RECYCLING ACTION YORKSHIRE

Commercial plastic collection feasibility Study

Conducted by Resource Futures on Behalf of RAY

Supported by

Resource Futures

Plastics feasibility study

Prepared for Recycling Action Yorkshire

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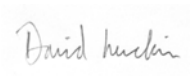

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Executive summary

RAY commissioned a feasibility study to investigate plastic film recycling in parallel with a larger recycling project facilitating glass and cardboard recycling in licensed retail establishments (LREs) and small and medium enterprises (SMEs).

The project involved visual audits of waste generated by various company types and used volumetric conversion factors to project a wider picture of waste arisings. Five rounds, each representing one day's work per vehicle, were sampled. The samples included three rounds where waste was collected in a mixture of bags, bins and smaller skips (up to 16 cu yd), and two samples focused on larger producers using roll on-off skips. The majority of customers (61%) used 1100-litre bins. Businesses were classified by type and comprised:

- retail - 33% of businesses sampled
- industrial – 24% of businesses sampled
- hospitality – 19% of businesses sampled
- office – 13% of businesses sampled
- other – 11% of businesses sampled.

A reality check on appropriate samples was undertaken to compare actual weighbridge weights with values calculated following the audits; this suggested projections were within acceptable limits.

The results of the audit were split into samples one, four and five (which comprised bags, bins and skips up to 16 cu yd) and roll on-off samples. This data was also split into the various business types; the data showed that cardboard was the most common material in the residual waste of most business types, ranging from 7.4% in other businesses to 38.3% in industrial businesses. Food waste was particularly common in retail (46.7%) and hospitality (52%) businesses. The data from the study showed plastic film was most prevalent in retail (9.4%) and industrial (7.9%) waste streams. The study also considered data from businesses that had recycling services and highlighted that these producers still have large amounts of recyclable material within their general waste skips; this highlights poor segregation, even in companies that have recycling systems. The roll on-off samples produced similar results.

The study also collated and assessed data from previous studies; this provided some comparisons and an additional secondary reality check.

The audit findings were projected to assess the feasibility of implementing a collection round. The study found that even large producers in the various business types produced low weights of plastic. This was compared on a like-for-like basis with other materials to determine the number of 1100-litre bins required to collect one tonne of recyclate; this exercise suggested plastic collection will be unfavourable compared to cardboard, paper and glass. The situation is slightly different for roll on-off collections as plastic is baled or compacted and these skips can accommodate larger tonnages of material. Space, difficult handling and segregation issues all represent important practical obstacles that would need to be overcome from the producer and collector point of view to facilitate increased collections of plastic film.

In terms of end markets there is a strong regional presence of contractors who will collect plastic film, but they are very sensitive to contamination. On the other hand, producers would prefer to carry out as little segregation as possible. However, collecting mixed film would secure little income from the sale of material. The reprocessors are much more interested in collecting baled material direct from the producer as opposed to a commercial collector. If a commercial collector wished to operate a collection they would need to deliver large uncontaminated loads to a reprocessor and would need to invest in bulking/segregation infrastructure. This at present represents a major barrier for commercial collectors.

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There are clear barriers, issues and opportunities for plastics recycling based on the current market and data gathered as a result of this project. There are four main areas RAY could offer support to facilitate increased plastics recycling:

- **Waste produces with small amounts of plastic –** These types of producers would not attract large-scale interest from commercial collectors. However, RAY could consider supporting a pilot for small-scale producers to determine the best methods of collecting this material and highlight the feasibility to other commercial collectors.
- **Medium-sized producers of waste plastic** – These producers may produce enough plastic to justify use of a baler and attract a direct collection from a reprocessor, but at present cannot make the investment required in a baler. RAY could facilitate recycling from this group by providing grants/funding for balers.
- **Larger producers of waste plastic –** These producers have often invested in a baler and sell the material direct to a reprocessor. RAY could consider promoting case studies to other large producers to increase activity in this area. They could also support education and training for producers staff to encourage better segregation.
- **Business clusters and coordination –** There are a number of sites such as shopping centres, Industrial estates and City centres that could benefit from intervention from RAY. There are clear opportunities for RAY to provide joint plastics recycling infrastructure to clusters of businesses, and the combined volumes of plastic and other materials may provide cost and environmental benefits for the businesses.

Introduction

Recycling Action Yorkshire (RAY) has provided funding to 3b Waste Solutions and Resource Futures Ltd to help increase recycling of cardboard and glass in Licensed Retail Establishments (LREs) and small and medium-sized enterprises (SMEs). As part of this project, and in the context of RAY's wider remit, this report investigates the feasibility of segregating and recycling plastics from various waste producers.

Project scope and objectives

The purpose of the study is to focus on plastic film but highlight other materials in the producers' bins.

The project objectives were to:

- estimate basic waste type and amounts in a sample of 3b Waste's customers bins using visual audits
- conduct research into the best possible methods for collecting suitable materials, based on amount, storage requirements, space issues and collection logistics
- highlight potential income against costs and determine potential costs of collection for various options.

Methodology

The project sampled a number of 3b Waste customers across five rounds to sample a good cross section of customer types. Each round consisted of one days work over a 7.5 to ten hour period. Table 1 highlights the five samples.

Table 1: Sampled rounds

Sample no.	Area location	Date	Potential Customers*	Type of collection
1	Leeds city centre	March 6	150	Wheeled bin/bags
2	General larger producers	March 8	4-6	Roll on-off
3	General larger producers	March 9	4-6	Roll on-off
4	Commercial collections industrial estates (urban)	March 15	35	Mixture of bins
5	Commercial collections mixed outlying round	March 16	60	Wheeled bins/bags

* Approximate number of customers sampled.

For each container emptied a visual percentage estimate of the contents was made, based on a simple classification system. Further categories were added during the audits as additional materials were found to be present. The final classification system is detailed in Table 2.

Table 2: Classification of materials

Cat. No.	Category	Sub cat.
1	Paper	
2	Cardboard	
3	Glass	
4	Plastic	Film
		Rigid (including bottles)
		Other - eg expanded polystyrene
5	Metals	
6	Food	
7	Hazardous	
8	Wood	
9	Green waste	
10	Other	
11	Unknown	This category relates to bagged waste where the contents could not be identified. Bagged waste is often similar in composition to mixed household waste.

Each customer was also classified into one of five main business types, as shown in Table 3.

Table 3: Business classification

Cat No.	*Business Type*
1	Retail
2	Office
3	Hospitality
4	Industrial
5	Other commercial – eg nursery

The data from the samples was collated on an excel spreadsheet and modelled to determine waste arisings versus business classification. This has been achieved by volumetric conversion factors to convert the percentage estimates into weights. This is then compared with the overall tonnage from vehicles where appropriate to provide a reality check. In addition, the research has been carried out with other published figures and composition studies to provide a wider background.

Visual observation was also carried out during the audits to determine the best practical collection methods. Desk-based research was also undertaken to provide further evidence for the study.

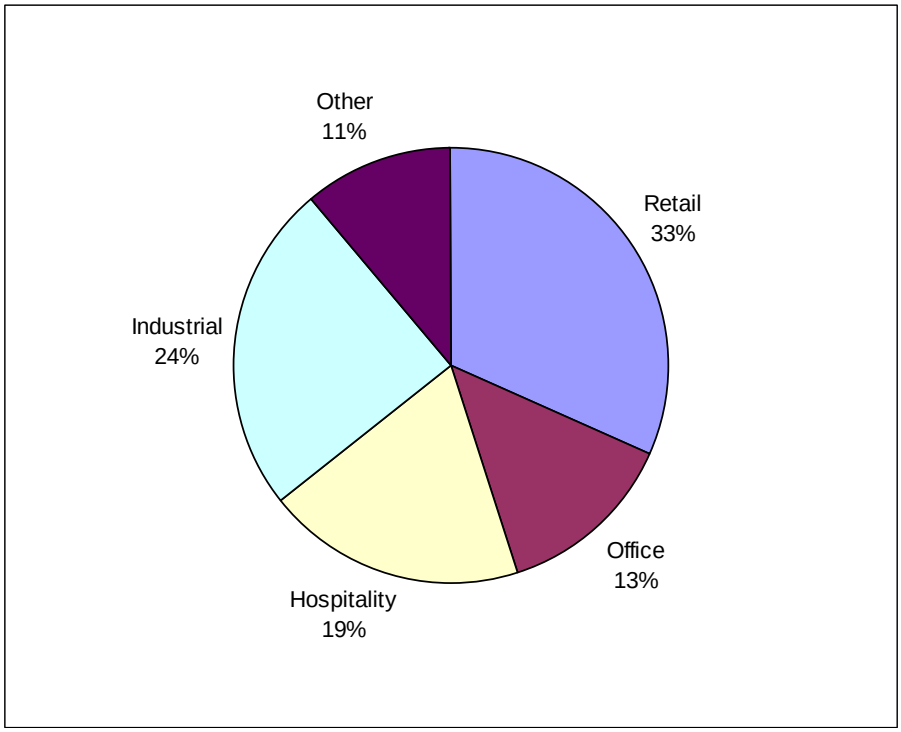
Regional reprocessors and traders were be contacted to determine potential income from the plastics this would be fed into the various collection scenarios to determine potential collection

costs for customers. These scenarios might include direct delivery by the collection vehicle reprocessors or baling at a transfer station for bulk transfer/collection.

Results of audit

The results of the audit are presented in the following sections. A total of 97 customers were visited during the project and this equated to a total of 144 bins. This is slightly lower than highlighted in Table 1 due to vehicle breakdowns during the period of the audit. Figure 1 shows the types of businesses where containers where audited.

Figure 1: Types of customers audited



Although companies were not profiled in detail, during each site visited the type of company was recorded in more detail, as shown in Table 4.

Table 4: Business types in more detail

		Sample (Number of customers)				
Business Type	**Sub-type**	**Roll on Roll off (Combined)**	**6_03**	**15_03**	**16_03**	**Total**
Retail	Independent small retailer		5	2	1	8
	Larger retail chain		4	7	9	20
	Shopping centre		1			1
	Charity shop		1		1	2
Office	Small local firm		3			3
	Larger regional firm		5	2		7
	National/international firm		2	1		3
Hospitality	Independent		7	4	3	14
	Chain		1	1	3	5
Industrial	Service engineers/processes	1	1	1	1	5
	Printers	1	1	2		4
	Food and drink			1		1
	Manufacturing	3	2	4	6	13
Other	Hospital/care-home/dental		3	3	1	7
	Church		1			1
	Public building			1		1
	Mixed use		1			1
	Nursery			1		1
Totals		**5**	**38**	**30**	**25**	**97**

Small independent retailers included convenience stores and newsagents. The larger retail chain shops included supermarkets, DIY stores and fashion shops. For the majority of these larger companies, waste is collected through a broker who has the national contract for waste collection but organises collections with local/regional firms such as 3b Waste Solutions. This category also included one shopping centre and two charity shops.

Offices included small local independent firms such as solicitors. Larger regional offices included a cleaning services company and the national/international firms included property development companies.

Industrial customers included a number of service-based industrial premises such as a vending machine servicing company. Printers in this category consisted mainly of medium-sized companies; however one printer using the roll on roll off (ro-ro) skip was an extremely large business. There was one food and drink manufacturer that was a regional SME business. The remaining businesses manufactured products varying from windows to metal components.

In the “other” categories hospitals/care-homes/dental included one NHS hospital, one private hospital and a mixture of dental practices and care-homes. All the bins audited were

designated for general waste and excluded clinical waste. Other customers also included a city centre church, a railway station, mixed office/industrial premises and a nursery. Table 5 summarises the numbers and types of bins inspected during the audit

Table 5: Number and type of container inspected during project

Bin type	Cubic metres	Total number inspected	% of bins inspected
Trade sack	0.09	3	2.1
360-litre	0.36	10	7.0
660-litre	0.66	14	9.6
1100-litre	1.1	89	61.0
6 cu yd	4.59	5	3.4
8 cu yd	6.12	6	4.1
10 cu yd	7.65	3	2.1
12 cu yd	9.17	5	3.4
14 cu yd	10.7	1	0.7
16 cu yd	12.23	5	3.4
30 cu yd	22.94	2	1.4
35 cu yd	26.76	1	0.7
40 cu yd	30.58	2	1.4
Total	n/a	144	100

The vast majority of customers use 1100-litre bins due to their flexibility on site and ease of filling. Other bins observed during the audits, eg recycling bins, were recorded to act as a comparison; of the 97 customers visited, a total of 15 recycled waste. This is analysed in more detail in the results Section.

Composition

Operationally work is split between roll on-off work and refuse collection vehicle rounds that collect a variety of wheeled bins and skips. The RCVs used in the sample rounds were 18-tonne three-axle vehicles. As stated in the methodology volumetric to tonnage conversion figures have been used to calculate weights within bins. Published volumetric figures have a wide range, depending on methodology used and materials. For this study the figures shown in Table 6 have been used as they equate well with the actual tonnages collected and are based on volumetric data from a variety of sources. These sources include West Yorkshire Waste Management, Envirowise, Environment Agency and in-house figures from previous projects.

Table 6: Conversion factors used in this report

Material	Average density (kg/m^3)	Weight per 1100-litre bin if 100% single material (kg)
Paper	55	60.50
Cardboard	37.5	41.25
Glass	132.5	145.75
Plastic film	18	19.8
Plastics rigid	22	24.2
Plastics other (EPS)	20	22
Plastics (rubber)	68.5	75.35
Metal (based on non-compacted cans)	68	74.8
Green waste	65	71.5
Food	132.5	145.75
Hazardous	n/a	Variable depending on type
Wood	105	115.5
Other	n/a	Variable depending on type
Unknown (black bag waste)	75	82.5

It was found from visual observation during the audits that much of the waste was not compacted either mechanically or by hand so waste densities have been used that are lower than typical household waste where waste is often hand compacted.

