of the residual waste categorised as furniture which was predominantly comprised of sofas plus accompanying cushions and covers. Furniture was also the main material type which contributed to the estimate of potentially reusable materials.

The proportion of furniture found to be present in the HWRC residual waste is more than would normally be anticipated and whilst this may be a function of increased recycling and changing waste composition, it may also be a function of the change in methodology used in this study in comparison with the previous study. The furniture result for the HWRC waste is examined in more detail in Section 4.3 by comparing it to the results from previous studies for Merseyside and Halton.

Table 3.9 presents estimated capture rates for materials collected for recycling at the HWRCs. Note, these estimates have been calculated using the HWRC residual waste composition result and data on the tonnages of materials collected for recycling or reuse at the HWRCs in Merseyside and Halton.

Table 3.9 Estimated HWRC capture rates

Material	Capture rate
Recyclable paper	29.6%
Recyclable card	75.5%
Recyclable plastic	63.8%

Recyclable glass	40.3%
Recyclable metals	88.7%
Wood	97.9%
Textiles	27.9%
WEEE	88.0%
Cooking oils/fats	53.7%
Garden	99.5%
Potentially hazardous	72.9%
Furniture	0.0%
Carpet	94.1%
Mattresses	92.5%
Plasterboard	87.8%
Other non-combustibles	96.1%
Total	74.5%

3.3 Net Calorific Value

The calorific value (CV) of the average kerbside residual waste composition and average HWRC residual waste composition have been estimated using Amec Foster Wheeler's in-house model. The model uses reference values for the waste constituents[22] to estimate net CV. Net calorific value is a useful parameter for estimating the energy input to combustion processes since it takes account of potential losses.

The kerbside residual waste net CV is estimated to be 8.11 MJ/kg. The HWRC residual waste net CV is estimated to be 13.46 MJ/kg.

Reported net calorific values for European MSW are in the range 9 to 11 MJ/kg[23]. ***Note, this range is for non-segregated waste with low / no recycling***.

In 2010 the net CV of the kerbside residual waste was estimated to be 8.49 MJ/kg. The decrease to 8.11 MJ/kg may be linked to an increase in the organic waste (food waste, garden waste and other organics) composition of the kerbside residual waste from approximately 34% in 2010 to 44% in 2015/16 and associated increase in moisture content. The reduction in the proportion of paper and card in the residual waste from 19% in 2010 to 15% in 2015/16 will also have influenced the net CV of the residual waste.

The net CV of the HWRC residual waste was not estimated in 2010. The relatively high net CV reflects the different composition of HWRC residual waste and is driven by the high proportion of furniture estimated to be in the waste stream.

Table 3.10 Estimated Net Calorific value (CV)

	Unit	Kerbside household residual waste	HWRC residual waste
Net CV	MJ/kg	8.11	13.46
Hydrogen	% wt.	3.16	4.51
Carbon	% wt.	22.54	35.15
Nitrogen	% wt.	0.81	0.96
Oxygen	% wt.	13.93	27.38
Sulphur	% wt.	0.13	0.12
Chlorine	% wt.	0.77	0.67
Ash	% wt.	19.24	13.28
Moisture	% wt.	39.42	17.92

[22] The reference values used are derived from the UK National Household Waste Composition Study conducted in 1994. These are the reference values used in 'WRATE' the waste management lifecycle modelling tool originally developed for the Environment Agency and now owned and supported by Golders Associates (UK) Ltd.

[23] AEA Technology report to the European Commission (2001) Waste Management Options and Climate Change. ISBN 92-894-1733-1, pp 116.

3.4 MHWP Local Authority Collected Waste

The MHWP collects and manages more than just kerbside household waste and HWRC residual waste. Other local authority collected waste streams include:

- HWRC recycling, composting and reuse;
- Street cleansing and litter; and,
- Other household waste streams (such as bring banks, fly-tipped waste and clinical waste). Trade waste has not been included.

As shown in Table 3.11 and Figure 3.17 the kerbside household waste stream comprises over 70% of the total local authority collected waste. HWRC waste, recycling and composting was approximately a quarter and other waste streams including street cleansing approximately 4% of the local authority collected waste.

Table 3.11 MHWP LA Collected waste tonnages, 2015/16

	Waste stream	Total, 2015/16 (tonnes)
Kerbside	Residual	360,088
	Dry recycling	111,865
	Garden waste	68,678
	Food waste	5,114
HWRC	Residual	45,964
	Recycling and composting	134,329
Street cleansing and litter		17,489
Other		13,107

Source: Merseyside Recycling and Waste Authority.

Table 3.12 presents the compositional data for each of the LA collected waste streams.

Figure 3.17 MHWP Local Authority Collected Household Waste

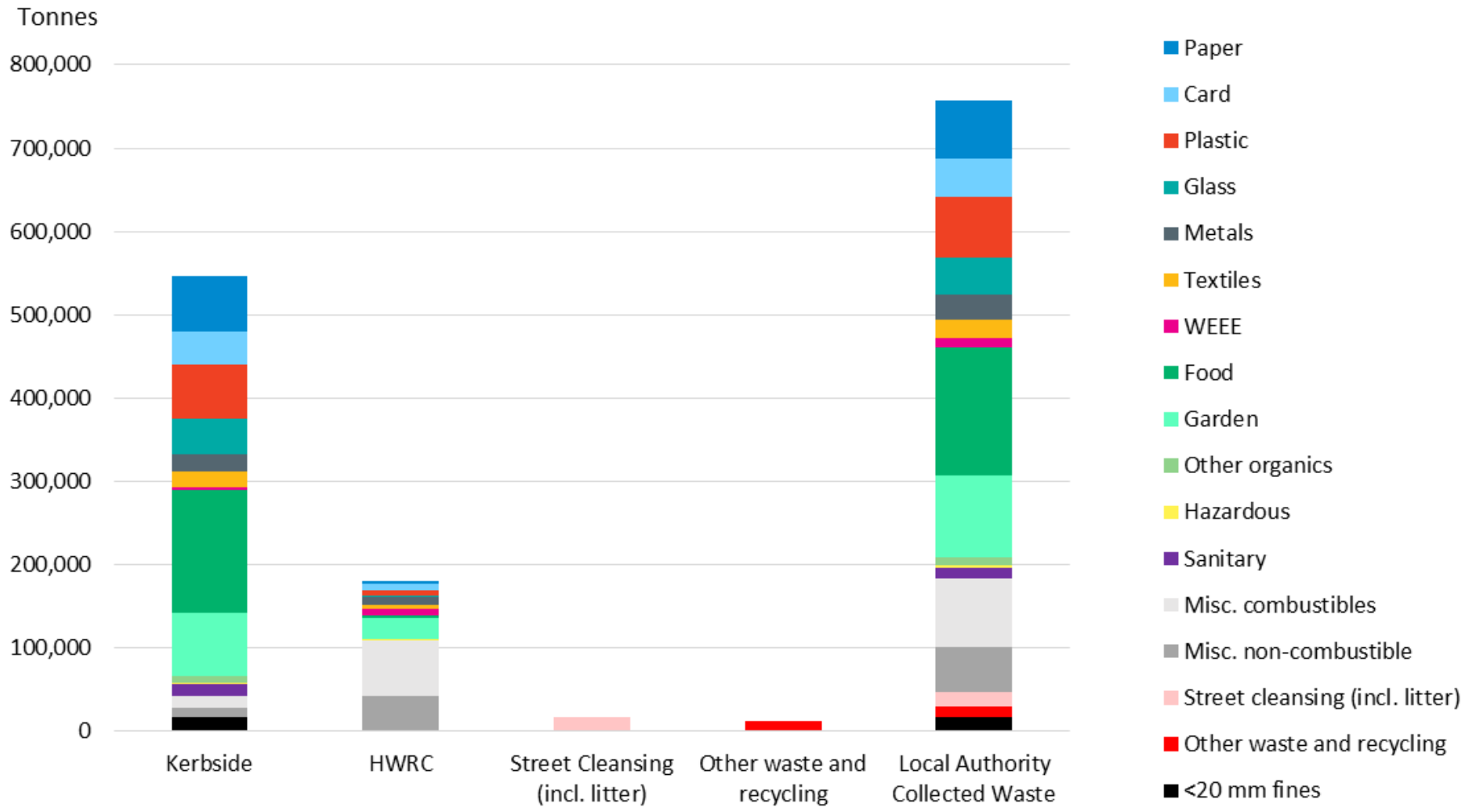
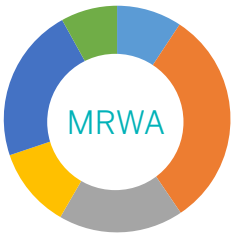


Table 3.12 MHWP Local Authority Collected Waste (% wt.)

	Kerbside	HWRC	Street Cleansing	Other waste and recycling	MHWP LA Collected Household Waste
Tonnes	545,750	180,288	17,489	13,107	756,634
% of MHWP LA collected waste	72%	24%	2%	2%	100%
Paper	12%	2%	0%	0%	9%
Card	7%	4%	0%	0%	6%
Plastic	12%	4%	0%	0%	10%
Glass	8%	1%	0%	0%	6%
Metals	4%	5%	0%	0%	4%
Textiles	3%	3%	0%	0%	3%
WEEE	1%	4%	0%	0%	1%
Food waste	27%	2%	0%	0%	20%
Garden	14%	14%	0%	0%	13%
Organics	1%	0%	0%	0%	1%
Hazardous	0%	1%	0%	0%	0%
Sanitary	2%	0%	0%	0%	2%
Misc. combustibles	3%	37%	0%	0%	11%
Misc. non-combustible	2%	23%	0%	0%	7%
Street cleansing	0%	0%	100%	0%	2%
Other waste and recycling	0%	0%	0%	100%	2%
<20 mm fines	3%	0%	0%	0%	2%
Total	100%	100%	100%	100%	100%

recycle for Merseyside and Halton

Merseyside and Halton Waste Partnership

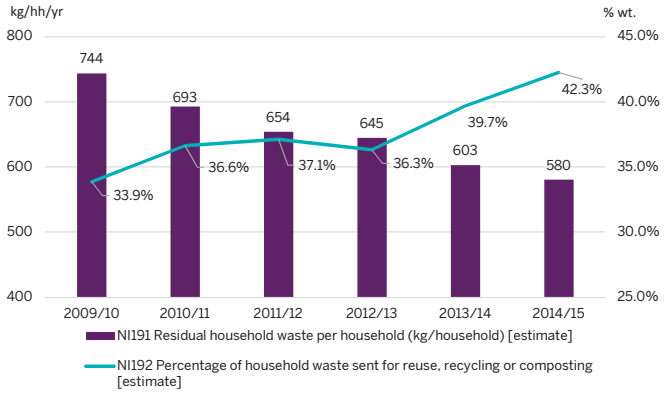


Halton Knowsley Liverpool
Sefton St Helens Wirral

Partnership household profile

Number of households in Partnership: 660,934

Partnership performance



Other household waste

546,000 t	180,000 t	17,500 t	13,000 t
72%	24%	2%	2%

Local Authority (LA) collected waste includes waste from the kerbside, HWRCs, street cleansing and other household sources. The local authorities are the Merseyside Waste and Recycling Authority, Halton, Knowsley, Liverpool, Sefton, St Helens and Wirral.

LA collected waste 2015/16
Approx. 756,634 tpa

Paper	9.2%	69,810 t
Card	6.1%	46,072 t
Plastic	9.5%	71,988 t
Glass	5.9%	44,685 t
Metals	3.9%	29,347 t
Food	20.1%	152,435 t
Garden	13.2%	99,760 t
Other	32.1%	242,537 t

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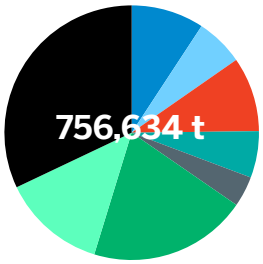

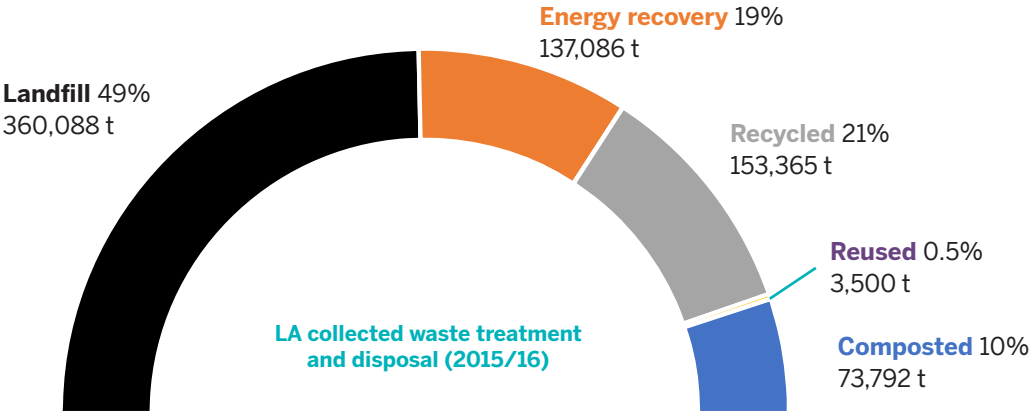

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4. Statistical analysis and comparison of the results

The section describes the findings from the statistical analysis and compares this data with previous and comparator studies.

4.1 Seasonal comparison

Garden waste is known to vary due to the variability of seasons (cold/warm, wet/dry) with arisings increasing during the growing season[24]. To confirm the basis of the sampling strategy the average size (kg) of the garden waste samples collected and level of garden waste in the residual waste stream were tested because these factors have been shown to vary with the seasons in previous studies.

