

Section 5

PACKAGING ANALYSIS

Introduction

Packaging and packaging materials are believed to make up a large fraction of the disposed MSW in Pennsylvania and across the country. The Pennsylvania legislature has defined packaging as:

“A container providing a means of marketing, protecting or handling a product, including unit packaging, intermediate packaging, and shipping containers. Includes unsealed receptacles such as carrying cases, crates, cups, pails, rigid foil and other trays, wrappers and wrapping films, bags and tubs. Tin-plated steel, hot-dip and electrolyte galvanized steel, and galvanized wire shall be considered packaging. Includes individual parts of a package such as blocking, bracing, cushioning, weatherproofing, exterior strapping, coatings, closures, inks, labels, dyes, pigments, adhesives, stabilizers, or any other additive.”

At the outset of the project, it was intended to devote both field data collection and laboratory analysis to the fraction of the waste stream that is made up of packaging and packaging materials. Specifically, samples of packaging and packaging components were to be tested for containing four hazardous elements: mercury, lead, cadmium and hexavalent chromium. However, data collection was ultimately limited to field sorting of packaging compared to non-packaging materials.

The remainder of this section describes the results of an analysis of packaging vs. non-packaging in the disposed waste stream.

Data Collection Summary

The packaging analysis was performed during the winter season of sorting only. During all six weeks of sorting that took place during the winter season, all physical samples were divided into the 37 targeted material categories, and then split between packaging and non-packaging within each material category. Table 1 summarizes the material categories that were found to include at least some packaging materials.

Table 1 Materials Containing Packaging

Paper Corrugated Cardboard Polycoated/Aseptic Containers Mixed Paper (Recyclable) Other Paper (Non-recyclable)	Metals Steel Cans Aluminum Cans Other Ferrous Metals Other Aluminum
Plastic #1 PET Bottles #2 HDPE Bottles #3 - #7 Bottles Expanded Polystyrene Film Plastic Other Rigid Plastic	Glass Clear Glass Containers Green Glass Containers Brown Glass Containers
Inorganics [none]	Organics Wood—Unpainted Wood—Painted

As shown a total of 19 materials were found to contain at least some packaging or packaging components.

Table 2 summarizes the total number of packaging samples that were taken during the winter season of sorting. As shown the packaging samples were distributed across all generating sectors and demographic areas, as well as regionally. However, because the analysis of packaging took place during only one of the seasonal sorts, the distribution of samples across demographic areas and generating sectors was not as consistent as the overall MSW composition results.

Table 2 Packaging Sampling Summary [1]

Generating Sector	Demographic Area			
	Urban	Suburban	Rural	Total
Residential Samples	59	32	51	142
Commercial Samples	46	27	59	132
Self-haul Samples	6	6	12	24
Total Packaging Samples	111	65	122	298

[1] Packaging and non-packaging analysis was only performed on physically sorted samples.

Results

This section provides an overview of the composition of packaging vs. non-packaging materials in the waste stream, based on an analysis of the winter season packaging samples. Individual tables and figures are described below, and shown at the end of the section.

Note that results are presented separately for each of the generating sectors—residential, commercial and self-haul. Because it was not possible to obtain representative samples across generating sectors and across demographic areas during a single season of sorting, no attempt has been made to aggregate the composition of packaging. Rather, results are presented separately for residential, commercial and self-haul waste. Additionally, visually surveyed bulky waste loads were excluded from the analysis, due to difficulties in differentiating between packaging and non-packaging in these loads. It is likely that the primary packaging found in bulky waste loads would have been corrugated cardboard.

Packaging in Disposed Residential MSW

The first four figures summarize the incidence of packaging in the residential waste stream. Figure 1 shows a pie chart (and tabular summary) of the composition by major material group of packaging and non-packaging material. As shown, roughly one-quarter of the disposed residential waste stream was found to be made up of packaging.

Figures 2 and 3 present the top five most prevalent packaging and non-packaging materials, respectively. Cardboard is by far the most prevalent packaging material in disposed residential waste, followed by non-recyclable paper, recyclable paper, film plastic and steel cans. Food waste is the most prevalent non-packaging item (as well as the most prevalent material in the disposed residential waste stream).