Due to 3b Waste Solutions operational activity it is not always possible to obtain an actual weight ticket for general waste collected. This is because vehicles are only sent to disposal sites when full. Very often, at the end of each shift a vehicle is only half full so is not tipped. During the sampling actual weight tickets where obtained for samples two, three, four and five. Therefore a reality check can be carried out to determine the potential difference between actual weight of waste and the estimated weights of individual bins. Table 7 shows the estimated and weighed tonnages and gives a reality check on the data for samples four and five, representing skips and bins, but excluding roll on-off tonnages. This suggests that estimated tonnages for individual bins using the volumetric figures are accurate within 10%.

Each roll on-roll off skip had an actual weight recorded when tipped and these figures are used to estimate the weight of each component within these samples.

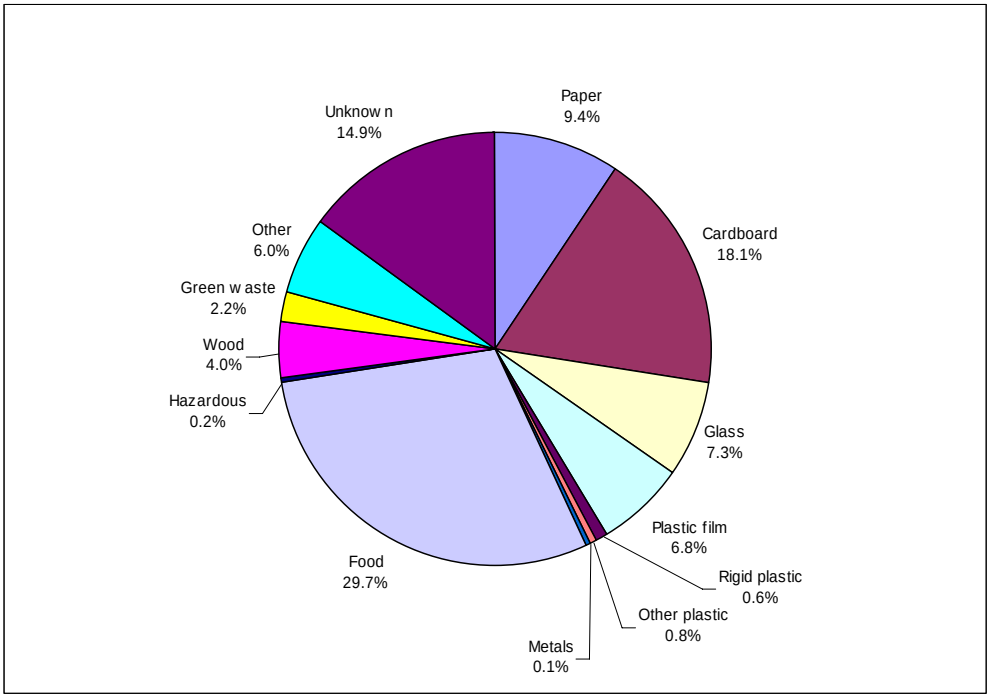
Table 7: Reality check for skips and bins

Sample	Actual tonnage	Estimated tonnage (m^3 to Kg)	Difference (%)
Samples four and five	11.12	12.17	9.44

Wheeled bin and skip collections

Wheeled bin and skip collections comprise samples one, four and five. All the data presented below converts volumes into weights using bulk density conversion figures (see Table 6). The data is then presented as a percentage by weight in each of the pie charts. The overall waste composition for all three samples is highlighted in Figure 2.

Figure 2: Overall waste composition for samples one, four and five



Data can also be split into business type for samples one, four and five. These are represented in the following charts.

Figure 3: Retail business waste composition for samples one, four and five

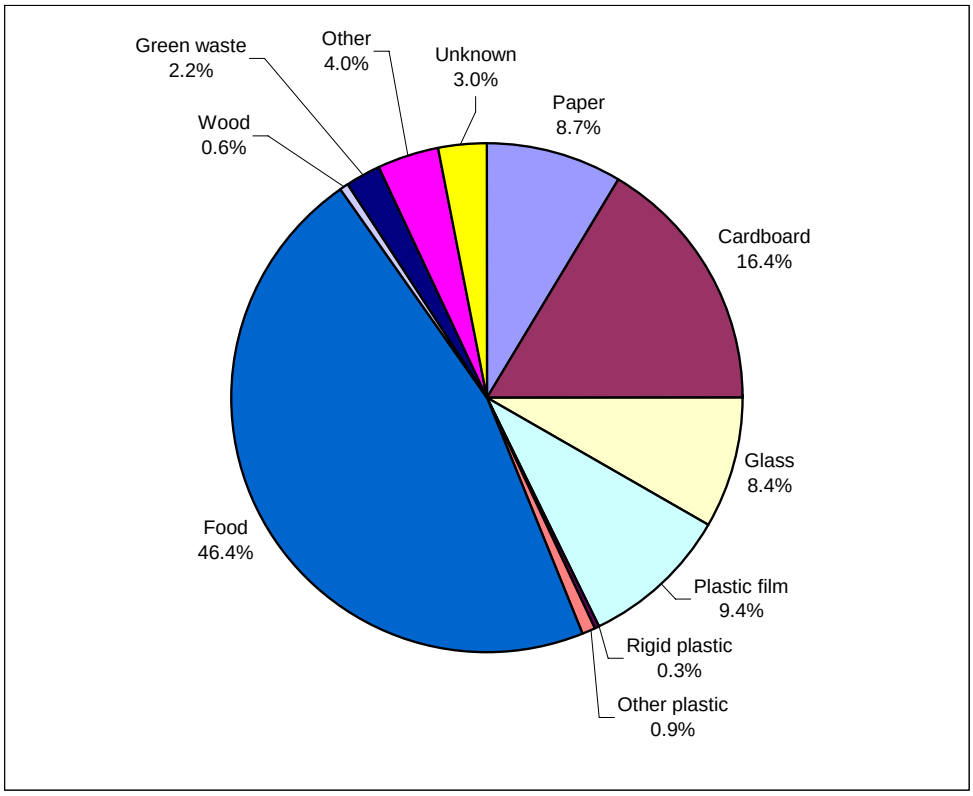
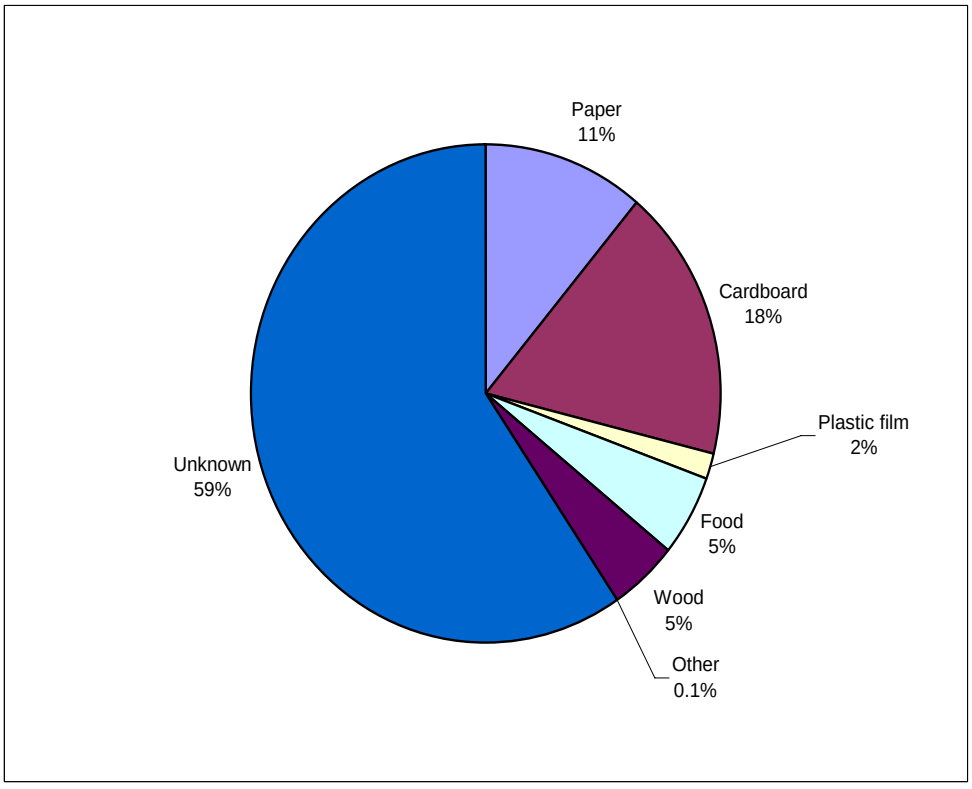
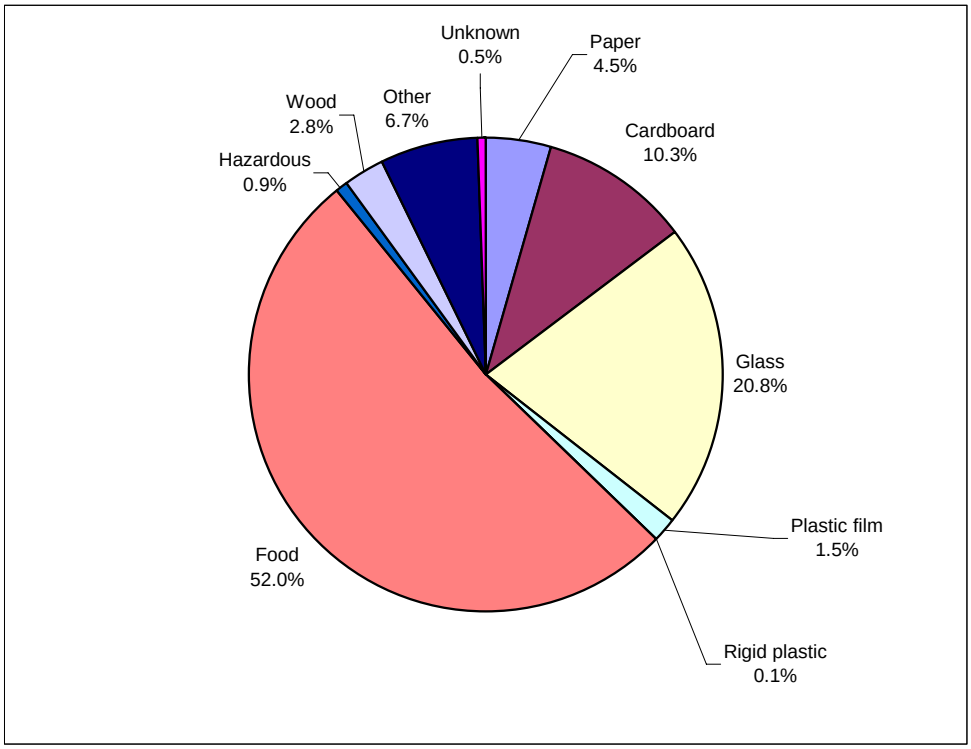


Figure 4: Office business waste composition for samples one, four and five



Notes: Other consisted of WEEE in this business type. Unknown was mainly black bag waste which consisted of mixed food, cardboard, paper and plastic.

Figure 5: Hospitality business waste composition for samples one, four and five



NOTES: The high proportion of hazardous waste is due to one skip having a high number of fluorescent tubes present in the skip. “Other” in this case was identified as mixed fast food waste consisting of paper plates, cups, napkins