Statistical analysis of the sample data showed that the garden waste composition and arisings data was not normally distributed. Therefore the non-parametric Mann-Whitney U test[25] was used to test for significance between the seasonal results (i.e. whether there was significantly more garden waste in the sample during Season 2 than in Season 1).

The result of the Mann-Whitney U test shows a statistically significant difference between the average size (kg) of the garden waste samples in Season 1 and Season 2 (at the 5% level). This suggests that the quantity of garden waste being generated increased in Season 2. However this difference could also be explained by other factors including the fact garden waste services had recently resumed after a temporary suspension during winter.

On average a larger proportion of the residual waste was composed of garden waste in Season 2 (2.7%) than in Season 1 (2.3%) however the difference was not significant.

Overall, these results support the approach adopted (i.e. applying the Season 2 results to the growing season and summer months and the Season 1 results to the winter months) however it also suggests that study may have benefited from holding Season 2 later in the growing season. As a consequence the level of garden waste within the residual waste stream (and consequently the kerbside waste) may have been underestimated. In addition, it is possible that the proportion of soil in the garden waste stream may also have been overestimated.

4.2 Comparison of results by ACORN

ACORN is a recognised socio-demographic tool used in a large number of household waste composition survey projects however, it has been suggested that there is no firm evidence that ACORN is a good basis for stratifying areas[26]. The collection of waste composition data from individual households of a specific ACORN category in this study provides an opportunity to examine and test for potential differences between the waste and recyclables produced by households in different ACORN categories.

Comparisons between the ACORN results have been undertaken using the non-parametric Mann-Whitney U Test.

[24] Defra/Open University (2008) The Open University Household Waste Study. Amec Foster Wheeler have also confirmed the influence of seasonality on garden waste arisings in previous studies.

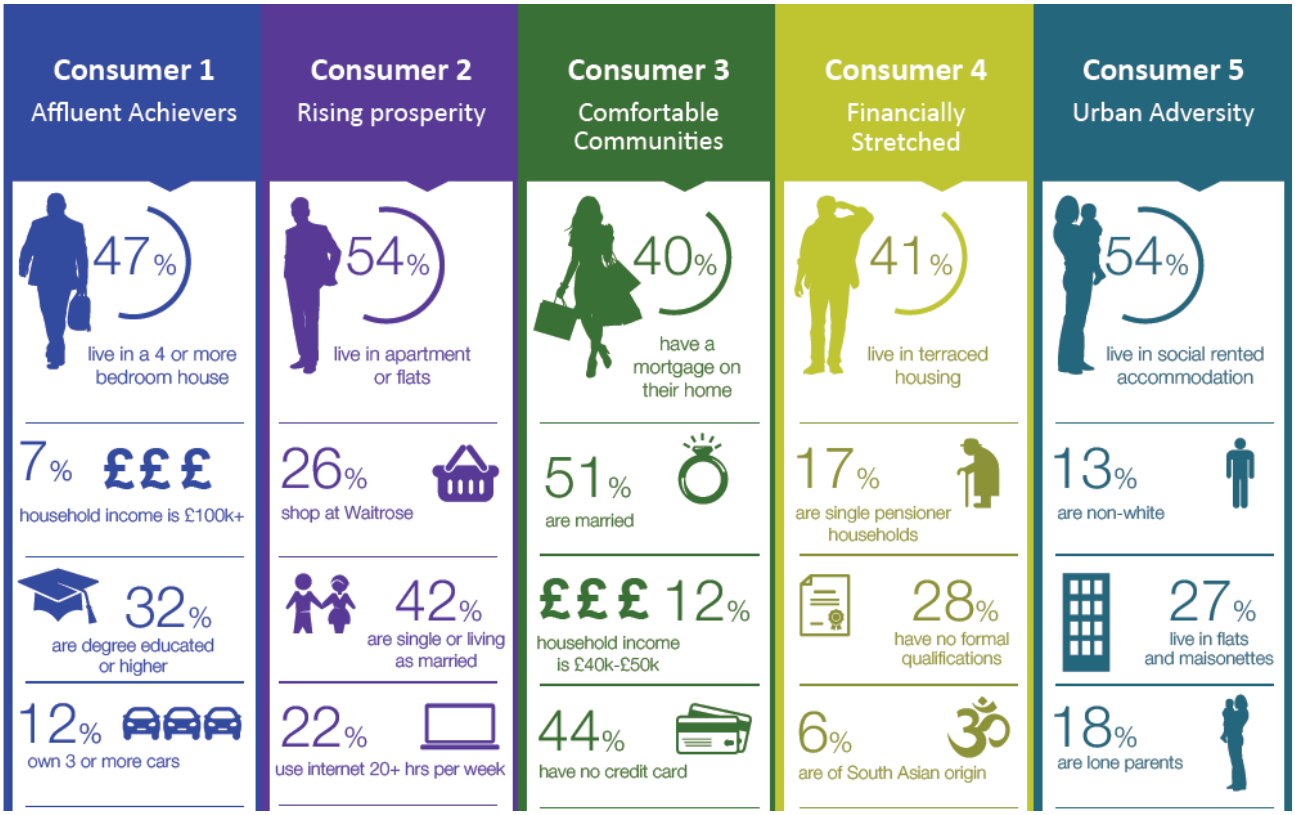
[25] https://en.wikipedia.org/wiki/Mann%E2%80%93Whitney_U_test

[26] Defra/Resource Futures (2009) WR0119 A Review of Municipal Waste Component Analyses Appendix 10.

ACORN categories

'A Classification of Residential Neighbourhoods (ACORN)'[27] is a leading geodemographic segmentation of residential neighbourhoods in the UK. It classifies each postcode in the country into one of 62 types that give a distinctive picture of the kinds of people who live in an area, their attitudes and how they behave. The ACORN segmentation has a hierarchical structure. The 62 types aggregate into 18 ACORN groups which lie within 6 descriptive ACORN categories at the top level. Five of the ACORN categories, comprising 17 of the groups and 59 of the types, represent the population in private households. The last category is reserved for other kinds of postcode, primarily communal populations who live in various kinds of institution rather than in private households, and postcodes with no resident population. Figure 4.1 shows the five ACORN categories which are composed of private households.

Figure 4.1 ACORN categories



[27] ACORN is a recognised socio-demographic tool used in the majority of household waste composition survey projects. The database is widely used across disciplines and is owned and managed by CACI Ltd. The database was licenced to MRWA with Amec Foster Wheeler and Axion as named consultants.

Table 4.1 shows the ACORN profile for MHWP in 2015. ACORN 2 and category U where not included in the sample as they comprise less than 3% of the population.

Table 4.1 2015 ACORN Profile for MHWP

ACORN Category	MHWP
1	21.9%
2	2.8%
3	22.2%
4	22.9%
5	29.9%
U	0.2%
Total	100.0%

Affluent Achievers (ACORN 1) are some of the most financially successful people in the UK. They live in wealthy, high status rural, semi-rural and suburban areas of the country. Middle aged or older people, the 'baby-boomer' generation, predominate with many empty nesters and wealthy retired. Some neighbourhoods contain large numbers of well-off families with school age children, particularly the more suburban locations.

Comfortable Communities (ACORN 3) contains much of middle-of-the-road Britain, whether in the suburbs, smaller towns or the countryside. All lifestages are represented in this category. Generally people own their own home. Most houses are semi-detached or detached, with an overall average value for the region. Incomes overall are average, some households will earn more than average with younger people tending to earn slightly less than average.

Financially Stretched (ACORN 4) contains a mix of traditional areas of Britain. Housing is often terraced or semi-detached, a mix of lower value owner occupied housing and homes rented from the council or housing associations, including social housing developments specifically for the elderly. This category also includes student term-time areas.

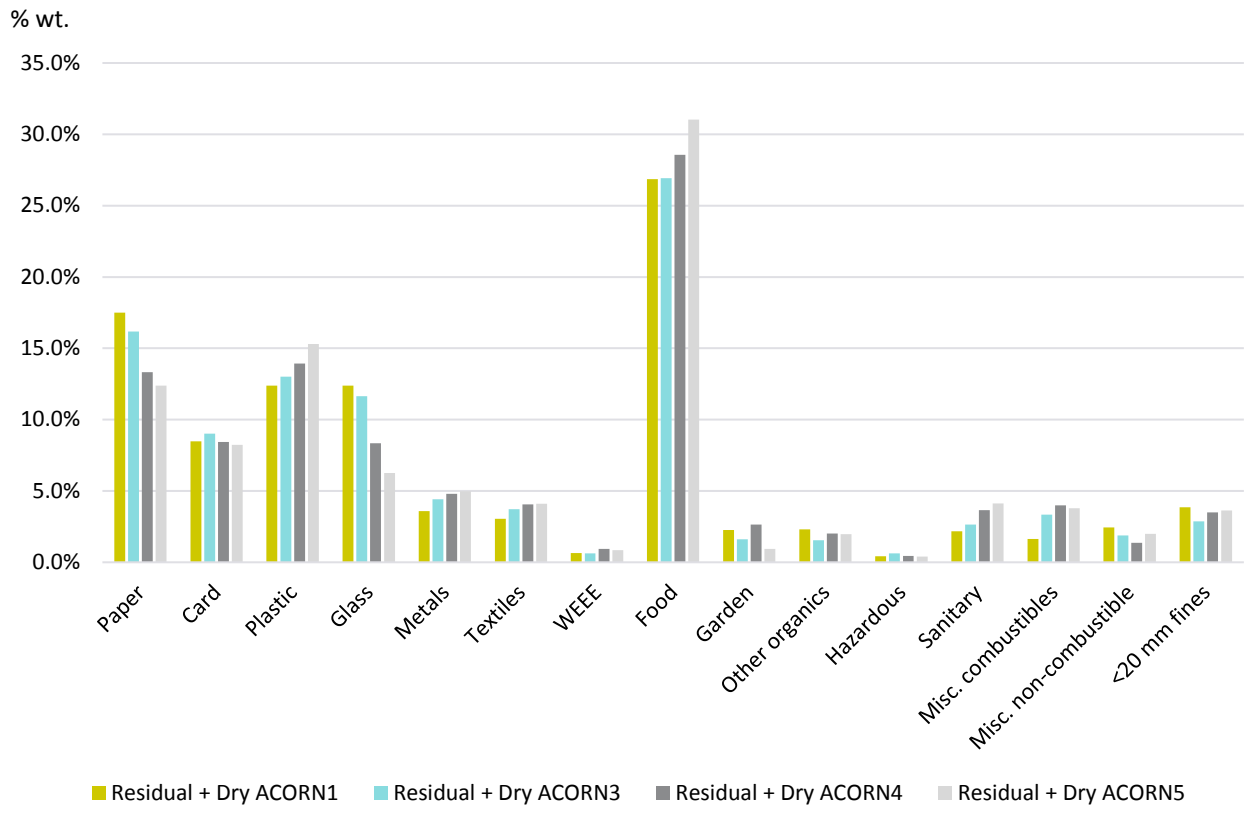
Urban Adversity (ACORN 5) contains the most deprived areas of large and small towns and cities across the UK. Household incomes are low, nearly always below the national average. The level of people having difficulties with debt or having been refused credit approaches double the national average. The numbers claiming Jobseeker's Allowance and other benefits is well above the national average.

Summary of Findings

Although the limitations associated with this analysis (see Appendix D) mean that all results on how waste and recycling varies by ACORN are only indicative, there does appear to be support for the assumption that waste produced by households will vary by socio-demographics represented by ACORN categories.

The differences identified between the residual waste and dry recyclables produced by households from different ACORN categories are primarily associated with materials used for packaging such as paper, card, plastic, glass and metals as shown in Figure 4.2. The results indicate that the paper and glass composition of the combined residual waste and dry recycling streams decreases as affluence decreases (ACORN 1 is the most affluent and ACORN 5 the least affluent category). In contrast the plastic composition of the combined residual waste and dry recycling streams appears to increase as affluence decreases.

Figure 4.2 Average composition of the residual waste and dry recycling samples by material category and ACORN

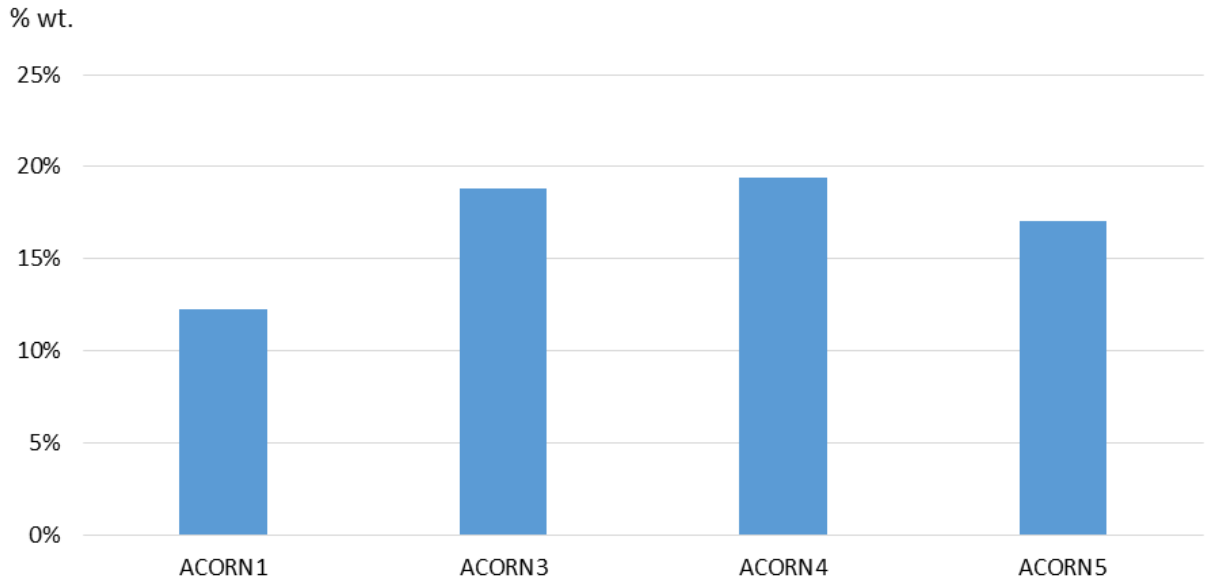


Similar differences have also been found in other studies undertaken by Amec Foster Wheeler and we have previously hypothesized that these differences may be due to differences in consumption habits (i.e. more affluent households may tend to purchase more products packaged in glass and less affluent households more products packaged in plastic), however, there are also other potential explanations. For example, increased levels of metal packaging have been associated with pet ownership and the household age profile has been associated with waste paper production[28]. It is possible that the ACORN categories and/or households sampled from also correlate with factors such as age profiles and pet ownership and these factors may explain the variations observed.