Figure 4 compares packaging and non-packaging in the disposed residential waste stream by major material group for the urban, suburban and rural demographic areas. The fraction of packaging is comparable across generating sectors, although some variation is evident among different material groups. It is of interest to note that glass, plastic and metal are over one-half packaging, while other categories are primarily non-packaging.

Finally, Table 3 presents slightly more detailed comparisons of packaging and non-packaging residential waste from urban, suburban and rural areas. The table includes the sample mean composition, as well as confidence intervals at a 90 percent level of confidence. A complete description of these statistical measures is provided in Section 4 of this report.

Packaging in Disposed Commercial MSW

A duplicate set of figures and tables are used to illustrate packaging and non-packaging in disposed commercial waste.

Figure 5 shows a pie chart (and tabular summary) of the composition by major material group of packaging and non-packaging material. As shown, there was slightly more packaging in the commercial disposed waste stream compared to the residential stream.

Figures 6 and 7 present the top five most prevalent packaging and non-packaging materials, respectively. Cardboard is once again the most prevalent packaging material, by an even wider margin compared to the residential stream. However, the

Section 5

remaining materials are significantly different than the residential stream, with plastics and wood appearing instead of paper products.

Figure 8 compares packaging and non-packaging in the disposed commercial waste stream by major material group for the urban, suburban and rural demographic areas. Finally, Table 4 presents a more detailed statistical comparison of packaging and non-packaging commercial waste from urban, suburban and rural areas. A complete description of these statistical measures is provided in Section 4 of this report.

Packaging in Disposed Self-haul MSW

Self-haul waste is typically made up of different materials compared to regularly collected residential and commercial waste collected curbside or from dumpsters. The same figures and tables are used to illustrate the composition of self-haul waste.

Figure 9 shows a pie chart (and tabular summary) of the composition breakdown by major material group of packaging and non-packaging material. As shown, self-haul waste contains the least amount of packaging—not surprising, given that self-haulers are typically transporting larger, bulky items such as attic and basement clean-outs, small renovation debris and the like.

Figures 10 and 11 present the top five most prevalent packaging and non-packaging materials, respectively. Although cardboard is once again the most prevalent packaging material, it does not stand out as much as in the commercial or residential streams.

An insufficient number of samples were obtained to attempt to distinguish packaging composition by demographic area for self-haul loads. Consequently, Figure 12 compares packaging and non-packaging in the disposed self-haul waste stream by major material group for the residential and commercial generating sectors. Table 5 presents a more detailed statistical comparison of packaging and non-packaging self-haul by generating sector. A complete description of these statistical measures is provided in Section 4 of this report.

Conclusion

The results shown here provide insight on the differing fractions of packaging and packaging components in the residential, commercial and self-haul waste streams. This information can be used in future efforts to evaluate or monitor compliance with safe packaging standards within the Commonwealth.

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Section 5

Figure 1

Residential Composition by Material Group

Material Group		Mean	Confidence Interval	
		(%)	Lower	Upper
Paper	Packaging	11.0%	10.1%	12.0%
	Non-packaging	26.5%	24.4%	28.5%
Plastic	Packaging	6.8%	6.3%	7.4%
	Non-packaging	5.2%	4.6%	5.7%
Glass	Packaging	2.8%	2.4%	3.3%
	Non-packaging	0.5%	0.3%	0.6%
Metal	Packaging	2.8%	2.5%	3.2%
	Non-packaging	2.6%	2.0%	3.2%
Organics	Packaging	0.9%	0.6%	1.3%
	Non-packaging	35.7%	33.3%	38.1%
Inorganics	Packaging	0.0%	4.3%	6.2%
	Non-packaging	5.2%	4.3%	6.2%
Total Packaging		24.4%		
Total Non-packaging		75.6%		
Total		100.0%		