Figure 6: Industrial business waste composition for samples one, four and five

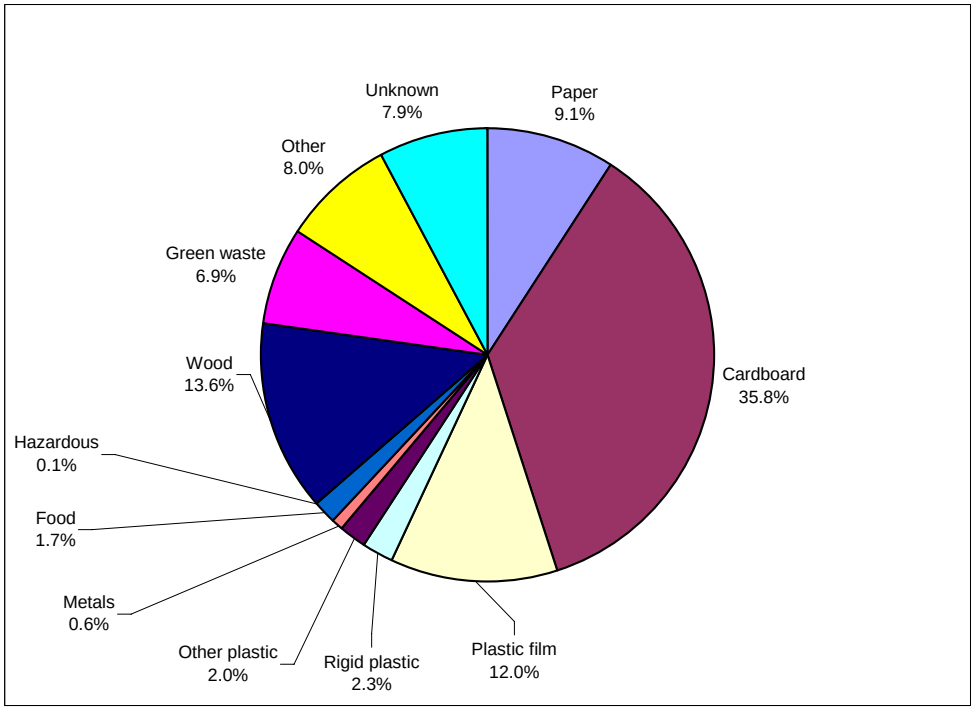
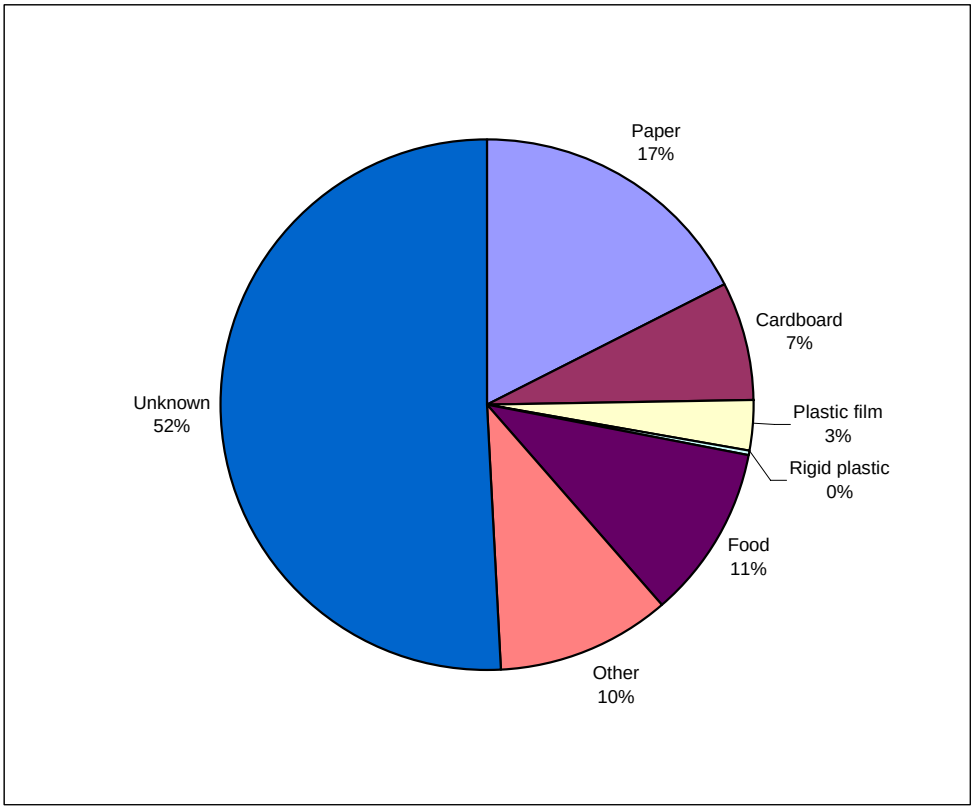


Figure 7: "Other" business waste composition for samples one, four and five



NOTES: Unknown consists mainly of black bag mixed waste. It also consisted of used car parts which were a mixture of plastic, glass and metal.

All types of plastic found in each type of business is further summarised in the Table below.

Table 8: Summary of plastic types found in each business type.

Business type	Film (%)	Rigid (%)	Other (%)
Retail	9.4	0.3	0.9
Office	2	0	0
Hospitality	1.5	0.1	0
Industrial	12	2.3	2
Other	3	0.1	0

The main constituent of waste from each business type is highlighted in Table 9.

Table 9: Main constituents based on audit

Business type	Material	% in sample
Retail	Food	46.4
Office	Cardboard	18
Hospitality	Food	52
Industrial	Cardboard	35.8
Other	Paper	17

NOTES: This excludes unknown categories.

Residual waste composition for businesses with recycling

During the audit any businesses with recycling were also noted. The composition of the residual bins were still noted and provide an interesting comparison between the overall samples in the previous sections. The following figures show residual waste composition for companies with recycling schemes in operation.

The data shows businesses with paper, card and glass recycling have high volumes of unsegregated material in their residual waste which demonstrates segregation is poor. With the exception of hospitality business establishments.

Figure 8: Retail establishments with cardboard and paper recycling

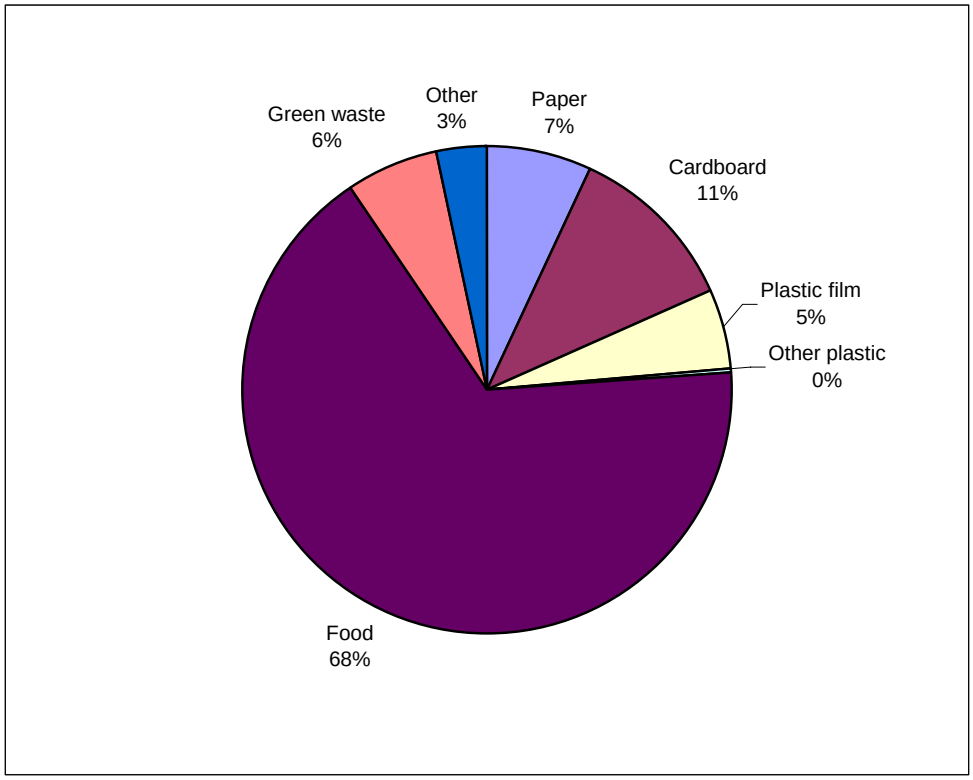


Figure 9: Office establishments with cardboard and paper recycling

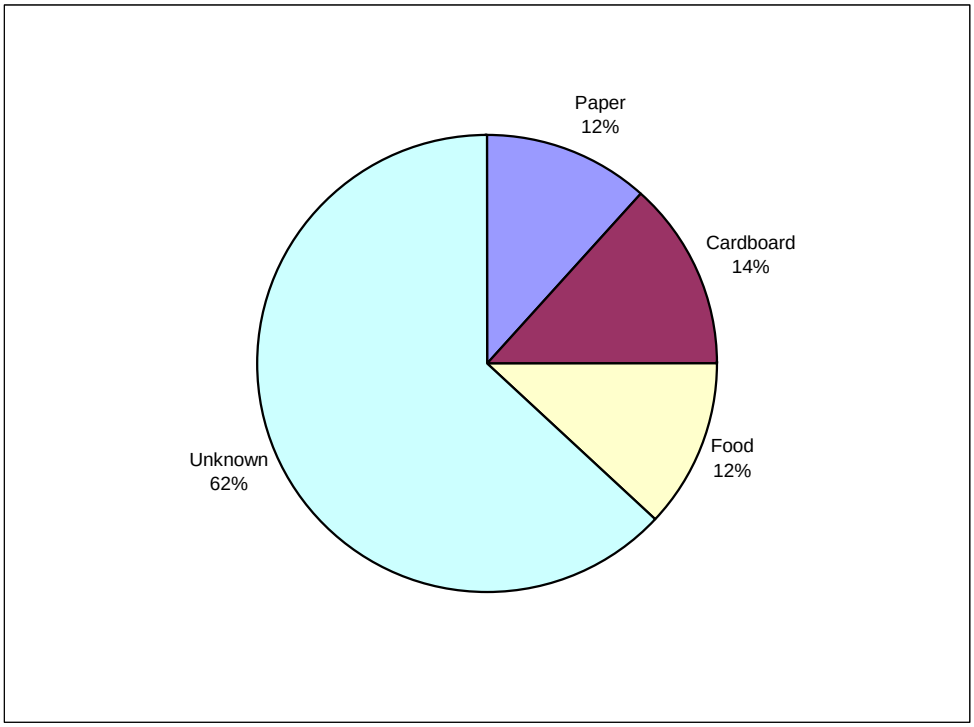
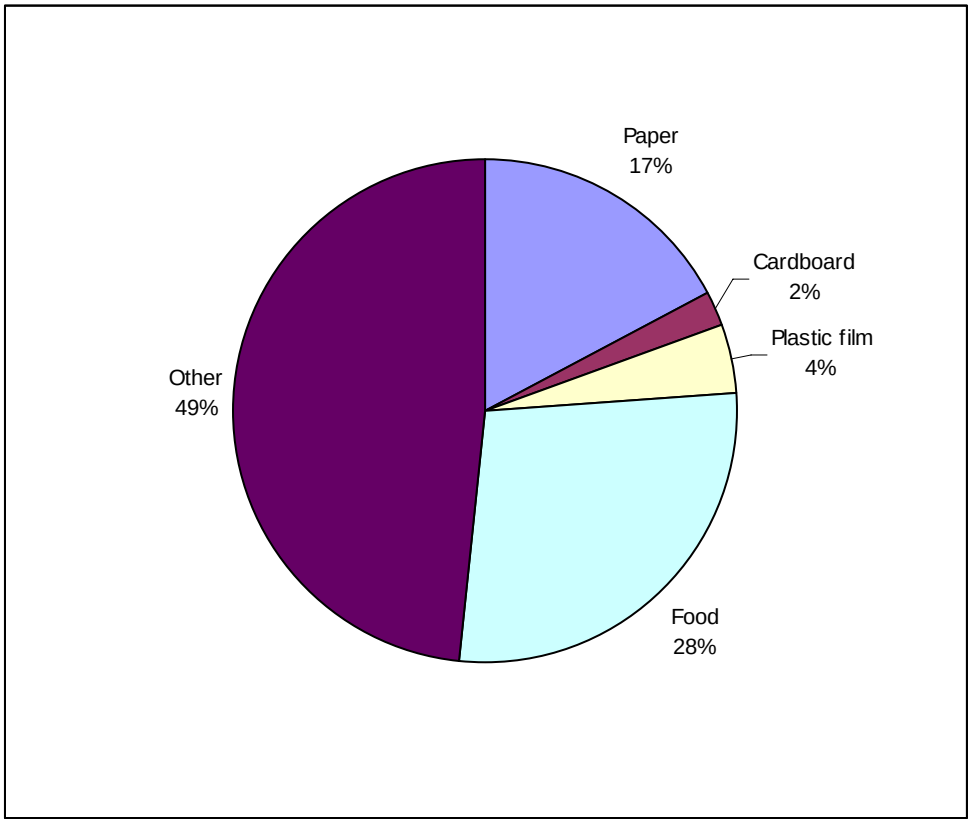
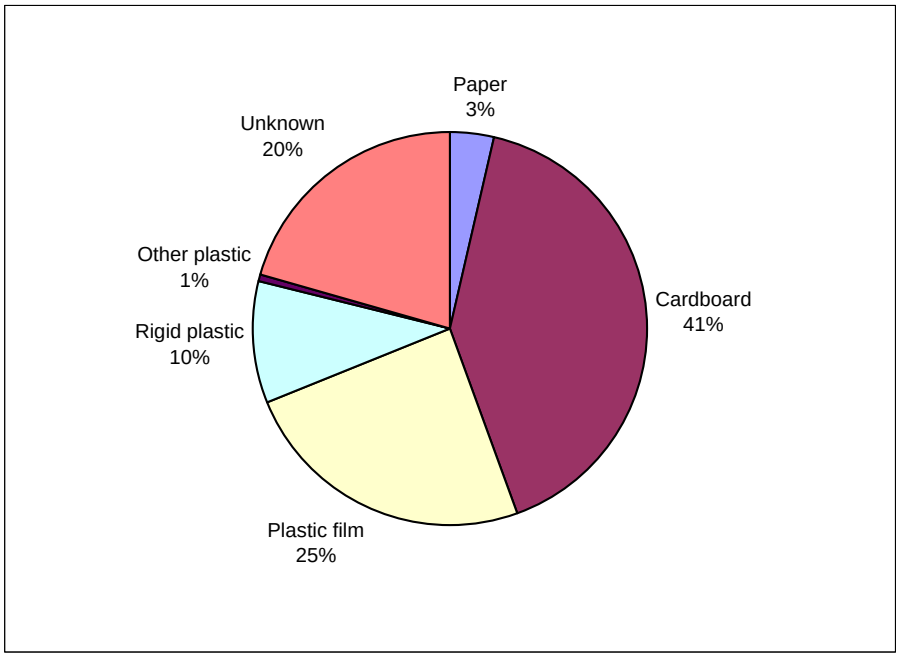


Figure 10: Hospitality establishments with cardboard and glass recycling



The data from Figure 10 suggests hospitality establishments with glass and cardboard recycling have good segregation because no glass was found in their residual waste bins and very little cardboard.