Levels of non-target materials / contamination were found to vary by ACORN category as shown in Figure 4.3. This is the perhaps one of the most robust results because it is less influenced by factors such as set out and hence could be used to justify targeted campaigns to reduce contamination levels. The results of Mann-Whitney U tests show a statistically significant difference in the contamination levels in the dry recycling stream from ACORN 1 households and ACORN 3 and 4 households (at the 5% level). The average level of contamination from ACORN 5 households was also higher than the average level for ACORN 1 households but it was not found to be statistically significant.

[28] Defra/Open University (2008) The Open University Household Waste Study.

Figure 4.3 Average contamination levels of dry recycling samples by ACORN



In summary, the analysis by ACORN category provides some insight to how waste may vary by ACORN category however because a number of factors have not been controlled for it would be inaccurate to assume socio-demographics are responsible for all of the observed differences. Please see Appendix D for a more detailed discussion of the findings by ACORN category.

4.3 Comparisons with other studies

Kerbside waste

The kerbside waste result for the Merseyside and Halton Waste Partnership (MHWP) for 2015/16 have been compared to a composition estimate for England in 2010/11 and the previous MHWP study in 2010. No other recent and comparable studies were identified for the kerbside waste.

Compared to the estimate for England in 2010/11 the largest difference (at over 10%) was in garden waste. The most likely reason for this difference is the provision of kerbside garden waste services by all the Districts the majority of which are free to use[29]. The England dataset will include local authorities who do not provide a garden waste service as well as local authorities which charge for garden waste collections. Another notable difference is the proportion of glass waste which is present in the kerbside waste however this is consistent with the previous study in 2010 when glass comprised 7.6% of the kerbside waste.

Finally, sanitary waste comprises 2.4% of the kerbside waste in 2015/16 estimate. This is lower than estimated for England 2010/11 and the MHWP in 2010 and may indicate that the proportion of sanitary waste may have been underestimated in the MHWP 2015/16 study. Large variations in material categories such as sanitary waste and miscellaneous non-combustibles are common because they are either regularly produced by a minority of households (e.g. nappies) or produced by most households but infrequently (e.g. miscellaneous non-combustibles from house improvements or clearances).

Table 4.2 Kerbside waste composition results (% wt.) comparison

	MHWP 2015/16	England 2010/11	MHWP 2010
Paper	12.2%	10.5%	15.5%
Card	7.1%	3.9%	5.6%
Plastic	11.9%	14.9%	10.7%
Glass	7.9%	3.7%	7.6%
Metals	3.7%	3.2%	3.9%
Textiles	3.4%	4.1%	3.2%
WEEE	0.6%	1.2%	1.9%
Food	27.2%	30.9%	20.3%
Garden	13.7%	4.1%	17.5%
Other organics	1.5%	5.1%	1.9%
Hazardous	0.4%	0.6%	0.4%
Sanitary	2.4%	7.0%	5.7%
Misc. combustibles	2.7%	5.8%	1.8%
Misc. non-combustible	2.2%	2.7%	2.0%
<20 mm fines	3.1%	2.3%	2.1%
Total	100.0%	100.0%	100.0%

[29] Halton and Wirral charge for garden waste collections.

Kerbside residual waste 2005/06 to 2015/16

This section compares the residual waste composition in Merseyside Waste Partnership (MWP)[30] in 2005/06 and Merseyside and Halton in 2010 and 2015/16.

Apparent trends include the reduction in the levels of paper, card and glass and increase in the proportion of food waste in the residual waste.

Table 4.3 Kerbside residual waste composition results (% wt.) comparison

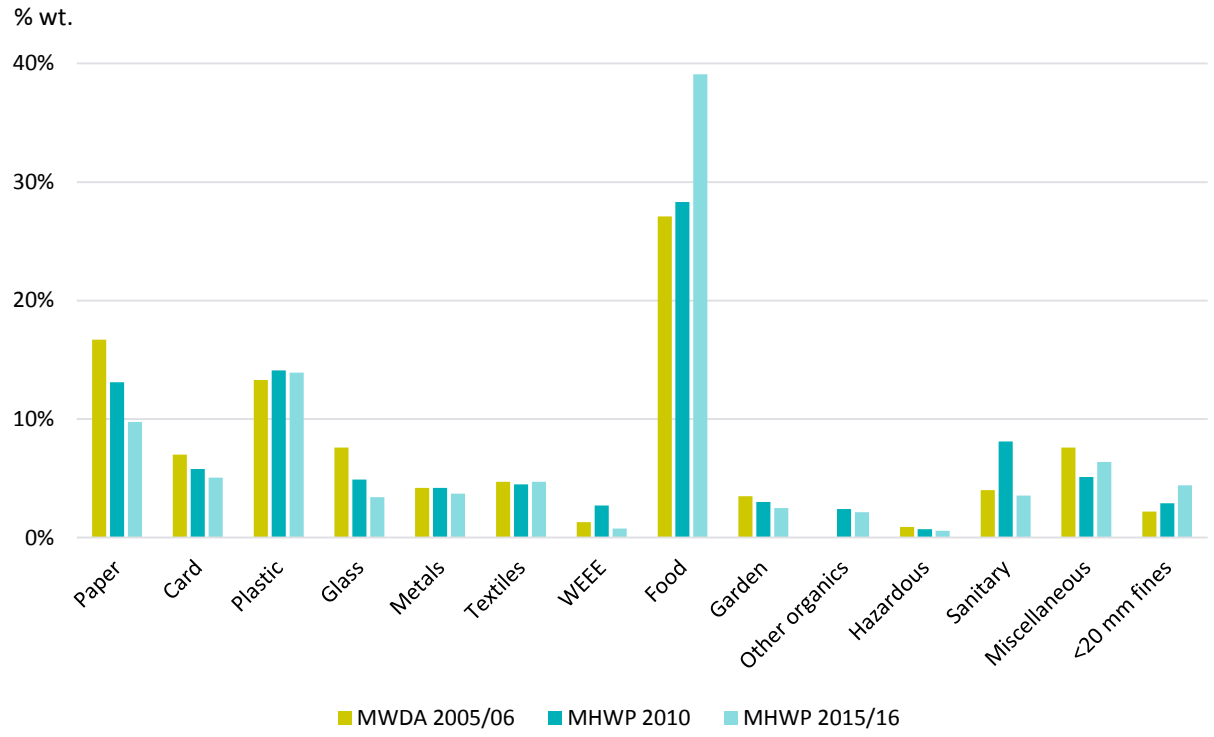
	MWP 2005/06	MHWP 2010	MHWP 2015/16
Paper	16.7%	13.1%	9.8%
Card	7.0%	5.8%	5.1%
Plastic	13.3%	14.1%	13.9%
Glass	7.6%	4.9%	3.4%
Metals	4.2%	4.2%	3.7%
Textiles	4.7%	4.5%	4.7%
WEEE	1.3%	2.7%	0.8%
Food	27.1%	28.3%	39.1%
Garden	3.5%	3.0%	2.5%
Other organics	In misc.	2.4%	2.1%
Hazardous	0.9%	0.7%	0.6%
Sanitary	4.0%	8.1%	3.5%
Misc. combustible	7.6%	2.3%	3.7%
Misc. non-combustible		2.8%	2.7%
<20 mm fines	2.2%	2.9%	4.4%
Total	100.0%	100.0%	100.0%

[30] The Merseyside and Halton Waste Partnership was not established until 2006.

These trends are more clearly illustrated in Figure 4.4. Food waste has increased substantially accounting for around 10% more of the kerbside residual waste than in 2010. After accounting for housing growth[31] this indicates that food waste arisings have increased from 3.1 kg/hh/wk in 2010 to 4.0 kg/hh/wk in 2015/16 – an increase of approximately 27%.

The decreases in paper, card and glass over time could have consequences for recycling rates. After accounting for housing growth the total quantities of paper, card and glass is estimated to have decreased from 2.7 kg/hh/wk in 2010 to 1.9 kg/hh/wk in 2015/16 – a decrease of 31%. This will partially be explained by the switch from paper to digital media but also potentially other factors such as the lightweighting of packaging materials or changes in the materials used for packaging (e.g. increased use of plastic bottles for products such as tomato ketchup).

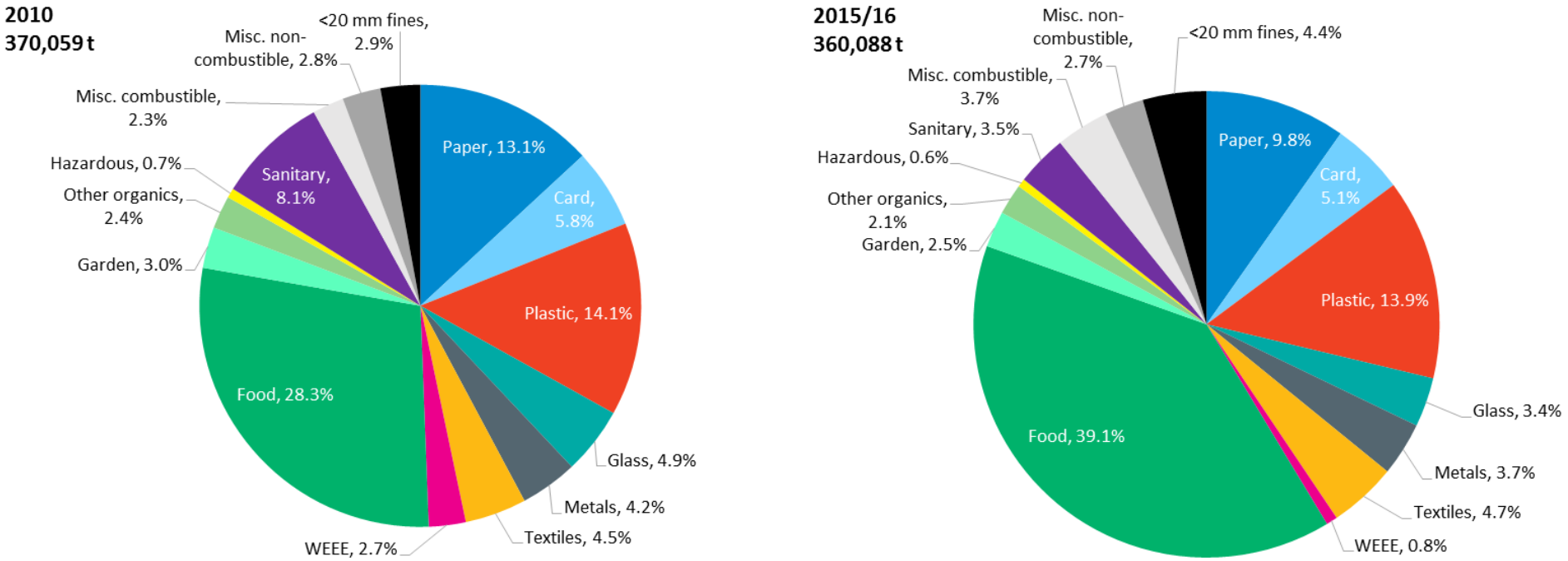
Figure 4.4 Kerbside residual waste compositions 2005/06 to 2015/16



The kerbside residual waste results from 2010 and 2015/16 are directly compared in Figure 4.5.

[31] Household numbers from the ACORN database have been used. In the 2009 ACORN database the number of households in Merseyside and Halton was 641,843. In the 2015 ACORN database the number of households in Merseyside and Halton was 664,544.

Figure 4.5 Kerbside residual waste compositions 2010 and 2015/16



HWRC residual waste

The HWRC residual waste results have been compared to a composition estimate for England in 2010/11 and the previous Mersey and Halton Waste Partnership study in 2010. No other recent and comparable studies were identified for the HWRC residual waste.

Compared to the estimate for England in 2010/11 the largest difference at over 35% is in furniture composition. The high proportion of furniture in the HWRC residual waste stream the key finding of the 2015/16 analysis and one which requires further explanation. Examining the 2015/16 result in relation to the comparator compositions it seems likely that furniture could compose a larger proportion of the HWRC residual waste as other materials (such as garden waste[32], wood and miscellaneous non-combustibles) are diverted from the residual waste to recycling or composting streams. However the potential impact of a change in analysis methodology is also likely to have affected the 2015/16 results. This issue is discussed in detail in the following section.

Table 4.4 HWRC residual waste composition results (% wt.) comparison

	MHWP 2015/16	England 2010/11	MHWP 2010
Paper	5.3%	4.8%	4.7%
Card	4.0%	2.0%	2.9%
Plastic	8.1%	18.6%	8.3%
Glass	1.7%	2.7%	2.0%
Metals	2.4%	2.2%	1.5%
Textiles	7.5%	7.7%	7.4%
Wood	1.5%	5.9%	3.7%
WEEE	2.1%	1.5%	1.8%
Food	8.5%	3.1%	1.3%
Garden	0.5%	5.1%	6.2%
Other organics	0.2%	2.0%	0.6%
Hazardous	0.6%	2.7%	1.0%
Sanitary	1.4%	0.6%	0.4%
Furniture	45.3%	8.4%	10.0%
Misc. combustibles	5.9%	22.8%	10.7%
Misc. non-combustible	3.9%	9.2%	10.5%
<20 mm fines	1.2%	0.8%	2.9%
Bagged waste			24.1%
Total	100.0%	100.0%	100.0%

[32] The garden waste composition result for HWRC residual waste may also have been influenced by the timings of the studies in November 2015 and February/March 2016.

HWRC residual waste 2005/06 to 2015/16

This section compares the residual waste composition for the Merseyside Waste Partnership (MWP)[33] in 2005/06 (excluding Halton) and Merseyside and Halton in 2010 and 2015/16 and discusses variations in the methodologies used and how these differences may have influenced the HWRC residual waste results.

The 2010 study used a method which analysed material sampled from a container delivered to a dedicated sorting site by the HWRC operator. Each sample represented the residual waste deposited at a site during the period the container was filled. This is a very different method to the one used in 2015/16 (where the waste from HWRC users was sampled directly) and neither the project team, nor the HWRC users had any control over what was and what was not included in the sample.

The 2005/06 study used an HWRC user sampling approach similar to the one adopted in the 2015/16 study. The sample of site users was selected "loosely based around every tenth vehicle entering the site". This implies an element of random sampling and crucially the report does not include any indication that site users were asked for their permission.

In 2015/16 the sample of site users was self-selecting as the permission of site users was required to include their waste in the sample. This introduces the potential for bias as some users may be more or less likely to agree to allow their waste to be sampled. This may account for the high levels of furniture and potentially for the apparent reductions in some other material types. For example, people with bulky and heavy items such as sofas may be more willing to agree to their waste being sampled possibly because the sample team will assist them with disposal. In contrast, people disposing of mixed waste in the residual waste stream may be less willing agree to their waste being sampled.

Even though the 2005/06 study used a very different method to the 2010 study, the results are relatively comparable. Some notable changes include a reduction in the proportions of wood and WEEE and increases in the proportion of plastic, textiles and bagged waste. Miscellaneous combustibles also decreased, however, this is influenced by the inclusion of a variety materials as miscellaneous which we have assumed to include food, other organic material, sanitary waste and fines. In contrast, the 2015/16 result is very different from both the 2005/06 and 2010 results even though the 2005/06 study used a similar method. The primary difference is the proportion of the HWRC residual waste estimated to be comprised of furniture.

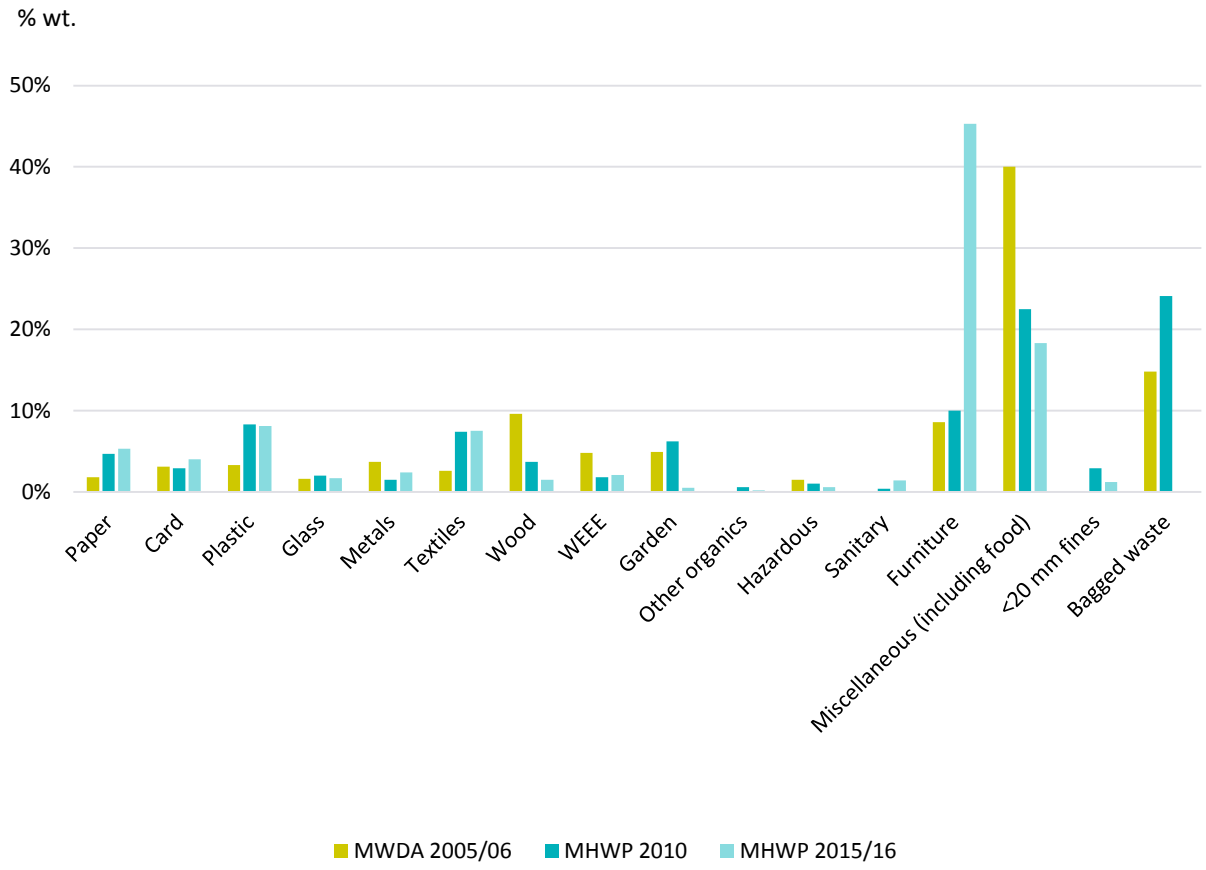
[33] The Merseyside and Halton Waste Partnership was not established until 2006.

Table 4.5 HWRC residual waste composition results (% wt.) comparison

	MWP 2005/06	MHWP 2010	MHWP 2015/16
Paper	1.8%	4.7%	5.3%
Card	3.1%	2.9%	4.0%
Plastic	3.3%	8.3%	8.1%
Glass	1.6%	2.0%	1.7%
Metals	3.7%	1.5%	2.4%
Textiles	2.6%	7.4%	7.5%
Wood	9.6%	3.7%	1.5%
WEEE	4.8%	1.8%	2.1%
Food	In misc.	1.3%	8.5%
Garden	4.9%	6.2%	0.5%
Other organics	In misc.	0.6%	0.2%
Hazardous	1.5%	1.0%	0.6%
Sanitary	In misc.	0.4%	1.4%
Furniture	8.6%	10.0%	45.3%
Misc. combustibles	27.2%	10.7%	5.9%
Misc. non-combustible	12.8%	10.5%	3.9%
<20 mm fines	In misc.	2.9%	1.2%
Bagged waste	14.8%	24.1%	
Total	100.0%	100.0%	100.0%

These differences between the HWRC residual waste composition estimates from 2005/06 to 2015/16 are more clearly illustrated in Figure 4.6. Furniture has increased from around 10% in 2010 to over 45% of the HWRC residual waste stream in 2015/16. Applying HWRC residual waste tonnages to the associated composition results suggests that the quantity of furniture disposed of at HWRCs in Merseyside and Halton has increased from approximately 9,000 tonnes in 2010 to over 18,000 tonnes in 2015/16. After accounting for housing growth[34] the quantity of furniture disposed of at HWRCs almost doubles from 14 kg/hh/yr in 2010 to 27 kg/hh/yr in 2015/16. This may accurately reflect the composition of HWRC residual waste in 2015/16 however it may also reflect temporary impacts (e.g. the Ikea effect[35]) or be a function of the sampling approach and the bias that may have been introduced by requesting HWRC user permission.

Figure 4.6 HWRC residual waste compositions 2005/06 to 2015/16



In conclusion, the results of the HWRC residual waste analysis strongly indicate that furniture, specifically soft furniture i.e. sofas, are becoming a more important component of the HWRC residual waste stream however it is possible that the furniture composition may have been over-estimated as a consequence of the methodology adopted. If furniture arisings were assumed to be the same as in 2010 (i.e. approximately 9,000 tonnes) the proportion of the HWRC waste composed of furniture in 2015/16 would be approximately 20%.

[34] Household numbers from the ACORN database have been used. In the 2009 ACORN database the number of households in Merseyside and Halton was 641,843. In the 2015 ACORN database the number of households in Merseyside and Halton was 664,544.

[35] Resource Futures/Defra (2009) WR0121 – Understanding Waste Growth at Local Authority Level describes a case where the introduction of a series of new budget furniture stores within the area which led to a temporary influx of furniture / office equipment being thrown out by local residents.

5. Recommendations

This section includes recommendations for the Merseyside and Halton Waste Partnership based on the results of the waste composition study.

Based on the findings of this study our recommendations for the MHWP are:

1. Approximately 64% of the kerbside residual waste in the MHWP was potentially recyclable. The main component of the potentially recyclable material was food waste which was estimated to comprise 39.1% ±2.1% of the kerbside residual waste (between 130,000 and 150,000 tonnes). The introduction of separate food waste collections has the potential to significantly reduce the quantity of residual waste requiring treatment and disposal and improve recycling performance. The "whole system costs" (i.e. from collection through to treatment/disposal) would need to be considered to fully assess the economic viability of separate food waste collections;

2. Approximately 24% (approx. 86,000 tones) of the residual waste was comprised of materials which are currently collected at the kerbside for recycling by at least one of the Districts. Recyclable materials present in the kerbside residual waste include recyclable paper (approx. 18,000 tonnes), textiles (approx. 17.000 tonnes), recyclable card including books and telephone directories (approx. 16,000 tonnes), glass (approx. 11,000 tonnes), metal packaging (approx. 9,000 tonnes) and plastic bottles (approx. 8,000 tonnes). There was also an estimated 7,000 tonnes of garden waste present in the kerbside residual waste stream. The Partnership should target these materials to divert them from the residual waste stream into the dry recycling or garden waste streams;

3. Approximately 16% (approx.18, 000 tonnes) of the dry recycling stream was comprised of materials which are not targeted for recycling. Communication and education initiatives which reduce the level of contamination in the kerbside dry recycling would improve the quality of recyclable materials collected by the Partnership. This could have benefits in terms of the prices achieved for dry recyclables; and,

4. Almost 45% (approximately 21,000 tonnes) of the HWRC residual waste stream was estimated to be composed of furniture. This is an unusual result which requires further investigation to confirm the contribution of furniture to this waste stream and identify ways in which furniture can be managed more sustainably. Furniture was also one of the main components contributing to the estimate that 45.5% of the HWRC residual waste was potentially reusable indicating that there is an opportunity to divert large quantities of material from disposal to reuse. At a minimum, if it is assumed the quantity of furniture arising at HWRCs has not changed between 2010 and 2015/16 approximately 9,000 tonnes (20%) of the HWRC residual waste stream would be furniture which could be potentially reusable.

Appendix A
Waste sort categories

Blue cells identify the materials which are targeted for recycling at the kerbside and at HWRCs. Cells which are not blue represent materials which are not targeted for recycling at the kerbside or HWRCs. Note, Sefton also target textiles at the kerbside and St Helens has an on-demand textiles service. Local charities also target textiles for kerbside collections in all Districts. Collections of furniture and WEEE for reuse or recycling are targeted by the bulky waste collection services provided by the Districts.

Green cells identify the materials targeted for garden waste collections. Cells which are not green represent materials which are not targeted by garden waste services.

Purple cells the materials targeted for food waste collections. Cells which are not purple represent materials which are not targeted by food waste services.