Figure 11: Industrial establishments with cardboard and paper recycling



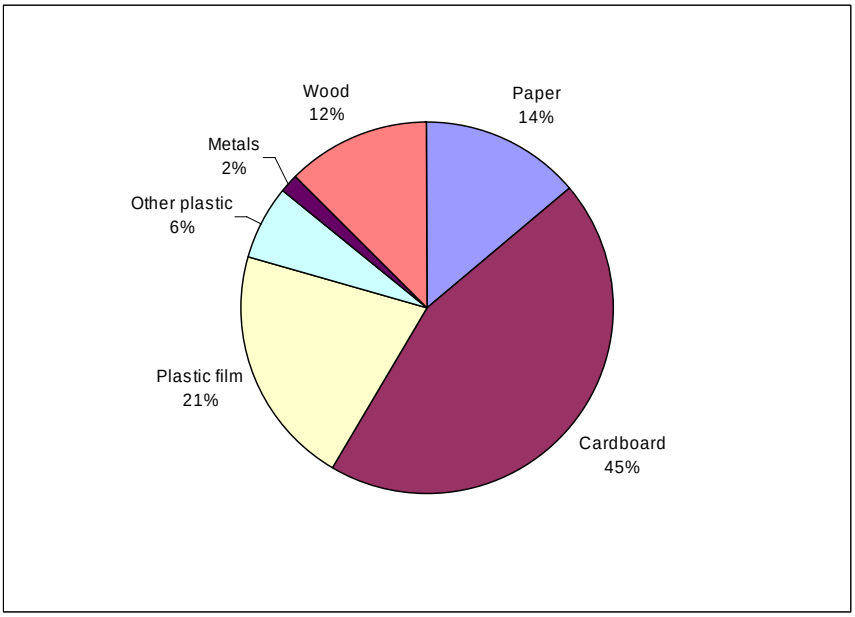
Roll on-off waste composition

Roll on-off skip collections consist of samples two and three. A total of five skips were audited from a variety of companies detailed below:

- skip 1: coach builders (22.94 cubic metres, non-compacted)
- skip 2: cardboard printing firm (26.76 cubic metres, compacted)
- skip 3: autoclaved clinical waste (30.58 cubic metres, compacted)
- skip 4: double glazing manufacturer (22.94 cubic metres, non-compacted)
- skip 5: component manufacturer (30.58 cubic metres, non-compacted)

The overall waste composition for all samples and each skip emptied is provided in the Figures below. Bulk densities have not been used for measuring the weight in these skips as the amount of compaction within each sample is very variable and will affect the accuracy of any results using bulk density conversions. Therefore, for these skips an estimate weight for each type of material was made based on the total tonnage recorded on the weighbridge.

Figure 12: Average composition



Skip 1 came from a firm that converted van and lorry bodies to refrigeration units; as such they used a lot of blue foam which is represented as 80% “other” in the chart. The sample weight of this skip was 2.24 tonnes. The company had no visible recycling occurring.

Figure 13: Skip one composition

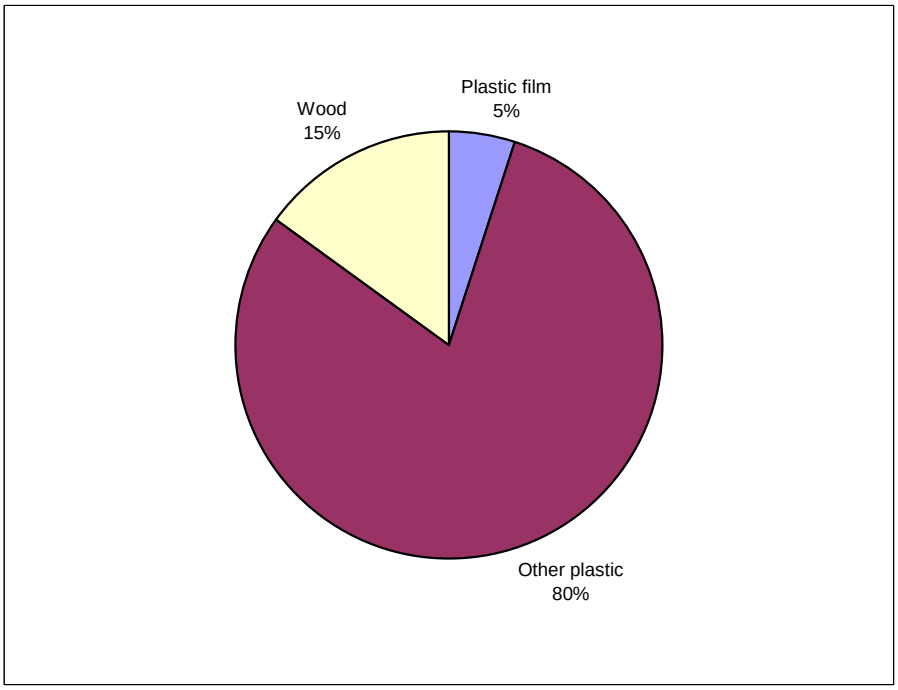


Figure 14: Skip one contents

Skip two came from a specialist printer; the main bulk of this skip was reject cigarette cartons made from cardboard. The company appeared to have good recycling infrastructure in place, and while there may have been some issues with recycling due to the cartons' shiny print finishing, there was also a good deal of corrugated cardboard in this general waste skip. This sample weighed 7.96 tonnes.

Figure 15: Skip two composition

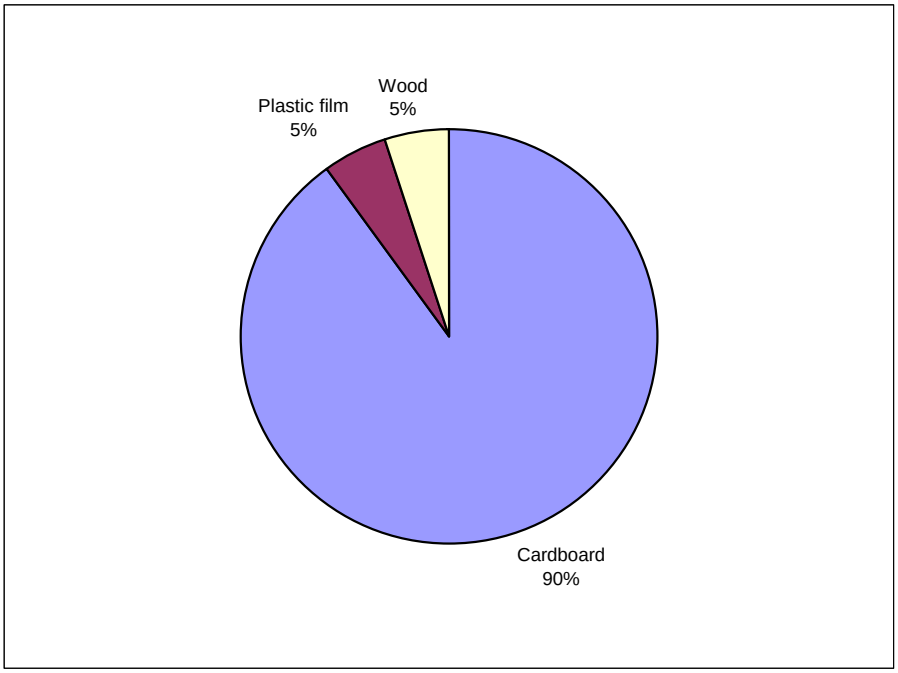


Figure 16: Skip two contents

Skip three come from a specialist waste management company and consisted of autoclaved waste from clinical sources and was highly mixed. The sample weighed 5.23 tonnes.

Figure 17: Skip three composition

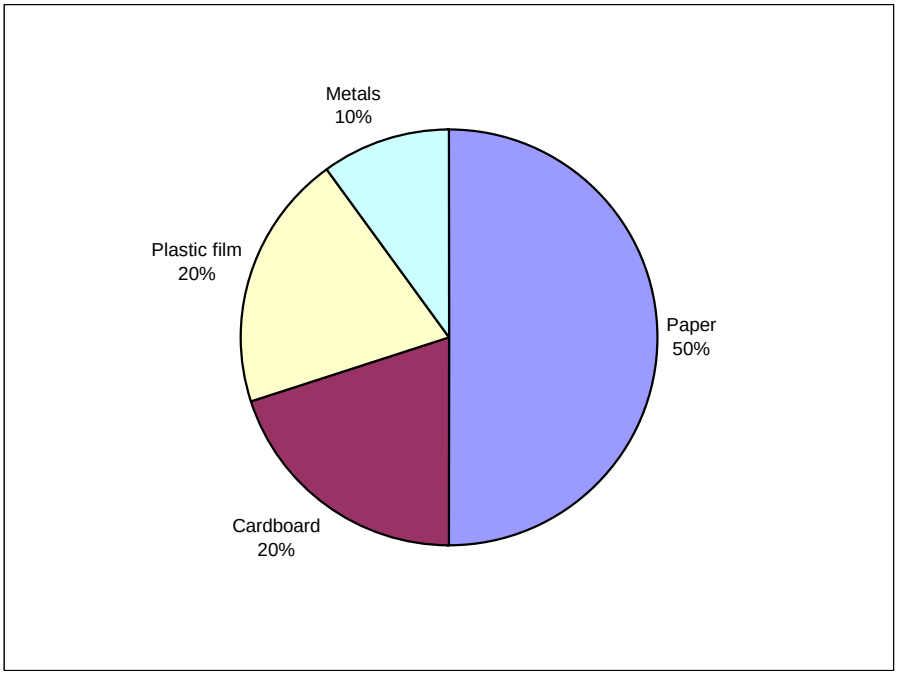


Figure 18: Skip three contents

Skip four was one of the most mixed loads collected from the roll on off samples, this came from a window manufacturer. The majority of the waste was wood. This company also segregated cardboard for recycling but there was still a high percentage of cardboard present in the skips. The weight of the sample was 4.97 tonnes.

Figure 19: Skip four composition

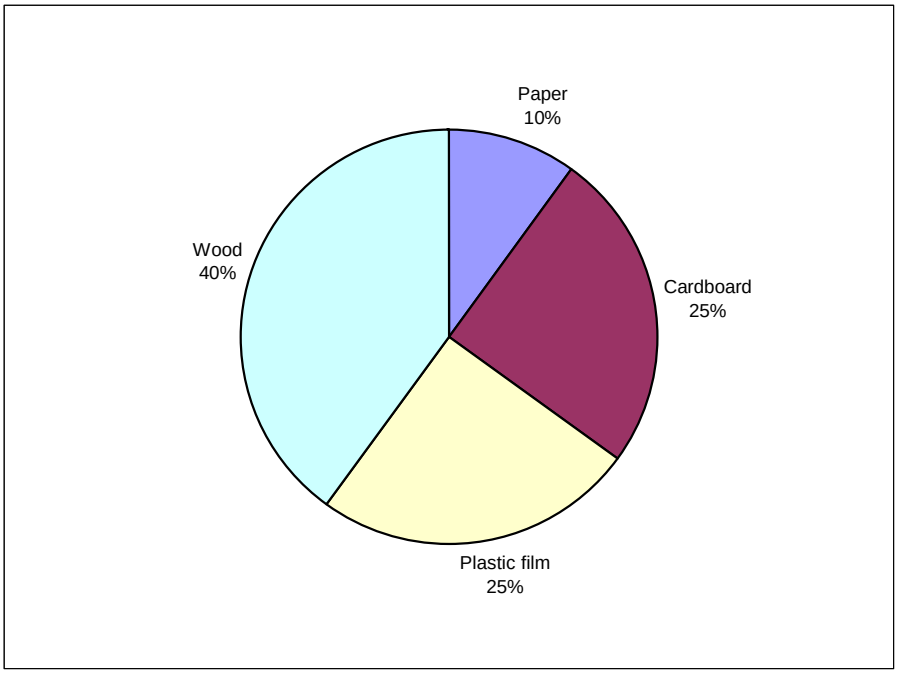


Figure 20: Skip four photograph

Skip five showed the most potential for recycling plastic, it was collected from a company that manufactured plastic components. Although the skip waste was not compacted, some of the general waste had been baled. There was no clear sign of other recycling on site. The waste from this sample weighed 7.65 tonnes. Many of the bales present in this load were already segregated into plastic film as the second photo shows.

Figure 21: Skip five composition

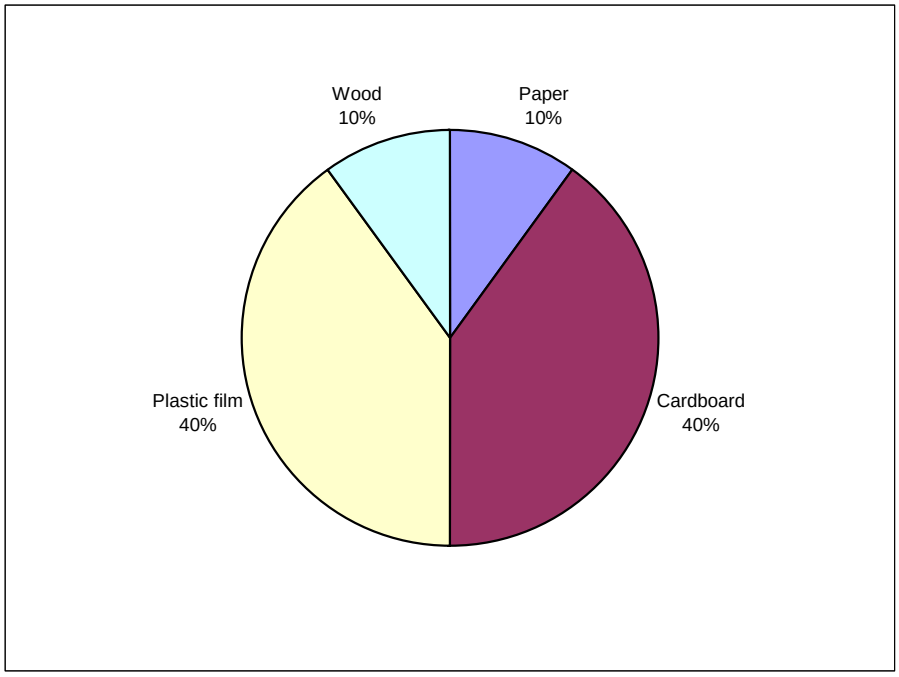


Figure 22: Skip five photographs

Other compositional and operational research

Resource Futures has carried out a number of waste analysis projects involving commercial waste data. In order to protect our clients we cannot provide full details but can summarise some of the data.

Compositional data from inner-city study

This data is taken from a central area of London where a full commercial waste analysis was undertaken by Resource Futures. The commercial samples were split into the same business types as this study and as such provide a useful comparison.

Figure 23: Composition of retail waste in inner-city area

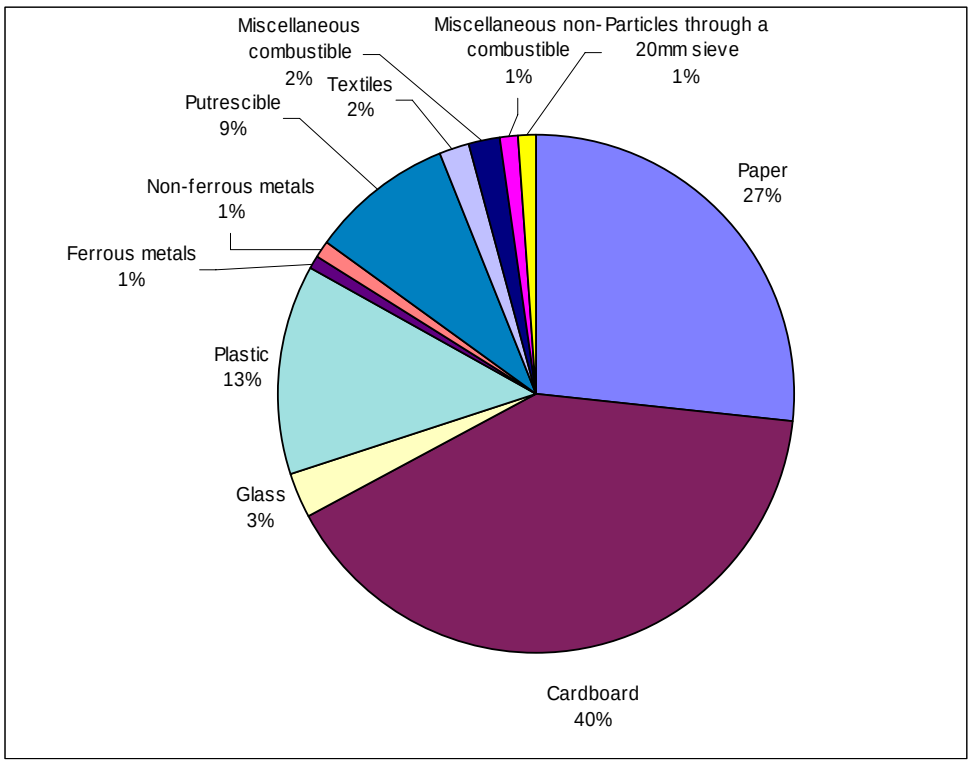


Figure 24: Composition of office waste in inner-city area

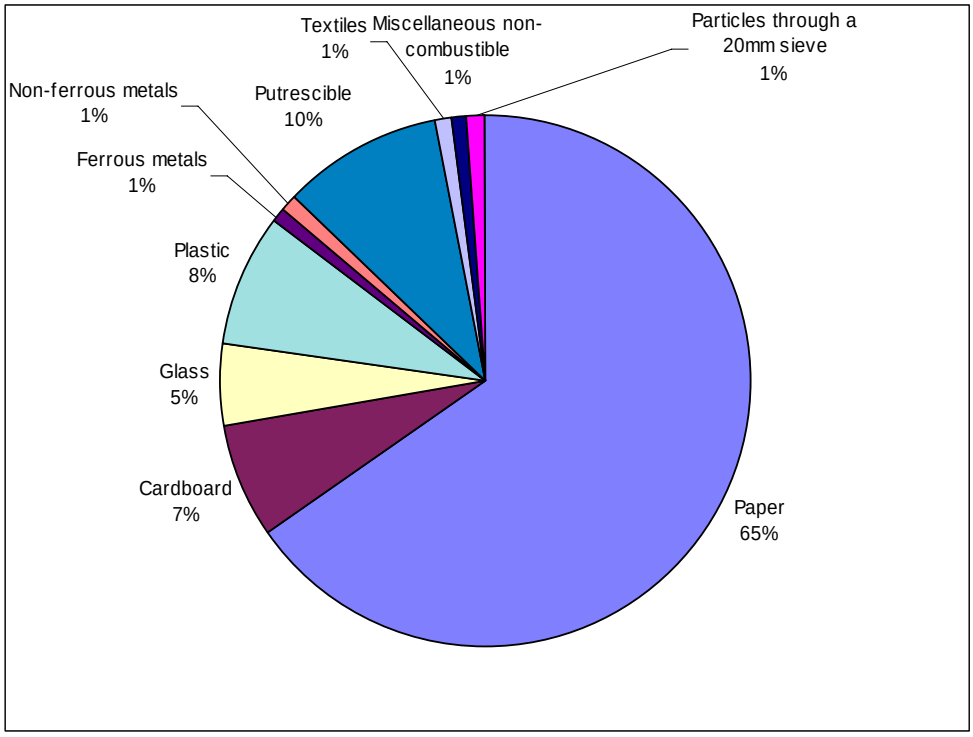
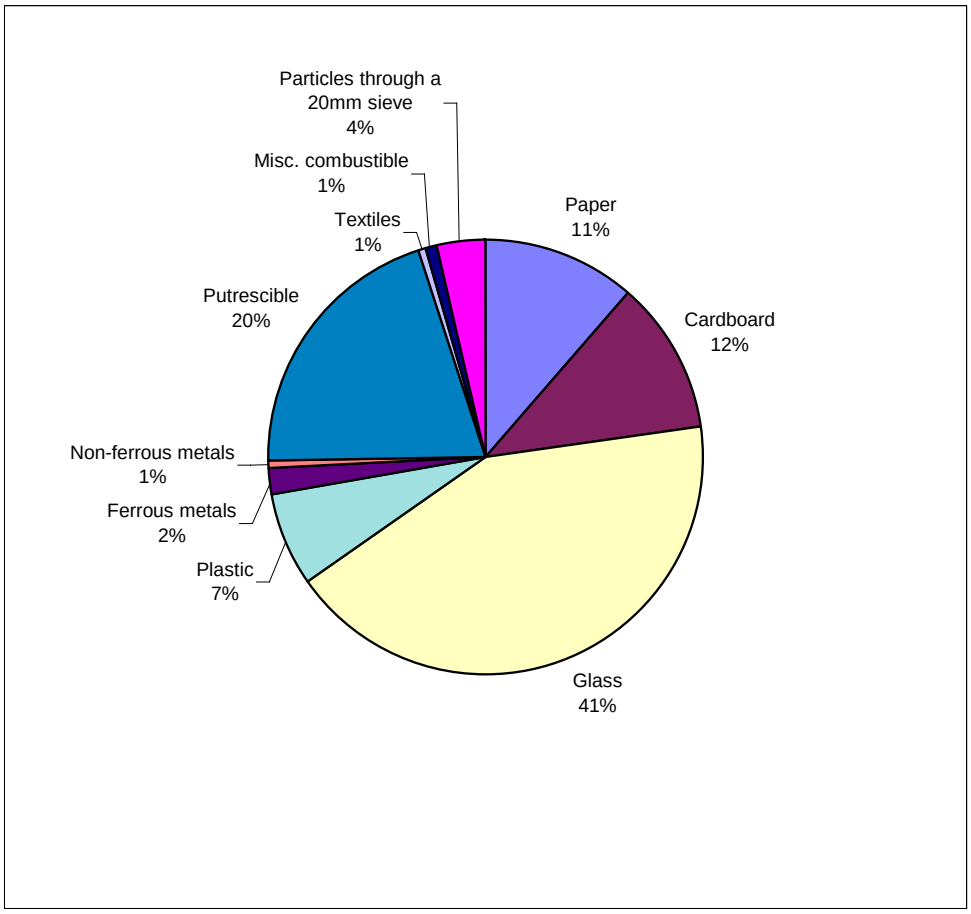


Figure 25 Composition of Hospitality waste in inner-city area



Compositional data from commercial and industrial sector

Resource Futures produced a report for Yorkshire and Humber Assembly entitled "Commercial and Industrial Waste in the Yorkshire and Humber region". The report found that there was limited data on the detailed composition of wastes, the most comprehensive data sets being the Environment Agency's strategic waste management assessment (SWMA). As part of this project Resource Futures carried out audits on the general/mixed wastes stream of various companies. The research focused on the sectors shown in Table 10.

Table 10: Sectors audited in commercial and industrial sector study

SIC code	Description
DA–DE	Manufacturing of food, textiles, leather, wood and paper
DF–DH	Manufacture of chemicals, rubber, plastics and fuels
DJ	Manufacture of metals and metal products
DK–DN	Manufacture of electrical and transport equipment and machinery
E–O	Utilities, construction, retail, hospitality, education, transport and office-based sectors

The report found that cardboard was the most frequently recycled material in all sectors but it was also the biggest contributor in the general waste stream. Plastics recycling activity is limited within the commercial and industrial sector, with larger companies generating significant quantities being the main participants in segregation activity. Waste composition for the different sectors studied is highlighted in Table 11.

Table 11: Summary of report findings

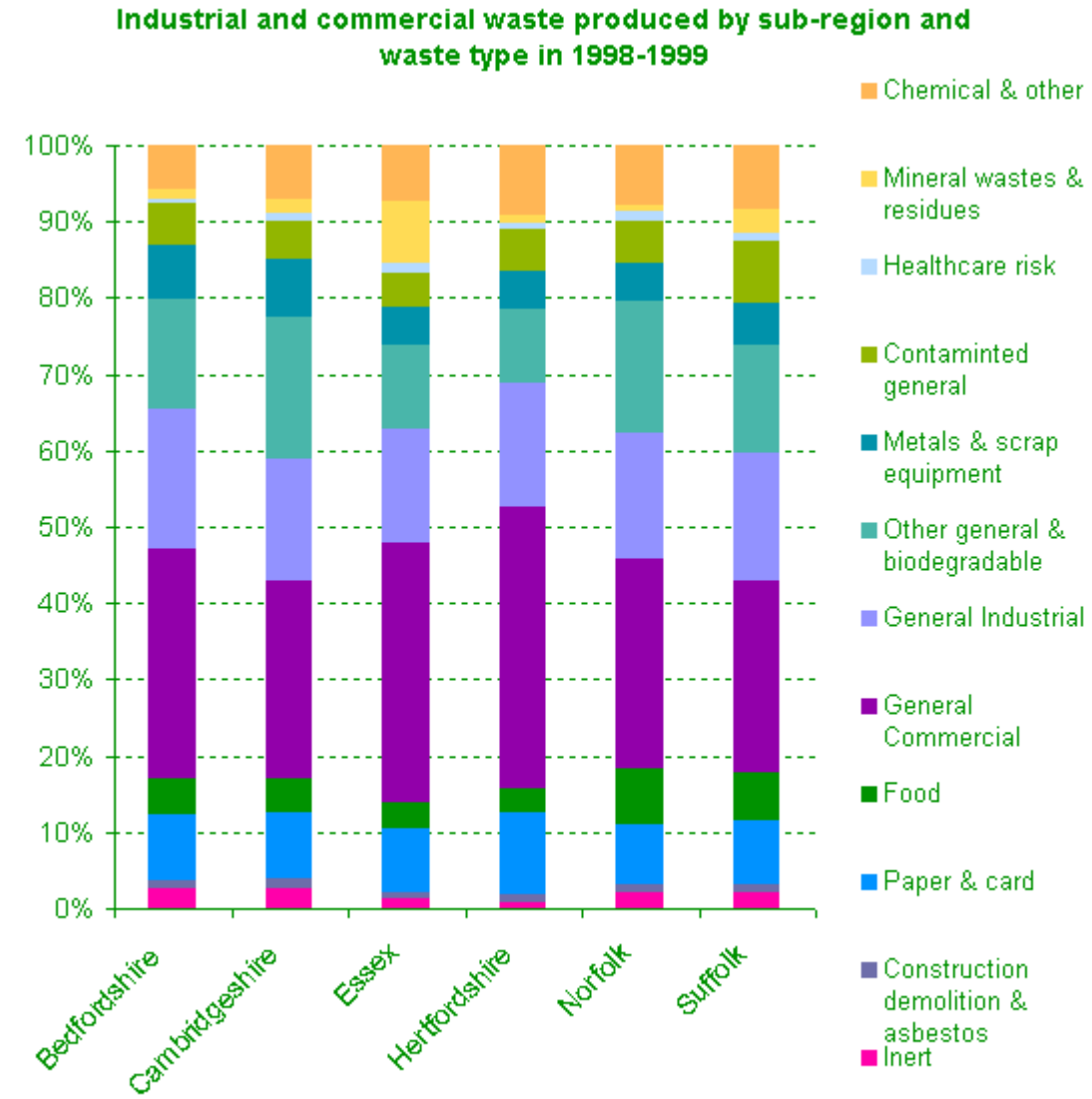
Sector group DA – DE	
Detail of sub-sectors	**Main general waste components**
DA – Manufacture of food products, beverages and tobacco DB – Manufacture of textiles and textile products DC – Manufacture leather and leather products DD – Manufacture of wood and wood products DE – Pulp, paper, and paper products	kitchen non-compostable (19% - 87,992 tonnes) cardboard (17% - 77,924 tonnes) plastic film (15% - 68,486 tonnes) kitchen compostable (10% - 47,300 tonnes) rigid plastics (9% - 41,197 tonnes) other (6% - 26,751 tonnes)
Sector group DF – DH	
Detail of sub-sectors	**Main general waste components**
DF – Manufacture of coke, refined petroleum products and nuclear fuels DG – Manufacture of chemicals and chemical products DH – Manufacture of rubber and plastic products	other (19% - 11,060 tonnes) recyclable paper (17% - 9904 tonnes) compostable paper (13% - 7281 tonnes) rigid plastics (10% - 5649 tonnes) plastic film (8% - 4640) ferrous metals (6% - 4145 tonnes)
Sector group DJ	
Detail of sub-sectors	**Main general waste components**
DJ – Manufacture of basic metals and fabricated metal products	ferrous metals (42% - 50,164 tonnes) other (10% - 12,052 tonnes) recyclable paper (9% - 10,552 tonnes) wood (8% - 9215 tonnes) plastic film (7% - 7769 tonnes) non-recyclable paper (5% - 6229 tonnes)
Sector group DK – DN	
Detail of sub-sectors	**Main general waste components**
DK – Manufacture of machinery and equipment not elsewhere classified DL – Manufacture of electrical and optical equipment DM – Manufacture of transport equipment DN – Manufacturing not elsewhere specified.	recyclable paper (15% - 29,461 tonnes) hazardous waste (12% - 24,482 tonnes) cardboard (11% - 20,481 tonnes) WEEE (10% - 19,253 tonnes) wood (9% - 17,650 tonnes) ferrous metals (8% - 14,947 tonnes)