	Kerbside	HWRC
Primary Category	**Secondary Category**	**Secondary Category**
Paper	Newspaper	Newspaper
	Magazines	Magazines
	Other recyclable paper	Other recyclable paper
	Non-recyclable paper	Non-recyclable paper
Paper and card	Thick card (board packaging)	Thick card (board packaging)
	Thin card	Thin card
	Beverage cartons	Beverage cartons
	Books	Books
	Non-recyclable card	Non-recyclable card
	Yellow pages	Yellow pages
Plastic bottles	Clear PET	Clear PET
	Coloured PET	Coloured PET
	Natural HDPE	Natural HDPE
	Coloured HDPE	Coloured HDPE
	PP bottles	PP bottles
Rigid plastics	Trays (non-black)	Trays (non-black)
	Pots and tubs(non-black)	Pots and tubs(non-black)
	Black trays and pots	Black trays and pots
	Non-packaging rigid (Inc. Toys, Video tapes, DVDs, CDs)	Non-packaging rigid (Inc. Toys, Video tapes, DVDs, CDs)
	Expanded polystyrene	Expanded polystyrene
Flexible plastic	Refuse bags	Refuse bags
	PE film (plastic carrier bags, bread bags other thin film bags)	PE film (plastic carrier bags, bread bags other thin film bags)
	Empty packaging and other film	Empty packaging and other film
		Film being used to wrap food (i.e. Clingfilm round sandwich)
Glass	Glass bottle	Glass bottle
	Glass jar	Glass jar
	Non-recyclable glass	
Metals	Ferrous, packaging	Ferrous, packaging
	Ferrous aerosol	Ferrous aerosol
	Other ferrous	Other ferrous
	Non - ferrous, packaging	Non - ferrous, packaging
	Non-ferrous aerosol	Non-ferrous aerosol
	Other non-ferrous	Other non-ferrous
Textiles	Clothing	Clothing
	Shoes, belts, bags	Shoes, belts, bags
	Non-clothing textiles (Inc. duvets/pillows/curtains)	Non-clothing textiles (Inc. duvets/pillows/curtains)
Wood	Treated	Treated
	Non-treated	Non-treated
WEEE	Small Mixed WEEE - low value (hairdryer, kettle, toaster etc)	Small Mixed WEEE
	Small mixed WEEE - high value (phones, tablets etc)	Large Domestic Appliance
	Other WEEE	TVs and monitors
		Consumer equipment
		Electrical and electronic tools
		Toy, leisure & sports equipment
		Lighting
		Other WEEE
Food waste	Avoidable food waste	Avoidable food waste
	Unavoidable food waste	Unavoidable food waste
	Cooking oils/fats	Cooking oils/fats
Garden	Green garden waste	Green garden waste
	Woody garden waste	Woody garden waste
	Soil	Soil
Organics	Other organics (Pet excrement, dead animals)	Other organics (Pet excrement, dead animals)
Hazardous	Batteries	Batteries
	Lightbulbs	Lightbulbs
	Paint - Solvent	Paint - Solvent
	Paint - Water based	Paint - Water based
	Mineral oil (machine oil)	Mineral oil (machine oil)
	Other (toner cartridge/chemicals/gas bottles)	Other (toner cartridge/chemicals/gas bottles)
Sanitary	Disposable nappies/personal hygiene	Disposable nappies/personal hygiene
	Healthcare (medicine etc.)	Healthcare (medicine etc.)
Furniture	Soft Furniture	Soft Furniture
	Plastic furniture	Plastic furniture
	Wooden furniture	Wooden furniture
Misc. combustibles	Carpet	Carpet
	Mattresses	Mattresses
	Other combustibles	Other combustibles
Misc. non-combustible	Plasterboard	Plasterboard
	Other non-combustibles	Other non-combustibles
<20 mm fines	Materials less than 20mm	Materials less than 20mm

Orange cells identify the main materials types categorised as potentially reusable in the kerbside and HWRC residual waste.

Please note that the proportion of potentially reusable material present in HWRC residual waste was estimated as part of the sampling and sorting exercise. Potentially reusable materials were visually assessed before being categorised as reusable. As such, not all furniture or WEEE (for example) would necessarily be categorised as reusable.

	Kerbside	HWRC
Primary Category	**Secondary Category**	**Secondary Category**
Paper	Newspaper	Newspaper
	Magazines	Magazines
	Other recyclable paper	Other recyclable paper
	Non-recyclable paper	Non-recyclable paper
Paper and card	Thick card (board packaging)	Thick card (board packaging)
	Thin card	Thin card
	Beverage cartons	Beverage cartons
	Books	Books
	Non-recyclable card	Non-recyclable card
	Yellow pages	Yellow pages
Plastic bottles	Clear PET	Clear PET
	Coloured PET	Coloured PET
	Natural HDPE	Natural HDPE
	Coloured HDPE	Coloured HDPE
	PP bottles	PP bottles
Rigid plastics	Trays (non-black)	Trays (non-black)
	Pots and tubs(non-black)	Pots and tubs(non-black)
	Black trays and pots	Black trays and pots
	Non-packaging rigid (Inc. Toys, Video tapes, DVDs, CDs	Non-packaging rigid (Inc. Toys, Video tapes, DVDs, CDs
	Expanded polystyrene	Expanded polystyrene
Flexible plastic	Refuse bags	Refuse bags
	PE film (plastic carrier bags, bread bags other thin film bags)	PE film (plastic carrier bags, bread bags other thin film bags)
	Empty packaging and other film	Empty packaging and other film
		Film being used to wrap food (i.e. Clingfilm round sandwich)
Glass	Glass bottle	Glass bottle
	Glass jar	Glass jar
	Non-recyclable glass	
Metals	Ferrous, packaging	Ferrous, packaging
	Ferrous aerosol	Ferrous aerosol
	Other ferrous	Other ferrous
	Non - ferrous, packaging	Non - ferrous, packaging
	Non-ferrous aerosol	Non-ferrous aerosol
	Other non-ferrous	Other non-ferrous
Textiles	Clothing	Clothing
	Shoes, belts, bags	Shoes, belts, bags
	Non-clothing textiles (Inc. duvets/pillows/curtains)	Non-clothing textiles (Inc. duvets/pillows/curtains)
Wood	Treated	Treated
	Non-treated	Non-treated
WEEE	Small Mixed WEEE - low value (hairdryer, kettle, toaster etc)	Small Mixed WEEE
	Small mixed WEEE - high value (phones, tablets etc)	Large Domestic Appliance
	Other WEEE	TVs and monitors
		Consumer equipment
		Electrical and electronic tools
		Toy, leisure & sports equipment
		Lighting
		Other WEEE
Food waste	Avoidable food waste	Avoidable food waste
	Unavoidable food waste	Unavoidable food waste
	Cooking oils/fats	Cooking oils/fats
Garden	Green garden waste	Green garden waste
	Woody garden waste	Woody garden waste
	Soil	Soil
Organics	Other organics (Pet excrement, dead animals)	Other organics (Pet excrement, dead animals)
Hazardous	Batteries	Batteries
	Lightbulbs	Lightbulbs
	Paint - Solvent	Paint - Solvent
	Paint - Water based	Paint - Water based
	Mineral oil (machine oil)	Mineral oil (machine oil)
	Other (toner cartridge/chemicals/gas bottles)	Other (toner cartridge/chemicals/gas bottles)
Sanitary	Disposable nappies/personal hygiene	Disposable nappies/personal hygiene
	Healthcare (medicine etc.)	Healthcare (medicine etc.)
Furniture	Soft Furniture	Soft Furniture
	Plastic furniture	Plastic furniture
	Wooden furniture	Wooden furniture
Misc. combustibles	Carpet	Carpet
	Mattresses	Mattresses
	Other combustibles	Other combustibles
Misc. non-combustible	Plasterboard	Plasterboard
	Other non-combustibles	Other non-combustibles
<20 mm fines	Materials less than 20mm	Materials less than 20mm

Appendix B
Representation

Tables B.1 to B.6 compare the target sample profiles with the sample profiles that were achieved in each District. Table B.7 examines the samples targeted and achieved for the HWRC residual waste.

Data substitutions

A total of five data substitutions were made.

1. In Halton garden waste sample data from ACORN 3 households in Season 1 was incorporated into the Season 2 results to improve representativeness;
2. In Knowsley residual waste sample data from ACORN 5 households in Season 1 was incorporated into the Season 2 results;
3. In Sefton's results there were two data substitutions with Season 1 residual waste data from ACORN 1 households incorporated into the Season 2 results;
4. Also in Sefton dry recycling data from ACORN 1 households in Season 2 incorporated into the Season 1 results; and,
5. In Wirral garden waste sample data from ACORN 3 and 4 households in Season 1 was incorporated into the Season 2 results.

Representation

Due to the uncertainties associated with kerbside sampling some variance between the target sample profile and the achieved sample profile was inevitable. However in no case is this variance considered to undermine the representativeness of the achieved sample and associated results.

The low number of garden waste samples achieved was disappointing but it was primarily a function of the timing of the seasonal sampling events (in November/December 2015 and February/March 2016) which occurred just before and just after the garden waste services were temporarily suspended for winter. The garden waste collection service was chargeable in Halton and Wirral at the time of the study and this also influenced the availability of garden waste samples as not all households in the sample areas used the service. In some cases, the quantity of garden waste samples collected were much lower than planned and were missing samples from households from specific ACORN categories. However, this is not considered to undermine the garden waste results for two reasons:

- There is not a statistically significant difference between the composition of garden waste samples at the primary category level from households from different ACORN categories; and,
- The contribution of garden waste to the kerbside waste composition has been estimated using data on the actual tonnages of garden waste collected and not just the sample data.

Table B.1 Representation – Halton

	Dry recycling	Garden	Residual
Target no. of samples	139	80	175
ACORN 1	28%	23%	18%
ACORN 3	30%	35%	23%
ACORN 4	28%	15%	28%
ACORN 5	14%	28%	31%
Achieved no. of samples	134	48	145
ACORN 1	29%	35%	18%
ACORN 3	31%	35%	21%
ACORN 4	26%	15%	30%
ACORN 5	14%	15%	31%

Table B.2 Representation – Knowsley

	Dry recycling	Garden	Residual
Target no. of samples	139	80	175
ACORN 1	15%	8%	11%
ACORN 3	30%	35%	27%
ACORN 4	33%	25%	27%
ACORN 5	22%	30%	35%
Achieved no. of samples	135	43	183
ACORN 1	14%	9%	12%
ACORN 3	32%	42%	33%
ACORN 4	34%	19%	23%
ACORN 5	20%	30%	32%

Table B.3 Representation – Liverpool

	Dry recycling	Garden	Residual
Target no. of samples	140	80	175
ACORN 1	20%	18%	14%
ACORN 3	23%	15%	15%
ACORN 4	36%	25%	27%
ACORN 5	21%	43%	44%
Achieved no. of samples	124	27	159
ACORN 1	16%	48%	16%
ACORN 3	21%	0%	14%
ACORN 4	39%	22%	29%
ACORN 5	24%	30%	41%

Table B.4 Representation – Sefton

	Dry recycling (box)	Dry recycling (bin)	Garden	Food	Residual
Target no. of samples	140	140	80	80	176
ACORN 1	37%	37%	43%	28%	35%
ACORN 3	41%	41%	40%	58%	28%
ACORN 4	13%	13%	18%	3%	17%
ACORN 5	9%	9%	0%	13%	20%
Achieved no. of samples	125	149	38	66	173
ACORN 1	35%	34%	42%	32%	36%
ACORN 3	45%	43%	37%	56%	27%
ACORN 4	12%	13%	21%	0%	17%
ACORN 5	8%	11%	0%	12%	19%

Table B.5 Representation – St Helens

	Dry recycling	Garden	Food	Residual
Target no. of samples	140	80	80	150
ACORN 1	19%	28%	23%	17%
ACORN 3	51%	53%	53%	29%
ACORN 4	21%	20%	20%	28%
ACORN 5	9%	0%	5%	25%
Achieved no. of samples	127	14	71	151
ACORN 1	28%	18%	29%	17%
ACORN 3	48%	54%	64%	27%
ACORN 4	21%	19%	7%	32%
ACORN 5	6%	9%	0%	25%

Table B.6 Representation – Wirral

	Dry recycling	Garden	Residual
Target no. of samples	140	80	148
ACORN 1	41%	33%	32%
ACORN 3	26%	25%	26%
ACORN 4	11%	33%	19%
ACORN 5	22%	10%	23%
Achieved no. of samples	128	31	151
ACORN 1	45%	48%	30%
ACORN 3	29%	26%	25%
ACORN 4	5%	26%	22%
ACORN 5	22%	0%	23%

Household Waste Recycling Centres (HWRCs)

Table B.7 compares the target number of samples with the number of samples collected from each HWRC. The target number of samples was achieved providing samples of HWRC residual waste from all the Districts in the Partnership. Over a third of the samples were collected on weekends.

Table B.7 Representation – HWRCs

	Huyton	Otterspool / Old Swan	South Sefton	Ravenhead	Bidston	Picow Farm	Total
Target no. of samples	5	6	6	4	5	4	30
Achieved no. of samples	6	6	6	4	5	4	31

Appendix C
Confidence

All estimates have a margin of error associated with them. When estimates are derived from sampling one element of this error is sampling error. There are other, non-sampling errors (e.g. methodological errors) however whereas these are very difficult to estimate it is possible to estimate sampling error. The confidence interval provides a range in which the "true" value is likely to lie. The confidence interval is estimated as a function of the result (mean), variance in the sample data (standard deviation) and level of confidence required. The confidence level is a measure of certainty. A 95% confidence level means that if we were to repeat the study the new result would be expected to lie within the stated confidence interval 19 times out of 20. A 90% confidence level means that if we were to repeat the study the new result would be expected to lie within the stated confidence interval 9 times out of 10.

The calculation of confidence intervals assumes that the data is normally distributed. The statistical analysis showed that the sample data collected in this study was not normally distributed. Given this, and the potential for non-sampling errors which are not included in the confidence intervals estimates, **the confidence intervals presented may be an underestimate**. Hence, with the exception of the data shown below, information on confidence intervals has been presented in graphical format only.

Table C.1 presents the indicative confidence intervals for the Merseyside and Halton Waste Partnership (MHWP) kerbside waste composition result. The range of the composition estimates in tonnes for each material type is also shown. The MHWP kerbside waste composition estimate has been calculated using data from over 2,000 kerbside waste samples and as such is the most robust result in this study.

Table C.1 MHWP kerbside waste composition result (% wt.) with 95% confidence intervals

	Kerbside waste (% wt.)	Lower 95% CI	Upper 95% CI	Kerbside waste (tonnes	Lower 95% CI	Upper 95% CI
Paper	12.2%	9.3%	15.2%	66,675	50,654	82,696
Card	7.1%	5.0%	9.2%	38,892	27,514	50,269
Plastic	11.9%	9.9%	13.9%	64,731	53,768	75,695
Glass	7.9%	5.4%	10.5%	43,334	29,199	57,469
Metals	3.7%	2.3%	5.1%	20,233	12,518	27,948
Textiles	3.4%	2.3%	4.4%	18,357	12,817	23,898
WEEE	0.6%	0.2%	1.0%	3,283	896	5,670
Food	27.2%	24.5%	29.9%	148,532	133,794	163,269
Garden	13.7%	11.1%	16.3%	74,672	60,357	88,988
Other organics	1.5%	0.0%	3.3%	8,124	0	17,752
Hazardous	0.4%	0.2%	0.7%	2,259	829	3,689
Sanitary	2.4%	1.5%	3.3%	13,332	8,455	18,208
Misc. combustibles	2.7%	1.6%	3.8%	14,684	8,690	20,679
Misc. non-combustible	2.2%	0.6%	3.7%	11,903	3,494	20,311
<20 mm fines	3.1%	2.4%	3.7%	16,740	13,037	20,443

Appendix D
Analysis of waste data by ACORN category

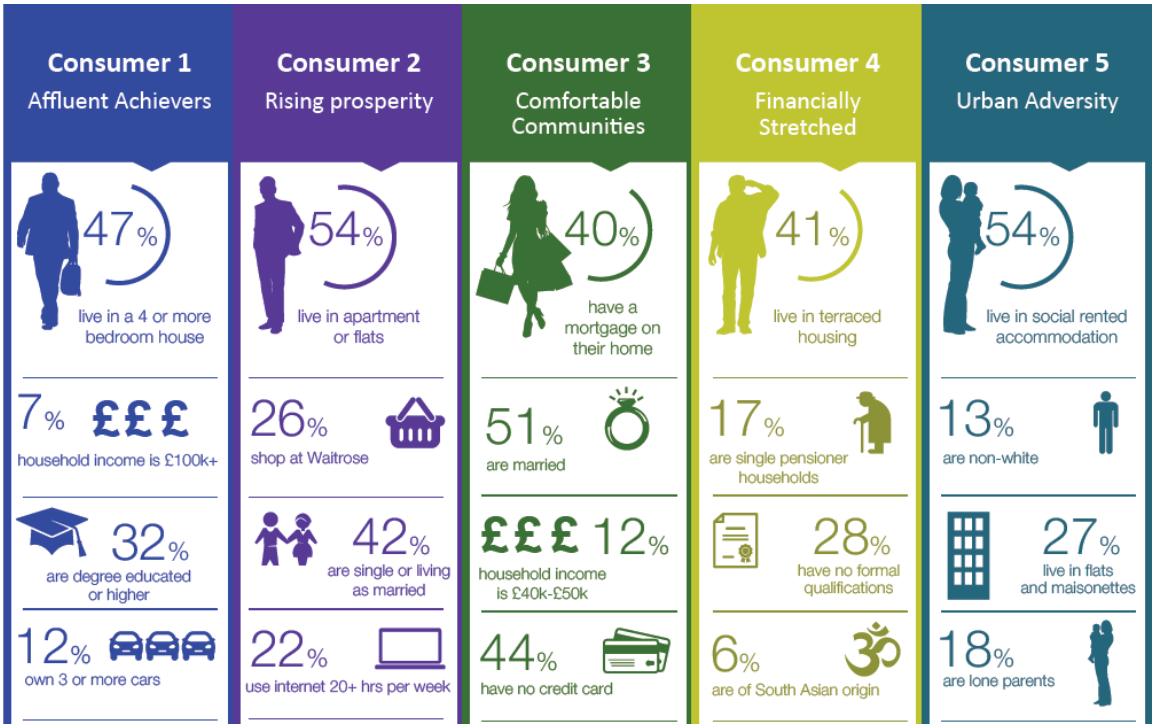
Comparisons between the ACORN results have been undertaken using the non-parametric Mann-Whitney U Test[36].

Graphs have also been produced with error bars showing the indicative confidence intervals for all the primary material categories to illustrate the level of uncertainty which is associated with the results. Note, the confidence intervals presented may be an underestimate.

ACORN **categories**

'A Classification of Residential Neighbourhoods (ACORN)'[37] is a leading geodemographic segmentation of residential neighbourhoods in the UK. It classifies each postcode in the country into one of 62 types that give a distinctive picture of the kinds of people who live in an area, their attitudes and how they behave. The ACORN segmentation has a hierarchical structure. The 62 types aggregate into 18 ACORN groups which lie within 6 descriptive ACORN categories at the top level. Five of the ACORN categories, comprising 17 of the groups and 59 of the types, represent the population in private households. The last category is reserved for other kinds of postcode, primarily communal population who live in various kinds of institution rather than in private households, and postcodes with no resident population. Figure D.1 shows the five ACORN categories which are comprised of private households.

Figure D.1 ACORN categories



[36] https://en.wikipedia.org/wiki/Mann%E2%80%93Whitney_U_test

[37] ACORN is a recognised socio-demographic tool used in the majority of household waste composition survey projects. The database is widely used across disciplines and is owned and managed by CACI Ltd. The database was licenced to MRWA with Amec Foster Wheeler and Axion as named consultants

Table D.1 shows the ACORN profile for MHWP in 2015. ACORN 2 and category U where not included in the sample as they compose less than 3% of the population.

Table D.1 2015 ACORN Profile for MHWP

ACORN Category	MHWP
1	21.9%
2	2.8%
3	22.2%
4	22.9%
5	29.9%
U	0.2%
Total	100.0%

Limitations

Whilst the study has provided an opportunity to examine and test for potential differences between the waste and recyclables produced by households in different ACORN categories there are a number of limitations associated with the dataset and analysis which should be noted.

- There is no information on the waste (tonnes) produced by different ACORN categories in Merseyside and Halton, therefore average compositions have been calculated using the sample data only;
- The kerbside waste streams were sampled separately and there was a different number of samples collected for each stream. This means it has not been possible to directly link samples of different waste streams to a single household. Hence where waste stream results have been combined to estimate arisings and composition the margin of error has been estimated using the square root of the mean squared (RMS) estimation;
- Set out has been accounted for using data from the 2010 study. Average arisings by ACORN category could be very different if set out was robustly accounted for;
- ACORN categories are broad including several “groups” and numerous “types”. The ACORN classification system includes 62 types sub-dividing the ACORN categories by various factors including location or housing types, household age profiles, marital status and presence of children. As such ACORN categories encompass a range of factors which may influence waste generation and composition and our dataset cannot be considered to be wholly representative of waste produced by households of different ACORN categories in Merseyside and Halton;
- The dataset includes waste sample data only. The composition analysis was not accompanied by a survey or other supporting data on the households that were sampled from (the study was anonymised). Therefore it has not been possible to control for factors such as household size, the presence of children or pet ownership; and,
- There are not enough samples to meaningfully analyse the ACORN categories at the District level so the dataset includes households from all Districts. Although there is fair degree of consistency in collection systems (fortnightly residual, co-mingled dry recycling, except for Sefton and St Helens, and the majority provide a free garden waste service) and materials collected, the District collection systems have not been specifically controlled for.

Given these limitations this statistical analysis should be considered to be to be an exploratory analysis to see what the data can reveal about the waste produced by households of different ACORN categories.

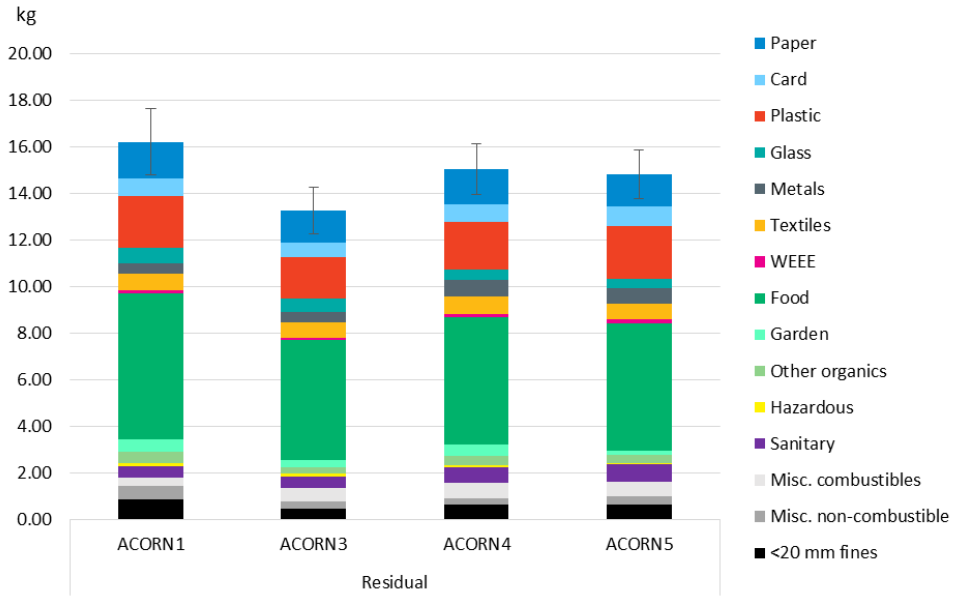
The analysis' primary aim is to explore the differences in the waste from households of different ACORN categories (representing different socio-demographics) to understand if ACORN categories provide a reasonable basis for stratifying a population. The secondary aim is to identify how the waste produced by households of different ACORN categories varies to inform how services and communications could be targeted at different socio-demographic groups.

Findings

Residual Waste

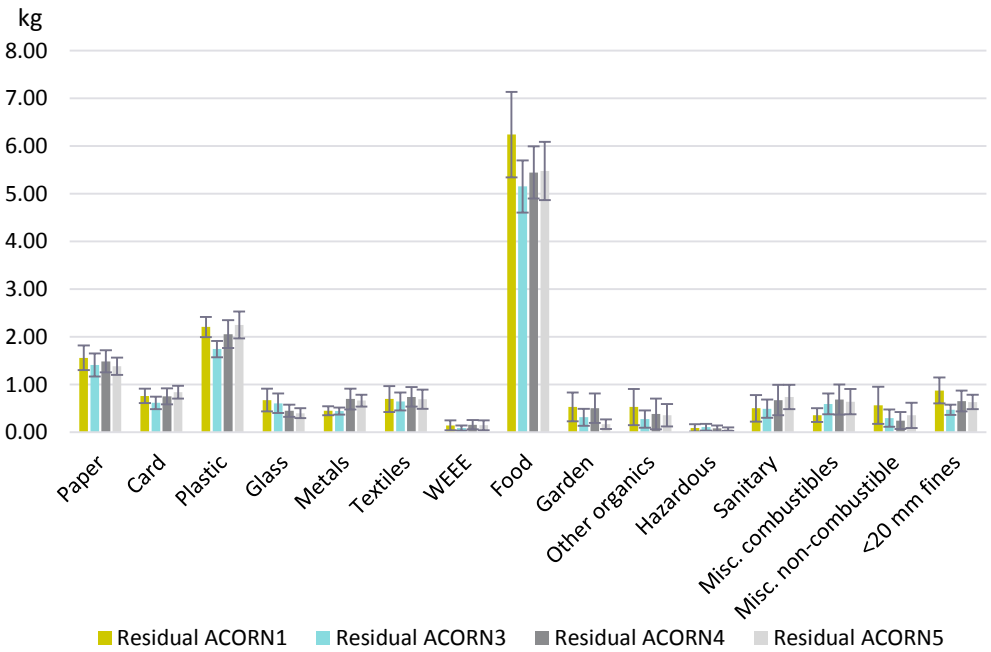
ACORN 3 households presented less residual waste per household sampled than households from the other ACORN categories. The result of the Mann-Whitney test shows a statistically significant difference between the average size (kg) of the residual waste samples from ACORN 1 and ACORN 3 households (at the 5% level). The differences between the other ACORN types are not significant.