Sector group E - O	
Detail of sub-sectors	**Main general waste components**
E – Electricity, gas and water supply F – Construction G – Wholesale and retail; repair of motor vehicles, motorcycles and personal household goods H – Hotels and restaurants I – Transport, storage and communication J – Financial intermediation K – Real estate, renting and business activities L – Public administration M – Education N – Health and social work O – Other community, social and personal service activities.	recyclable paper (23% - 196,114 tonnes) cardboard (18% - 150,138 tonnes) glass (10% - 87,548 tonnes) kitchen compostable (9% - 65,717 tonnes) other (7% - 59,975 tonnes) plastic film (5% - 42,210 tonnes)

External research

There have been a number of waste studies focusing on commercial and industrial waste around the country. The Environment Agency carried out a survey of the waste produced by the Industrial and Commercial sector in the East Anglia region. A copy of this graph is presented in Figure 26.[1]

Figure 26: Industrial and commercial waste in East Anglia



Source: Environment Agency

Unfortunately the Environment Agency East Anglia study does not represent plastic as a separate element, but does show paper and card composition of around 10% in each sub region. This is much lower than the findings in this study which suggests an overall combined total of 27.5% for paper and card.

[1] www.environment-agency.gov.uk/commondata/103196/872038?referrer=/regions/anglian/830408/842762/842923/845510/845599/

A more useful data set comes from "A municipal waste in Wiltshire, a compositional study, phase 2 report", December 2005 conducted by MEL Research ltd. In total 60 businesses waste was fully analysed across Wiltshire. The waste was sampled from each district councils trade waste service and included the following business types – education, health, retail, offices, public, food, leisure and other.

Table 12 highlights the composition in each of the districts plus the average percentage,

Table 12: Trade waste composition in Wiltshire (%)

	Kennet	North Wiltshire	Salisbury	West Wiltshire	Average
Paper and Card	47.5	33.2	30.5	32.6	33.1
Plastic film	7.8	6	6.4	7.6	6.9
Dense plastic	7.7	4.1	12.2	5.9	7
Textiles	0.7	5.1	0.9	1.1	2.5
Misc. combustible	2.6	1	14.7	0.3	3.7
Misc. non-combustible	1.7	1.3	3.1	0.1	1.2
Glass	2.4	8.4	6.4	9.3	8
Ferrous metal	8.7	7	1.9	4	4.7
Non-ferrous metal	0.7	0.7	0.5	0.5	0.6
Putrescibles	15	30.6	21.2	38	30.4
Fines	2.8	2.4	2.1	0.6	1.7
WEEE	0.9	0.2	0.1	0	0.1
Hazardous	0.5	0.1	0	0	0.1

Comparison of data

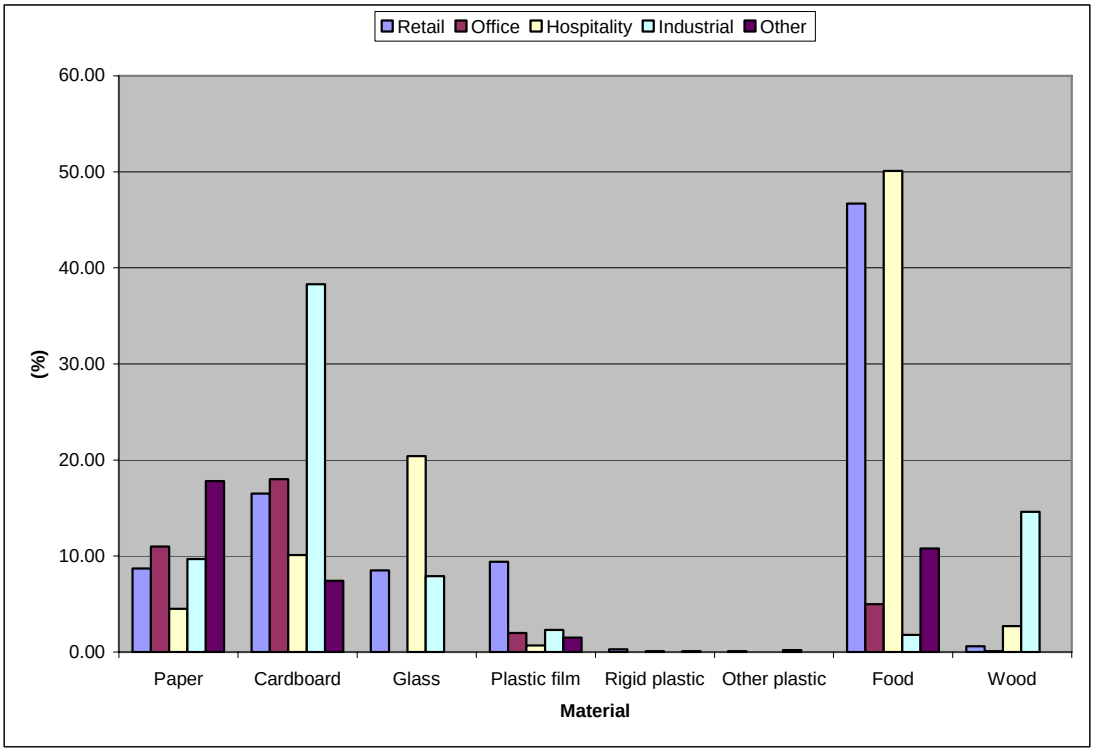
The data collected in this study can be compared with those from the other studies to provide a range of results for various commercial and industrial sectors. This section also provides a comparison between the basic business types used in the study.

Comparison between business types

A comparison of data collected in this study has been made on selected materials in the Figure 27. This excludes materials that have low percentage weights such as metals and the "other" and "unknown" categories.

The data shows that paper and cardboard are major constituents in all business types; cardboard was particularly prevalent in the industrial business types. In terms of plastic film retail had the highest percentage and was much higher than all the other sectors. Larger retail chains clearly had recycling infrastructure in place for plastic film, but still had large amounts of film present in their general waste. Due to the nature of businesses, food waste made up large proportions of waste for retail and hospitality business types. This gives an indication of what sectors could be targeted with campaigns, waste minimisation support and recycling services.

Figure 27: Comparison of waste composition between business types



Comparison between different studies

The results of this study can also be compared with the other studies which represent general trade waste collections. Table 13 highlights the difference between this study, the data from Wiltshire (Table 12) and the data from the "Commercial and Industrial Waste in the Yorkshire and Humber region" (entitled Y&H study in Table 11). The average of the data across all industry groups from this study was used..

Table 13: Comparison between different studies

Material	RAY	Y&H study	Wiltshire study
Paper	9.4	12.16	33.1
Cardboard	18.1	18.4	
Glass	7.3	0.03	8
Plastic film	6.8	16.57	6.9
Rigid plastics	0.6	0	
Other plastic	0.8	9.85	
Metals	0.1	3.29	5.3
Food	29.7	33.4	30.4
Hazardous	0.2	0.92	0.1
Wood	4	0.31	
Green Waste	2.2	0	
Unknown/Other	20.9	5.07	16.2

The data shows some variance in terms of paper and cardboard composition (the Wiltshire study had combined figures for paper and cardboard), with combined figures ranging from 27.5% to 33.1%.

The Y&H study and this study produced similar estimates of composition for paper and cardboard. The Y&H study showed a much lower average composition for glass; however this is due to the large amount of data from the industrial manufacturing sectors in this study, which have less glass present in its waste. This study and the Wiltshire study show similarities between glass composition in trade waste.

The Yorkshire and Humber study showed a much higher percentage of plastic film; again this may be due to the focus on manufacturing and industrial producers. Food waste proved similar between all three studies.

As there are a number of similarities and differences we feel that this study provides a good estimate of composition compared to other studies. Differences may be due to differences in sample type etc but there may also be other factors such as container type, socio-economic factors and regional differences. Regional differences such as make up of industry may play a role in this.

Projection of results

In consultation with RAY, it was decided to focus data projection on providing practical assessment of the potential for improving material recycling. Therefore, data was projected onto a typical collection round, assessing how many bins of plastic film and other materials would be required to operate a day's collection. This does not take into account other factors that may influence feasibility of plastics collection recycling customers, which are discussed practical issues and economics Sections of this report.

It should also be noted that even in similar types of businesses, waste composition varied and so this data is provided as an indication rather than an absolute guide. The projections will assist RAY and its partners to understand the potential of collection and some potential barriers.

The situation will also be slightly different for larger producers using roll on-roll off skips and this is discussed in a separate section.

All sections use the conversion factors highlighted in Table 6.

Retail businesses

This section projects differing weights per general waste bin based on the data collected at retail premises. Retail premises had the biggest range of bins present due to the varying sizes of company. Bins emptied during the sampling ranged from a 90-litre trade sack to a 16 cubic yard skip at the larger retail premises. Table 14 highlights the projected average weights of each material in each type of bin at retail premises.

Table 14: Projected weight of material in retail bins (kg)

Material	Trade sack	360-litre	660-litre	1100-litre	6cu yd	8 cu yd	10 cu yd	12 cu yd	16 cu yd
Paper	0.43	1.72	3.16	5.26	21.96	29.28	36.61	43.88	58.52
Cardboard	0.56	2.23	4.08	6.81	28.40	37.87	47.33	56.74	75.67
Glass	1.01	4.05	7.43	12.39	51.69	68.93	86.16	103.28	137.74
Plastic film	0.15	0.61	1.12	1.86	7.77	10.36	12.94	15.52	20.69
Rigid plastic	0.01	0.02	0.04	0.07	0.30	0.40	0.50	0.61	0.81
Other plastics	0.00	0.01	0.01	0.02	0.09	0.12	0.15	0.18	0.24
Food	5.57	22.28	40.84	68.07	284.02	378.69	473.36	567.42	756.76
Wood	0.06	0.23	0.42	0.69	2.89	3.86	4.82	5.78	7.70
Green waste	0.13	0.51	0.94	1.57	6.56	8.75	10.94	13.11	17.49
Other/Unknown	0.47	1.89	3.47	5.78	24.10	32.13	40.16	48.14	64.21
Total	**8.39**	**33.55**	**61.51**	**102.52**	**427.79**	**570.39**	**712.98**	**854.65**	**1139.84**

Office businesses

Office waste projections were based on data collected at the various offices audited during the study. Offices tended to have smaller bins, mainly due to space and visual issues. Bins ranged from trade sacks to an 8 cubic yard skip.

Table 15: Projected weight of material in office bins (kg)

Material	Trade sack	360-litre	660-litre	1100-litre	8 cu yd
Paper	0.54	2.18	3.99	6.66	37.03
Cardboard	0.61	2.43	4.46	7.43	41.31
Plastic film	0.03	0.13	0.24	0.40	2.20
Food	0.60	2.39	4.37	7.29	40.55
Wood	0.47	1.89	3.47	5.78	32.13
Green waste	0.01	0.02	0.04	0.07	0.40
Other/Unknown	3.98	15.93	29.21	48.68	270.81
Total	**6.24**	**24.97**	**45.77**	**76.29**	**424.42**

Hospitality businesses

Hospitality waste projections were based on data collected at the various different restaurants, bars and leisure complexes (eg cinemas) audited during the study. Hospitality businesses tended to have smaller bins mainly due to space and visual issues. Bins ranged from trade sacks up to 10 cubic yard skips.

Table 16: Projected weight of material in hospitality bins (kg)

Material	Trade sack	360-litre	660-litre	1100-litre	6cu yd	8 cu yd	10 cu yd
Paper	0.22	0.89	1.63	2.72	11.36	15.15	18.93
Cardboard	0.35	1.39	2.55	4.25	17.73	23.64	29.55
Glass	2.48	9.92	18.19	30.32	126.50	168.67	210.83
Plastic film	0.01	0.05	0.10	0.16	0.66	0.88	1.10
Rigid plastic	0.00	0.01	0.01	0.02	0.10	0.13	0.17
Other plastics	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food	6.20	24.80	45.47	75.79	316.25	421.67	527.09
Wood	0.26	1.06	1.94	3.23	13.49	17.99	22.49
Hazardous	0.10	0.40	0.73	1.22	5.07	6.76	8.45
Other/Unknown	0.49	1.94	3.56	5.94	24.79	33.05	41.31
Total	**10.12**	**40.47**	**74.19**	**123.65**	**515.96**	**687.94**	**859.93**

Industrial businesses

Industrial waste projections were based on data collected at a variety of different industrial premises audited during the study. Industrial premises tended to have larger bins ranging from 660 litre to 16 cu Yd.

Table 17: Projected weight of material in Industrial bins (kg)

Material	660-litre	1100-litre	6cu yd	8 cu yd	10 cu yd	12 cu yd	16 cu yd
Paper	3.52	5.87	24.49	32.65	40.81	48.92	65.25
Cardboard	9.48	15.80	65.92	87.90	109.87	131.70	175.65
Glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plastic film	0.94	1.56	6.53	8.70	10.88	13.04	17.39
Rigid plastic	0.33	0.56	2.32	3.10	3.87	4.64	6.19
Other plastics	0.03	0.04	0.18	0.24	0.31	0.37	0.49
Metals	0.31	0.52	2.18	2.91	3.64	4.36	5.82
Food	1.57	2.62	10.95	14.60	18.25	21.87	29.17
Wood	10.12	16.86	70.36	93.82	117.27	140.58	187.49
Green waste	3.17	5.29	22.08	29.44	36.80	44.11	58.83
Other/Unknown	8.37	13.94	58.18	77.57	96.96	116.23	155.02
Total	**37.85**	**63.08**	**263.20**	**350.93**	**438.66**	**525.82**	**701.29**

Other businesses

The types of premises covered in this category are highlighted in the Results Section. Bin sizes in this business type varied between 360-litre bins to 16 cu yd skips.

Table 18: Projected weight of material in Other bins (kg)

Material	360-litre	660-litre	1100-litre	6cu yd	8 cu yd	10 cu yd	12 cu yd	16 cu yd
Paper	3.52	6.46	10.77	44.94	59.91	74.89	89.77	119.73
Cardboard	1.00	1.83	3.05	12.74	16.98	21.23	25.45	33.94
Glass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Plastic film	0.10	0.18	0.30	1.24	1.65	2.07	2.48	3.30
Rigid plastic	0.01	0.01	0.02	0.10	0.13	0.17	0.20	0.27
Other plastics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Metals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Food	5.15	9.44	15.74	65.68	87.58	109.47	131.22	175.01
Wood	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Green waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other/Unknown	16.85	30.89	51.48	214.81	286.42	358.02	429.16	572.36
Total	**26.63**	**48.82**	**81.36**	**339.51**	**452.68**	**565.85**	**678.28**	**904.62**

Operational implications

The figures represented in the last five Sections (Tables 14-18) present the amount of waste present in individual bins. In order to assess the operational feasibility of plastic recycling it is useful to know how much plastic could be collected during a vehicle and crew's average working day.

The first data to examine is the projected weights from samples one, four and five. This is because two of these samples have been reality checked in Table 7.

The potential amount of plastics collected is highlighted in Table 19.

Table 19: Projected weights from samples one, four and five

Material	Weight (kg)
Paper	1536
Cardboard	2966
Glass	1193
Plastic film	1118
Plastic rigid	100
Plastic other	124
Metal	22
Food	4870
Hazardous	32
Wood	662
Green Waste	368
Unknown/Other	3433
Total	16,426

This data suggests just over one tonne of plastics was collected over the three days. This equates to a collection from a total of 147 bins. However, readily recyclable materials such as cardboard and paper were present in much greater quantities than plastic with food waste present in the largest quantities.

Table 20 represents potential weights of various size bins if they were designated as plastic film recycling bins. The table also shows that differing business types will yield differing amounts of plastic.

Table 20: Projected weights (kg) from samples one, four and five (plastic film only)

Business Type	Trade sack	360	660	1100	6cu yd	8 cu yd	10 cu yd	12 cu yd	16 cu yd
Retail	0.15	0.61	1.12	1.86	7.77	10.36	12.94	15.52	20.69
Office	0.03	0.13	0.24	0.4		2.2			
Hospitality	0.01	0.05	0.1	0.16	0.66	0.88	1.1		
Industrial			0.94	1.56	6.53	8.7	10.88	13.04	17.39
Other		0.1	0.18	0.3	1.24	1.65	2.07	2.48	3.3

This suggests that retail has the most potential but a company using one 16 cu yd skip may only produce 20.69kg of plastic film during every emptying period (which is usually a week in this instance). Alternatively a retailer with 4x1100 litre bins emptied once per week would produce an estimated 7.44kg of plastic film per week. In volumetric terms this would equate to a non-compacted volume of 414 litres. Clearly the limiting factor for any commercial plastics collections utilising these sizes of bins is volume, rather than weight, for the collecting company and storage area for the waste producer.

The data from previous Sections (Tables 14-18) can be used to determine how many equivalent residual bins a commercial waste contractor would require to extract 1 tonne of plastic film compared with other materials. This is represented in Table 21, which shows how many 1100 litre bins would be required to collect one tonne of various materials, This would rely on 100% segregation which is not always practical and does not take into account different plastic film types.

Table 21: Number of 1100 litre bins equivalent required to collect 1 tonne of each recyclate

Business type	Plastic film	Cardboard	Paper and cardboard combined	Glass
Retail	537	147	83	
Office	2525	135	71	
Hospitality	6250	235	143	33
Industrial	639	63	46	
Other	3367	328	72	

This data provides an indication of how many customers any commercial company would need to target to obtain the same weight of different materials. The data shows that the ratio of residual bins to one tonne of material is much higher for plastic film and this is clearly less attractive for a commercial organisation.

This data would also suggest targeting retail would be the most economic for the collection of plastic film. However, this data does not take size of business into account.

Roll on off projections

Roll on off projections are based on collections of larger containers and assume that they are 100% full of plastic film. Table 22 shows how many roll on off skips would be required to collect one tonne of various materials, This would rely on 100% segregation which is not always practical and does not take into account different plastic film types.

Table 22: Number of roll on off skips required to collect 1 tonne of each recyclate (non-compacted)

Volume/size of skip (m^3)	Plastics number of skips	Cardboard number of skips
22.94	2.42	1.16
26.76	2.08	1.00
30.58	1.82	0.87

Clearly, weight in these skips is very low for both materials and in practice either a baler or compactor would be used to increase the weight to a reasonable level. Figures for compaction rates vary enormously. Figures quoted by manufacturing websites suggest a volume reduction of 90%. However, this is often “theoretical” and is based on best-case scenario for the equipment. We would suggest that a figure of 70% for plastic film is more realistic and 50% for cardboard.

The other option would be to collect from companies that had or were supplied with balers. The bales are then emptied into the skip and collected. Using a compactor and/or baler would obviously be the most environmentally and economically effective model for waste producer and collector, after the initial investment has been made.

Practical issues

It is obvious that plastic film recycling presents many practical issues to overcome for both the collector and the producer. Table 23 represents the factors involved in the waste chain that would encourage plastics recycling.

Table 23: Factors supporting material recycling

Producer factors	Collector factors
• material can be easily segregated • space is available for storage of material • the cost of recycling is cheaper than the cost of disposal • good quality collection service eg reliable, good quality containers and customer service. • landfill tax increases will raise uplift costs for general waste by 20% from April 2008	• collection round is profitable • contamination level is low • container/material can be collected on a weekly basis/fortnightly is worse case scenario • stable regional end markets • no further segregation is required • the collector has the opportunity to deal with both waste and recyclables from each customer

The data collected indicate that there are a number of critical barriers to overcome in terms of plastic film recycling.

Cost is obviously a major issue for the producer. Where sufficient material is available, a recycling service can offer potential cost savings, and these savings will become even more apparent when the landfill tax escalator rises to £8/tonne per year from April 2008.

Producers may still be discouraged by the requirement to segregate materials. Any successful scheme must be kept simple either by collecting a clearly identifiable material or by collecting a mixture of materials and sorting them post collection at the transfer stage in the waste management process.

The producer must have space for containers and/or storage. This could be addressed by working with container manufacturers and collection companies to provide appropriate bin sizes. Also, encouraging collectors to offer a fully integrated service so that as producers recycle more waste their residual waste bin container size/number are reduced could make recycling more appealing. City centre locations could benefit from a recycling co-ordinator who could help companies share recycling bins.

Segregation is also an issue, perceived as being a “hassle” when companies are required to segregate several polymer types. This is evidenced by a number of LREs unwilling to recycle mixed glass. These issues are exacerbated in inner-city areas where there is a lack of space for storage and additional bins. However, the increasing cost of waste disposal may overcome this barrier particularly in relation to the increased landfill tax escalator from April 2008.

Smaller producers may not generate enough plastic to warrant a weekly collection and so the collection company must potentially invest in expensive containers that only require collection every month or less. A bag collection may be a potential solution for small producers but this may not be economic for the collection company. Plastic film is also difficult to empty from bins and skips; lighter waste often becomes trapped in the bin and requires additional assistance to ensure it is loaded into the RCV. A small-scale operational pilot may be an option to overcome some of these issues.

Larger producers tend to have more space and could produce quantities of mixed plastic film waste but the largest retailers utilising 16 cu yd skips will only produce 20 kg of plastic per week.

Extremely large producers are likely to be either obligated under the Packaging Regulations or already have a baler/compactor system in place for plastics.

National retail chains also tend to back haul recyclables including plastic and this was evident during the audits. Although plastic and cardboard was present in residual waste containers where producers had recycling in place, they still tended to back haul plastics/cardboard or use a local contractor for waste collection and a national contract for collection of recyclables.

In addition, visual observation on collection rounds indicated that collecting low density materials can be problematic for collection crews as materials are more difficult to tip from skips and may require repeated operation of on vehicle compaction equipment. Perhaps one solution is to investigate a unique way of collecting this material eg. In compactable bags.

The practical issues highlight that there are many barriers to plastic film recycling. However, increased plastic recycling could be viable if certain conditions where met which would include:

- a carefully designed collection system with appropriate containers and vehicles
- provision of support to encourage larger producers to bale and segregate plastic waste
- provision of co-ordination to help waste producers share services and bins
- provision of infrastructure to encourage mixed stream collections and post producer segregation
- Increased awareness for business managers to ensure materials are segregated for recycling

It is also clear from the audits carried out that there is a great deal of potential for additional cardboard to be recycled.

There are some options for plastics recycling that RAY may wish to consider and these are discussed in the Recommendations and conclusions.

Economics of collection

This section deals with the potential income/costs of operating a plastic collection and supports the conclusions and recommendations for this report.

Practical end markets and income

A total of twenty three plastic reprocessors were contacted from a database of contacts provided by RAY. Of these contacts, nine reprocessors were available to be interviewed. The companies were asked a number of questions regarding their capability to reprocess mixed plastic film.

Recycling of mixed film

Four out of the nine companies offered plastic film recycling. One company would not actually recycle the film; they would use a number of technologies to sort the film into different polymer types (LDPE and PVC) and colours. This processing would result in 3 grades of plastic film for the company to sell onto reprocessors. This company was therefore more willing to take mixed colours and polymers.

The other three companies were all keen to reprocess clean natural (clear) LDPE film. As different colours are introduced the value of the material drops and they feel recycling it becomes less worthwhile. One company was used to accepting mixed colours as they currently regrind and pigment it black for their end products.

Mixed polymer types cause all of the reprocessors problems as it damages the end materials' physical properties, and this has to be compensated for by adding additives. This adds to expense and also creates problems as the additives are toxic. One company suggested if the waste contains more than 2% of non-LDPE polymers it is better to sort the material prior to reprocessing, rather than trying to compensate afterwards using additives. The only company spoken to with the facilities to sort film in this manner is the company discussed in the first paragraph of this section. One company stated it would only accept LDPE film. A full list of firms contacted is provided in Table 24.