Figure D.2 Average weight (kg) of residual waste samples by ACORN



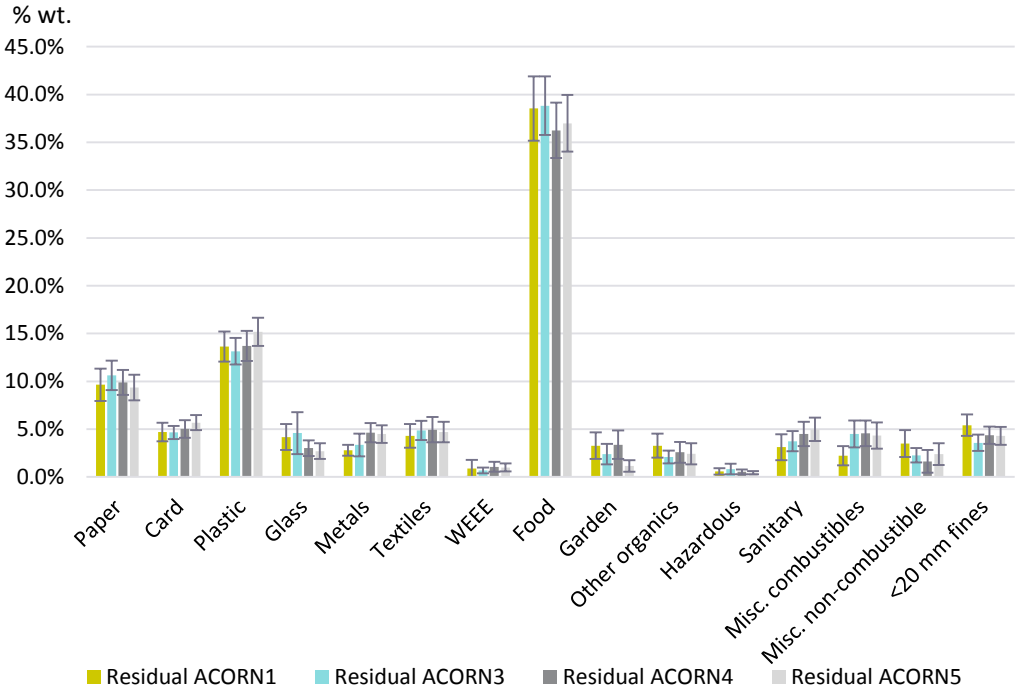
When the quantity (kg) of residual waste produced by the different ACORN categories is examined by material type there are some identifiable differences, for example, ACORN 1 households appear to dispose of a higher quantity of food waste via the residual waste stream than other households. The only significant different however is between ACORN 1 and ACORN 3 households with ACORN 3 households disposing of less plastic in the residual waste than ACORN 1 households.

Figure D.3 Average weight (kg) of residual waste samples by material category and ACORN



Although the quantity of residual waste produced by different households appears to vary by ACORN category there were no significant differences identified in the composition of the residual waste generated by households from different ACORN categories.

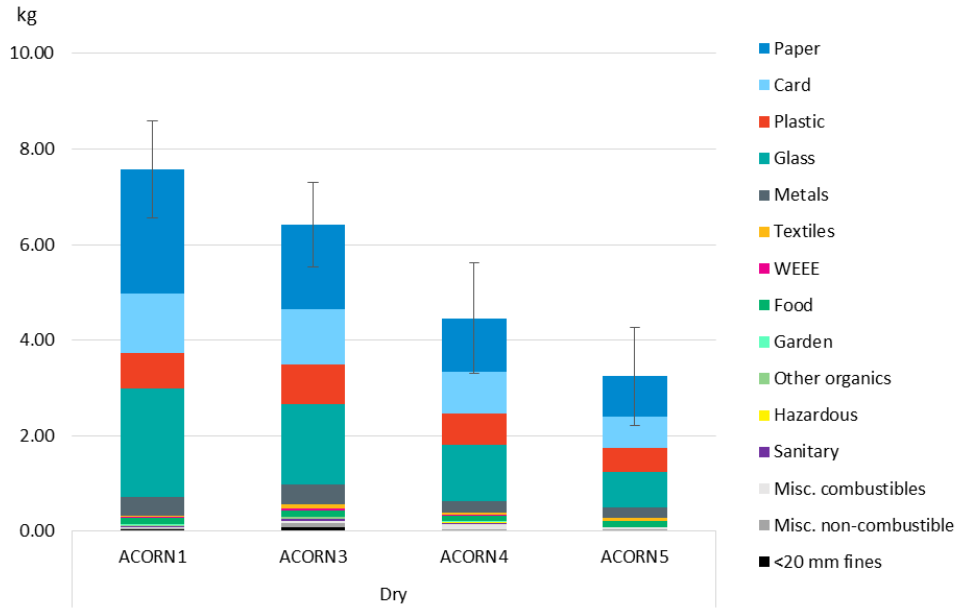
Figure D.4 Average composition of residual waste samples by material category and ACORN



Dry recycling

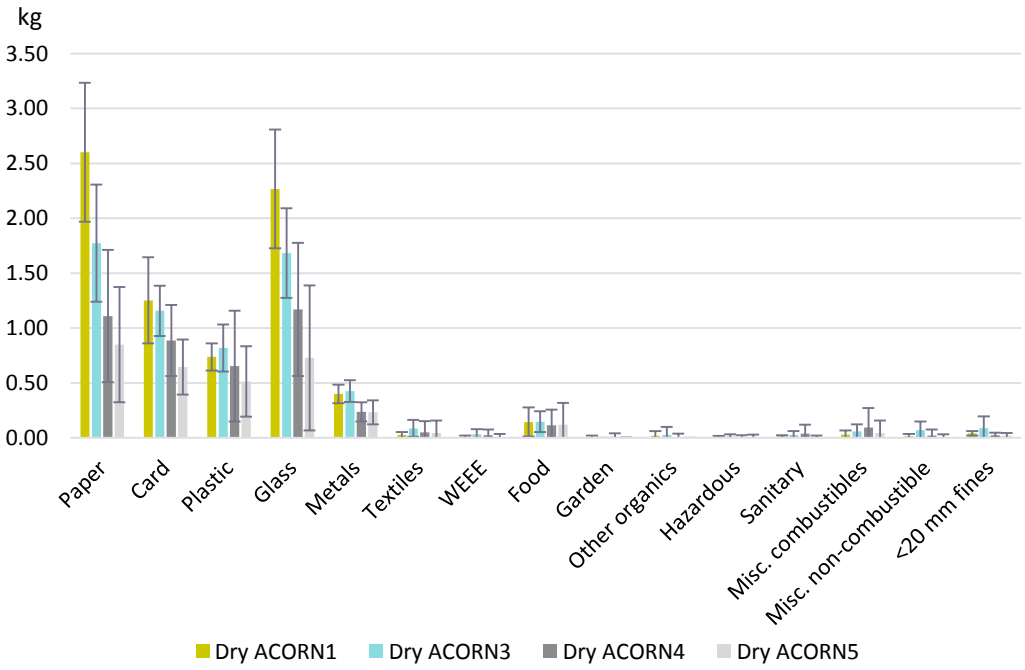
ACORN 3 and ACORN 5 households had the smallest dry recycling sample sizes (kg) on average and the differences were found to be statistically significant between ACORN 1 and ACORNs 4 and 5 and ACORN 3 and ACORN 5. However these results should be treated with caution as they utilise set out data from 2010.

Figure D.5 Average weight (kg) of dry recycling samples by ACORN



When the dry recycling sample sizes (kg) are examined by material there are a number of identifiable differences. The quantity of paper and glass in the dry recycling appears to reduce as affluence decreases (ACORN 1 is the most affluent and ACORN 5 the less affluent category). The results of Mann-Whitney U tests show a statistically significant difference between the quantity of paper in the dry recycling stream from ACORN 1 households and ACORN 4 and 5 households (at the 5% level). The test also showed a statistically significant difference between the quantity of glass in the dry recyclables from ACORN 1 households and ACORN 5 households (at the 5% level).

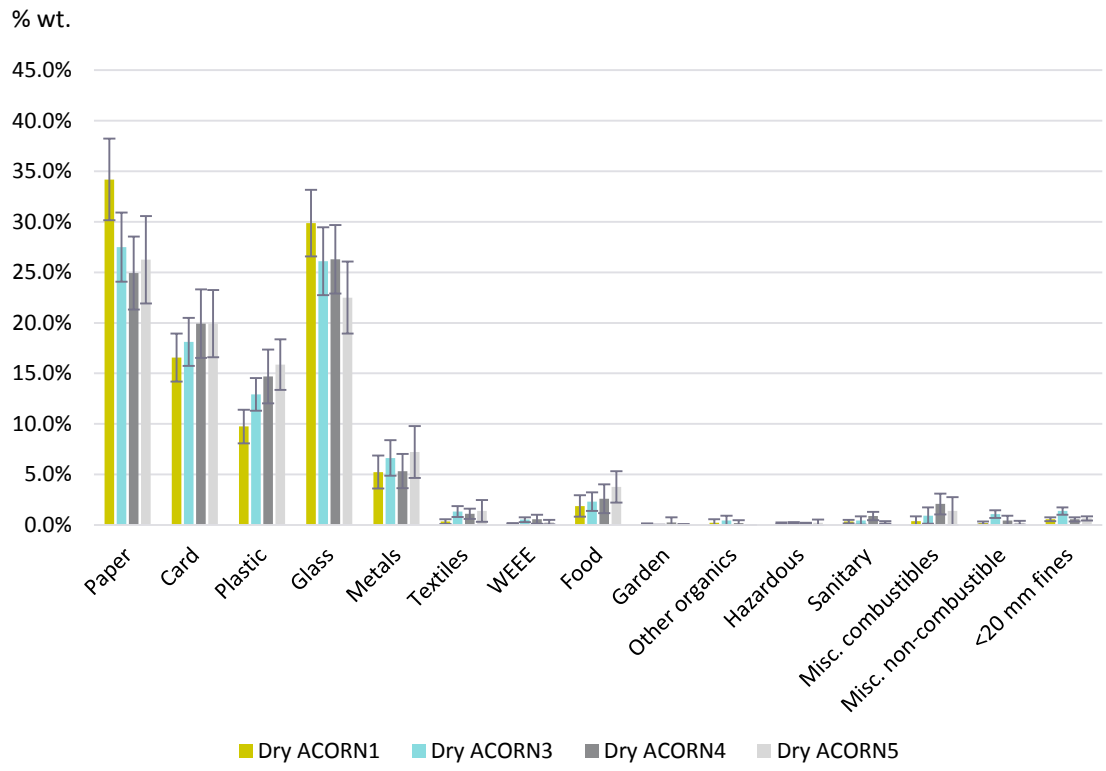
Figure D.6 Average weight (kg) of dry recycling samples by material category and ACORN



The differences identified between the quantities (kg) of dry recycling sampled from households from different ACORN categories are also present when the composition of the dry recycling stream is considered. From composition perspective a higher proportion of recyclables from ACORN 1 households is composed of paper and glass. In contrast the waste from less affluent households (e.g. ACORN 4 and 5) appears to be composed of a higher proportion of card and plastic. The results of Mann-Whitney U tests show a statistically significant difference in the paper composition of the dry recycling from ACORN 1 households and ACORN 4 households (at the 5% level) and a statistically significant difference in the glass composition of the dry recycling stream from ACORN 1 households and ACORN 5 households (at the 5% level). The tests also show a statistically significant difference in the plastic composition of the dry recycling stream from ACORN 4 and 5 households compared to ACORN 1 households (at the 5% level). The differences in the card component of the dry recycling stream were not found to be statistically significant.

Overall, the analysis of the dry recycling stream indicates that the dry recyclables generated by households from different ACORN categories varies in terms of quantity (kg) and composition. However, because of the various limitations associated with the analysis this is far from 100% certain and further study would be necessary to corroborate the findings.

Figure D.7 Average composition of dry recycling samples by material category and ACORN



The contamination levels in the dry recycling were also investigated. The results of Mann-Whitney U tests show a statistically significant difference in the contamination levels in the dry recycling stream from ACORN 1 households and ACORN 3 and 4 households (at the 5% level). The average level of contamination from ACORN 5 households was also higher than the average level for ACORN 1 households but this was not found to be statistically significant.

Figure D.8 Average contamination levels of dry recycling samples by ACORN

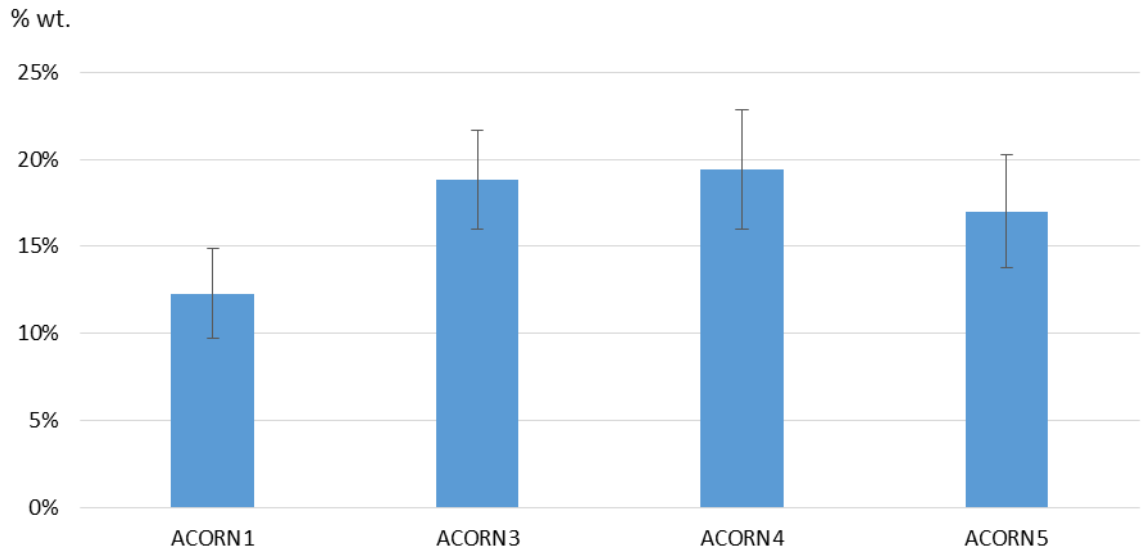


Table D.1 shows estimates of the capture rates for dry recyclables by households from different ACORN categories. Note, as the estimates are based on the sample data and set out information from the 2010 study the figures can only be indicative of the capture rates achieved by households from different ACORN categories.