Table 24: List of reprocessors providing data for project

Company	Activity	Location
Alternative Waste Solutions	Reprocessor	Lincolnshire
Buzz Recycling	Reprocessor	Barnsley
C.Plumb & Sons (Hatfield) Limited	Reprocessor	Doncaster
Cargo Loops Ltd	Reprocessor	Doncaster
Centriforce	Reprocessor	Merseyside
Denroyd Ltd	Reprocessor	Halifax
Derek Lambert Polythene Ltd	Trader	Bingley
Econoplas Ltd	Manufacturer	Scarborough
Ecoplas Ltd	Reprocessor	Selby
Ezikerb	Manufacturer	Wakefield
G & H Plastics Ltd	Trader	-
Glenpac Ltd	Reprocessor and trader	Leeds
Intruplas Limited	Reprocessor and trader	Sheffield
JFC Plastics	Reprocessor	Merseyside
JKN Polymers	Reprocessor	Hull
Linpac Plastics Recycling	Reprocessor and trader	Castleford
Luxus Ltd	Reprocessor	Louth, Lincs
M & B Haulage Waste Paper Co Ltd	Reprocessor and exporter	Dewsbury
Mirus Plastics	Reprocessor	Halifax
Monoworld Limited	Reprocessor and trader	Whitley
Moorhall Plastics ltd	Trader and exporter	-
Monoplas/Plasrock Group Ltd	Reprocessor and trader	Halifax
Plastic Trading Ltd	Trader	-
Rainbow	Manufacturer	Hull
Styrene Packaging and Insulation Ltd	Manufacturer	Bradford
Vencel Resil Limited	Reprocessor	Goole

Collection/delivery of film

Three of the companies would collect baled and palletised material with a delivery charge. One reprocessor did not own any vehicles, but would consider renting if a contract required it. Minimum quantities for them to collect ranged from 5 to 20 tonnes, with no time limit on collection frequency. Minimum quantities for customers to deliver baled material to them range from 400kg to 1 tonne. Typically a bale weighs between 200 and 400kg. Two of the reprocessors would consider accepting the material straight from the back of an RCV, but at a

cost to ensure this was economical to them. Wherever bales of material were being moved a pallet lifter or bale clamps would be required.

Contamination

Most of the reprocessors stated no set acceptable levels, and said it would depend upon on them seeing it. One reprocessor which only recycles LDPE film specified that 1 to 2% PP is acceptable, as well as paper labels. Other contaminants, typically including different polymers, strapping, plastic trays and cardboard can render the material unusable.

Potential income

Most of reprocessors would not provide a price without first seeing the plastic on offer, knowing where the material came from and a full specification of what the contract would involve. Prices are therefore approximate figures. Prices typically ranged from £0 for mixed colours or polymers to £300 per tonne for natural LDPE. The most accurate figures were available from the company who sort the film into three grades. Based upon 200-tonne baled loads, with no contamination, delivered to them they would pay from £140 to £250 per tonne dependent of the proportion of LDPE as follows:

- 100% natural clear LDPE - £250 per tonne
- 95% natural clear LDPE - £200 per tonne (the company felt this would be the typical composition for the film generated in a corner shop)
- 60% natural clear LDPE - £155 per tonne
- 50% natural clear LDPE - £140 per tonne.

Reprocessors will pay higher prices for the following:

- segregated polymer type – LDPE demands the highest prices
- segregated colour – natural (clear) colour demands the highest prices. Limiting the amount of black film in mixed colour film can also increase prices.
- limiting contamination
- delivering large quantities to them baled.

Other materials

Four companies can reprocess expanded polystyrene (EPS). One company only accepted EPS if it was in briquette form to remove the air. Another company, which is primarily a manufacturer, will collect a lorry load of white, clean EPS, with no labels for free. They offer no payment for the material. If there is any contamination whatsoever they will not collect the load. Typically the company requires the EPS to be on a pallet and shrink wrapped. Two of the other companies did not have prices available for EPS. One recycles EPS as extracted from inside refrigerators. They pay £350 per tonne for this material.

Two companies can potentially reprocess blue foam, although neither has reprocessed this material yet.

Projection of collection costs

Collection costs can be broken down into three separate elements:

- basic collection costs – costs of operating a vehicle including fuel, lease and staff costs
- Transfer, segregation and bulking costs – costs depend on the level to which a collection company would need to segregate, bulk and store plastic before it is passed onto a reprocessor.

The costs in this section are not comprehensive but are aimed to provide an estimate of costs to help inform RAY. For example they do not include developmental costs or the costs for new bins etc.

Basic collection costs

Basic collection costs are based on a daily cost for each element of the collection. The data contained within the report is based on figures used within the original proposal for the cardboard and glass project. Table 25 represents these costs. These relate to operating a mixed round of wheeled bins and skips.

This figure excludes smaller items such as PPE, staff bonuses and deprecation therefore this estimate should be viewed as a best case scenario.

The cost of operation for a roll on off skip are slightly cheaper and work out at approximately £250 per day.

Table 25: Basic collection costs

Item	Average daily cost (£)
Vehicle running costs	92.88
Driver	62.47
Collection operative	36.16
Operational management	16.68
Fuel	55.00
Total	**263.19**

Bulking costs

These costs are much harder to determine even as an estimate. These figures will also depend on types of material and the reprocessor market and the relative amounts collected. Table 8.3 represents these basic transfer costs based on requiring one member of staff and a baler. This excludes costs for leasing extra land/buildings and bulk transport costs.

Table 26: Basic bulking costs

Item	Average daily cost (£)
Baler	41.10
Segregation and baling staff	36.16
Operational management	16.68
Total	**93.94**

These costs are again indicative but demonstrate the extra potential costs for collecting plastic. 3b Waste Solutions operation does not incur these costs as part of its current recycling activities for cardboard and glass. These costs would be lower for another commercial company with an already established transfer station that could accommodate additional machinery and storage space. The additional costs highlighted in Table 26 would also be incurred by Roll on-off operations as most reprocessors require plastic to be delivered in a baled form.

Costs to the producer

It can be seen that the cost of collection at £263 per day and the additional cost of bulking at transfer site would cost £94 per day will add a considerable amount to the costs. If materials were bulked up at a transfer site prior to being sent to a reprocessor it would add an extra 26% to the costs which will be reflected in the collection costs to the producer. The costs highlighted in Tables 25 and 26 represent basic costs including revenue and capital costs, but do not include a management overhead and all of the basic day to day operational costs. The tables do not provide a detailed costing and this does not include depreciation.

Collection of mixed plastics is likely to provide very little income based on information retrieved from reprocessors therefore no income can be used to off set the costs of collection/bulking. If polymers are segregated at the transfer stage additional costs will be incurred to pay for machinery and staff to segregate. These additional costs would also be incurred by a roll on-off customer because the material would still need to be bulked up before transfer.

As can be seen by the current commercial market place at present there are very few commercial collections of plastic film that do not involve the producer baling or compacting the material and the material being collected by the reprocessor.

Final comments on costs

Although the costs of operating a typical 3-axle RCV remain static regardless of material collected the costs of bulking are dramatically increased for plastic film as opposed to cardboard and glass. Based on the basic costs highlighted in this section plastic collection may still be cheaper than general waste collection as this incurs a disposal cost at landfill. This is providing a full and efficient round could be developed. Therefore it could be feasible for plastic to be collected in the same price range as residual waste providing investment in bulking and segregation was available.

Recommendations and conclusions

At present the opportunities for increasing plastic recycling are limited due to several barriers and issues mentioned in the report, including:

- Smaller producers will be paying for collection and the costs for the collection contractor to bale and bulk the material for transport to the reprocessor. The current costs of collecting and recycling plastic film, compared with the costs of simply sending it for waste disposal, will discourage recycling and the "hassle" factor for the producer in terms of segregating the waste will also be a major disincentive.
- Companies that produce large amounts of plastic waste are already likely to have their own baler and sell direct to the reprocessors, who prefer large baled deliveries or will collect in this format.
- Reprocessors are very wary of contamination and this presents a risk to the collector who may be left with material that they have to landfill or re-segregate.
- Reprocessors require large amounts of mixed plastic in order to accept mixed material and this presents a considerable risk in terms of capital investment for the commercial collector.
- Waste producers' staff need educating in improving segregation of recycling from waste.
- Where companies are not recycling cardboard/paper/glass they should be encouraged to recycle these materials through promotion to demonstrate cost savings.
- The other main cost driver for commercial collectors is the cost of disposal for general waste. If a commercial collector offers glass collection and general refuse services to a waste producer then it reduces the weight in the residual bin considerably. The volume in the residual bin is reduced by a smaller amount; therefore the collector saves on disposal costs and landfill tax, but is still required to provide a high level of service for residual waste, with a relatively small impact on revenue streams. Conversely a commercial collector offering plastic and residual services to a producer will experience a negative benefit to their business. They will reduce the volume in the residual bins considerably, but will not make a saving on the disposal costs, and will have to invest in plastics bulking equipment. This study indicates that this is a major barrier to development of commercial plastics collections.

The increased landfill tax costs from 2008 may have an impact on some producers. The barriers outlined above are not insurmountable and removing a high volume material from the residual waste stream could allow waste producers to reduce residual waste capacity, with associated cost savings. Clean segregated plastic film also has a high financial value which may provide incentives for collection schemes under the right conditions.

There are four main areas where RAY could provide support to facilitate increased plastics recycling,

AREA 1: Waste producers with small amounts of plastic

It would appear from the study that a high number of SMEs are producing relatively small amounts of plastic. It would not be prudent for these companies to invest in a baler/compactor due to the relatively low volumes of material. The small volumes do not make it attractive for commercial collections as yet. RAY could consider introducing pilot collections for small-scale producers to determine the best methods for collecting from such producers. Carrying out a small pilot would further test the market to see if, and under what conditions, collections could be financially feasible for both the producer and the collector.

AREA 2: Medium-sized producers of waste plastic

This is perhaps the hardest group of companies to define; they may be large companies that almost produce enough plastic to warrant a baler but cannot justify the investment due to other commitments. This group of companies warrants further intervention from RAY and

could yield the most positive results in terms of recycling more material. RAY could provide grants/funding for balers for companies in this position.

Area 3: Larger producers of waste

These producers tend to be obligated companies or large chains of companies, many of whom produce enough plastic to warrant a baler. These companies tend to sell their plastic direct as bales to reprocessors or back-haul the material for bulking at a regional/national distribution centre. These companies also tend to receive a revenue from this activity. RAY could consider promoting case studies from larger companies to encourage all larger producers to bale and recycle their plastic. It was also evident during the project that segregation was still poor even when recycling infrastructure was in place in these companies. Therefore, providing education and training for staff could improve levels of recycling in these companies.

Area 4: Business clusters and coordination

This is an area of intervention where waste producers may consist of small, medium and large producers, but are concentrated in particular locations. This involves business clusters such as city centres, shopping centres and industrial estates. There may be clear opportunities to provide joint recycling and collection services to a cluster of businesses, and the combined volumes of plastic and other materials may provide cost and environmental benefits for them. Clearly this would require a large amount of input to facilitate this approach but could also yield results.

The other area that RAY should consider is cardboard recycling, as this material was present in most waste producers' bins. There is also a well-established collection and reprocessing infrastructure; raising awareness of services and cost savings could increase cardboard recycling across the region.

In order to take plastics recycling forward across the region Resource Futures recommends the measures outlined in Table 27.

Other issues RAY may want to consider is the need to improve cardboard recycling which is a clear area for improvement. Offering capital support for medium sized waste producers to install balers, may be the easiest short term step that may improve plastics recycling. This solution may persuade many companies to recycle plastics and other materials into a collection system that has existing infrastructure and demand. Providing intervention in the collection side of the market may also warrant longer term progress but Resource Futures would strongly recommend a small scale pilot first to collect more data on how this could be made commercially attractive to the collectors.

Finally, promotion and awareness to waste producers on the cost and environmental benefits for recycling will stimulate demand for services and drive the plastics recycling market.

Table 27: Recommendations

Recommendation	Next steps/issues
1) Pilot collection of plastics from smaller producers	RAY could consider introducing a targeted pilot for smaller producers of plastic which would take into account the following factors/issues: • Small-scale pilot that would allow detailed monitoring to assess long-term feasibility • Encourage waste collector to offer innovative collection eg. draw-string bag collections, smaller container collections. • Strong marketing support to encourage waste producers to participate. RAY should also consider the potential link between emerging agricultural plastics collection services and how smaller producers could feed into this area.
2) Provide funding to encourage medium/larger producers to install baling/compaction equipment	RAY could offer grants to encourage medium producers to install baling equipment and sell plastics direct to reprocessors. RAY could introduce a 50% capital grant programme, taking into account the following factors: • Anyone taking up a grant would provide RAY with waste/recycling data • Simple application process with support to help businesses determine the most suitable equipment. • Provision of case studies highlighting cost savings to encourage other businesses to invest in equipment
3) Provide funding to commercial waste collectors and recycling companies	RAY could also offer grants to encourage waste collectors to install baling equipment to encourage investment in plastics collections. This might include capital grants or interest-free loans. This would encourage companies to provide lower cost plastics and cardboard collections. The funding would need to made available on the proviso that the collectors offer plastics recycling.
4) Highlight outcomes of this study to larger producers	The findings from this report highlight that many producers with recycling services still have poor levels of segregation. Provision of labelling kits and other awareness raising/training support could be offered to companies to encourage better levels of segregation.
5) Co-ordination of joint activities	RAY could consider supporting an exemplar project on an industrial estate/city centre/shopping centres to instigate a shared recycling centre with specific support for plastics recycling. The results and cost benefits could be promoted through production of case studies and workshops.
6) Provision of infrastructure to reduce contamination	It may be possible to increase recycling by collecting general waste in a mixed form and segregating through a merchant waste dirty MRF. This would require further investment in the region to instigate this. It may also include support for a commercial wash plant to provide a higher value end product to reprocessors. This would require substantial investment and further study which RAY could consider funding. It would provide several advantages including collection of contaminated film from the food and drink sector to be processed. RAY should consider further feasibility work in this area.