Table D.1 Capture rates by ACORN category

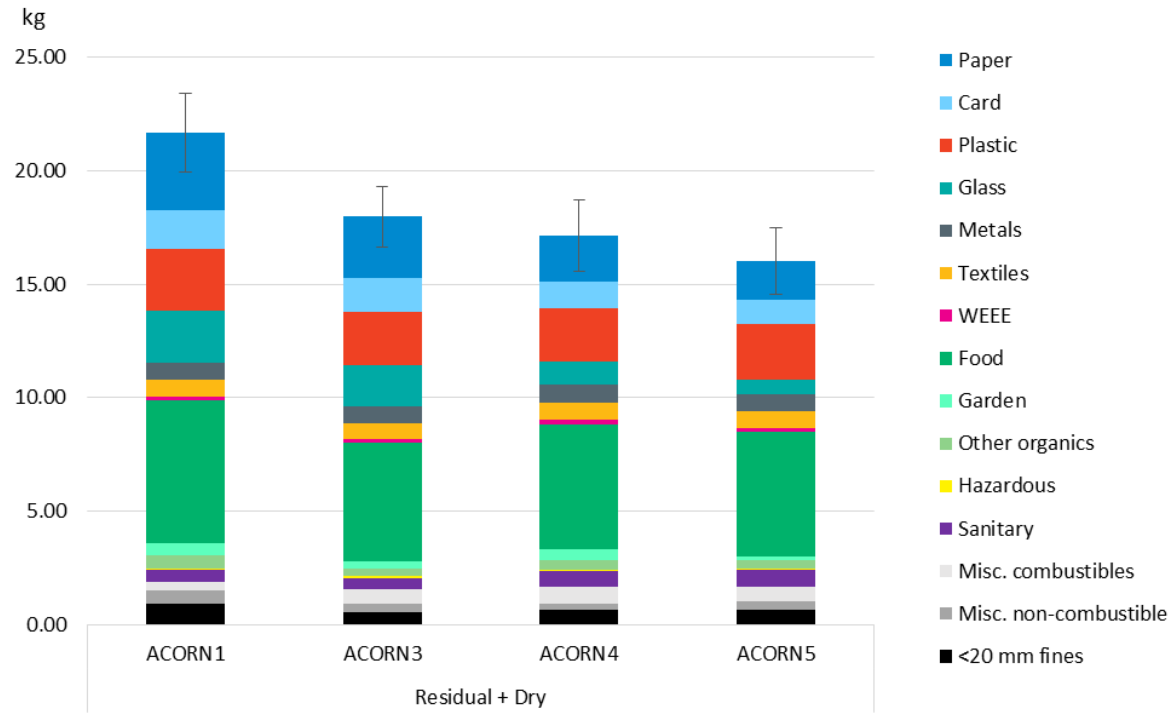
	ACORN 1	ACORN 3	ACORN 4	ACORN 5
Recyclable paper	78.7%	76.7%	72.5%	75.2%
Recyclable card	71.1%	73.6%	75.8%	69.0%
Plastic bottles	65.0%	77.2%	67.9%	67.0%
Recyclable glass	83.1%	80.8%	84.8%	84.2%
Recyclable metals	61.5%	63.2%	52.3%	53.6%
All dry recyclables	73.1%	74.3%	70.5%	68.8%

Residual waste and dry recycling (combined)

Using the results on the residual and dry recycling streams it is possible to estimate combined residual waste and dry recycling arisings (kg) and composition by ACORN category. Whilst this analysis is limited by excluding the garden and food waste streams it allows for the total amount of key materials (such as paper, card and glass) to be estimated. However, as the data below is calculated from the average results for each waste stream (residual and dry recycling) it is not possible to test these estimates for statistically significant differences. Indicative confidence intervals for the residual waste and dry recycling streams (combined) have been estimated using the square root of the mean squared error (RMS) but are for illustrative purposes only.

In terms of the weight (kg) of material collected in the residual waste and dry recycling streams the results indicate that ACORN 1 households may generate the largest quantities of residual waste and recyclables. If garden waste was included it is likely this difference would be increased as nationally around 47% of ACORN 1 households live in houses with four or more bedrooms[38] which are likely to have larger than average gardens.

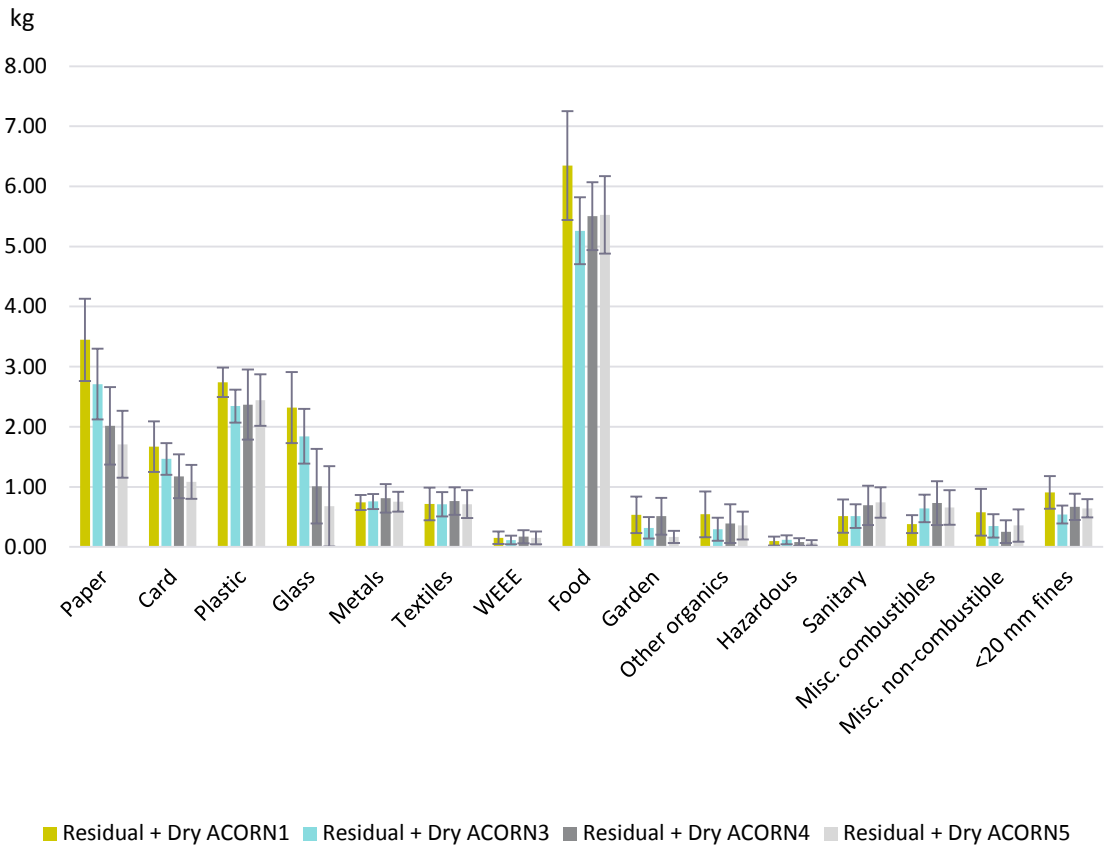
Figure D.9 Average combined weight (kg) of the residual waste and dry recycling samples by ACORN



[38] CACI, ACORN Infographic

When the quantity (kg) of the residual waste and dry recyclables sampled from the ACORN categories is examined by material type there are some clear differences, for example, ACORN 1 households appear to dispose of a higher quantity of paper, glass and food waste than other households.

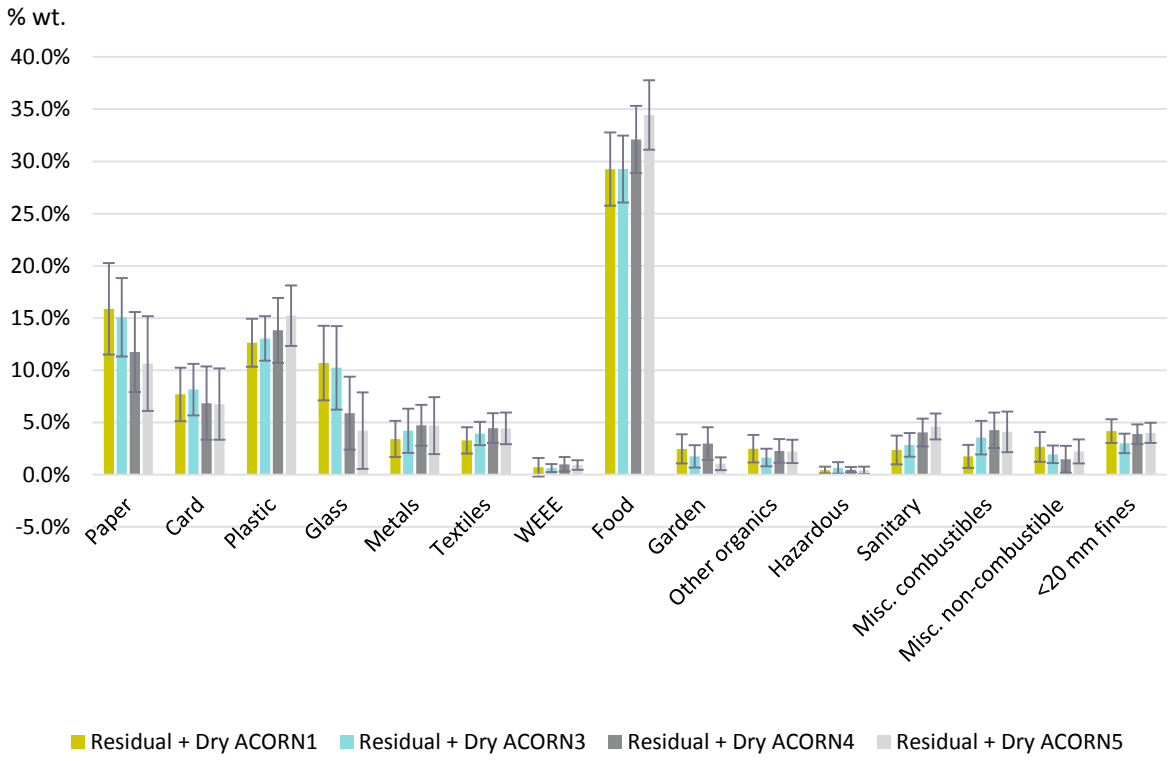
Figure D.10 Average weight (kg) of the residual waste and dry recycling samples by material category and ACORN



The differences identified between the quantity (kg) of the residual waste and dry recyclables sampled from households from different ACORN categories are also present when the composition of the material is considered. Although the differences cannot be tested for significance the trends in key recyclable materials (paper, card, plastic, glass and metals) are very informative

The results indicate that the paper and glass composition of the combined residual waste and dry recycling streams decreases as affluence decreases (ACORN 1 is the most affluent and ACORN 5 the less affluent category). In contrast the plastic composition of the combined residual waste and dry recycling streams appears to increase as affluence decreases. Whilst this finding must be treated with caution we note that this pattern has been observed in similar analyses undertaken by Amec Foster Wheeler[39] and others[40].

Figure D.11 Average composition of the residual waste and dry recycling samples by material category and ACORN



[39] Amec Foster Wheeler undertook an analysis of waste from high and low performing areas which closely correlated to socio-demographics (i.e. the high performing areas corresponded to ACORN 1 areas and low performing areas to ACORN 4 or 5 areas). Although these results were also not statistically significant this study also suggested that more paper and glass was generated by more affluent households and more plastic and metals were generated by less affluent households.

[40] Warren Spring and Aspinwall (1993) The National Household Waste Analysis Programme Phase Two - Results Report, Volume One - Category Analysis and Weight Data. Initial results from the United Kingdom's National Household Waste Analysis Programme suggest differences between total arisings from the neighbourhood types sampled. The more affluent neighbourhoods produced almost 50% more waste than the less affluent. Similar differences were also reported for paper and glass.

Discussion

Although the limitations associated with this analysis mean that all results on how waste and recycling varies by ACORN are only indicative there does appear to be some support for the assumption that waste produced by households (in terms of quantities and composition) will vary by socio-demographics identified using ACORN classifications. The differences in the residual waste and dry recycling produced by households from different ACORN categories are primarily associated with materials used for packaging such as paper, plastic and glass and similar differences have also been found in other studies undertaken by Amec Foster Wheeler. We have previously hypothesized that these differences may be due to differences in consumption habits (i.e. more affluent households may tend to purchase more products packaged in glass and less affluent households more products packaged in plastic) however there are also other potential explanations. For example, increased levels of metal packaging have been associated with pet ownership and the household age profile has been associated with waste paper production[41]. It is possible that the ACORN categories and/or the households sampled from also correlate with factors such as age profiles and pet ownership and that these factors may explain the variations observed.

In summary, this analysis provides some insight to how waste may vary by ACORN category, however, because a number of factors have not been controlled for it would be inaccurate to assume socio-demographics are responsible all of the observed differences.

The finding on the variable levels of contamination by ACORN category is the perhaps the most robust because it is less influenced by factors such as set out and hence could be used to justify targeted campaigns to reduce contamination. Other findings could also be used to inform other interventions[42] however we would not recommend that the data is used to inform major service changes (e.g. changes to collection systems). Further research would be necessary before major investment or spending decisions are made based on any of the findings presented in this statistical analysis of waste and recycling by ACORN category.

[41] Defra/Open University (2008) The Open University Household Waste Study.

[42] For example plastic appears to compose a larger proportion of the dry recycling stream in ACORN 4 and 5 households so areas composed of these households could benefit more from messages on plastic recycling.