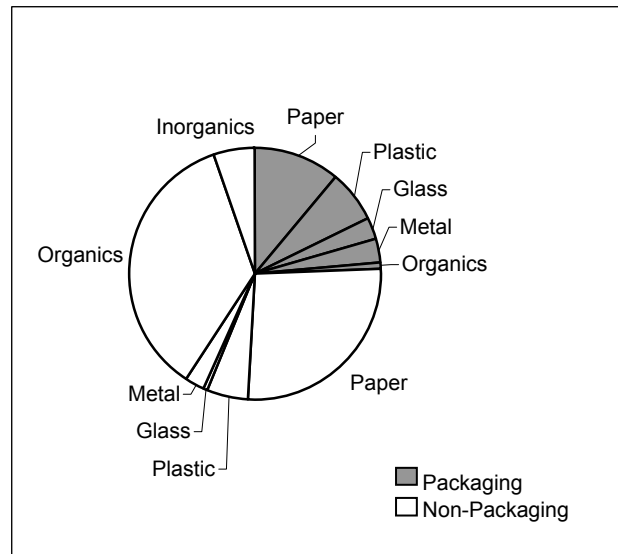


Figure 2

Top 5 Packaging Materials

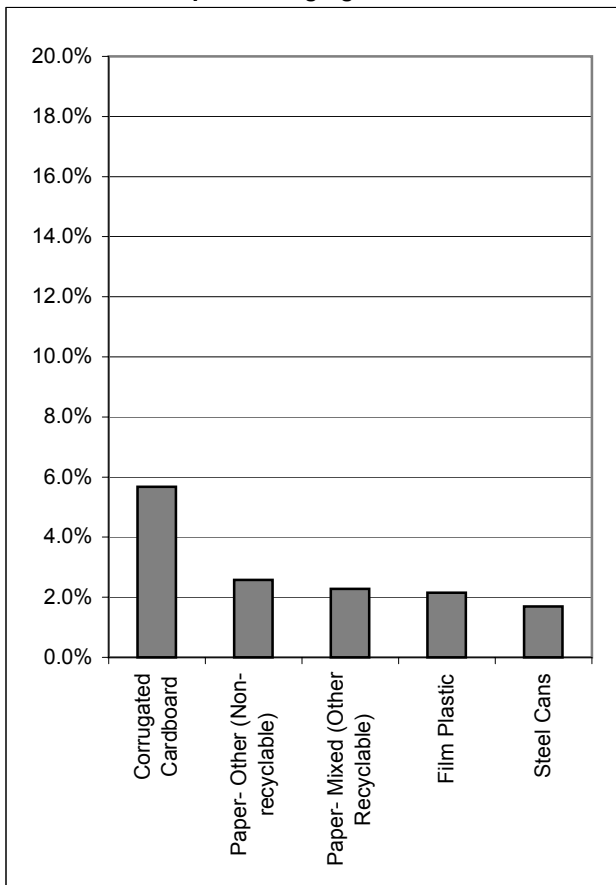
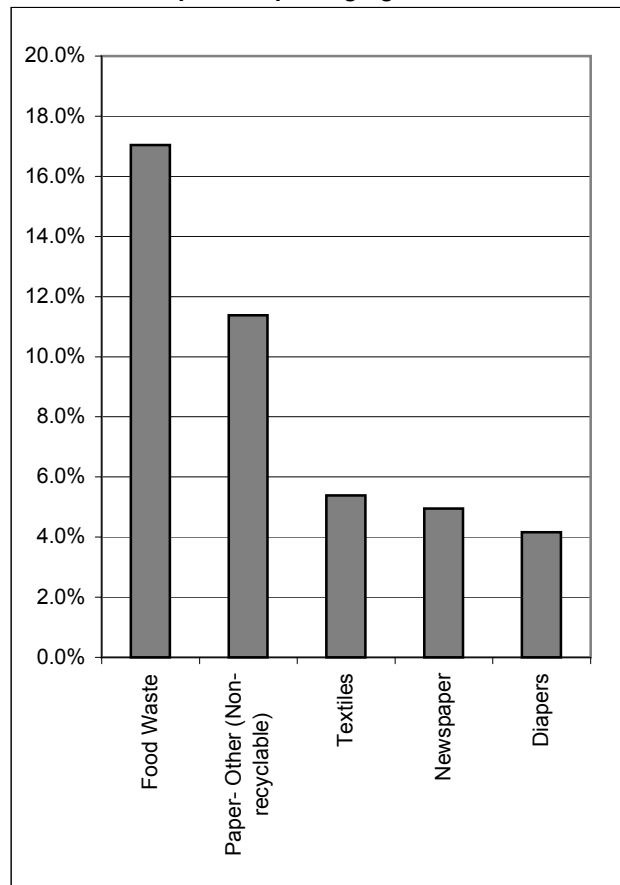


Figure 3

Top 5 Non-packaging Materials



Packaging Analysis

Figure 4
Residential Composition by Demographic Area

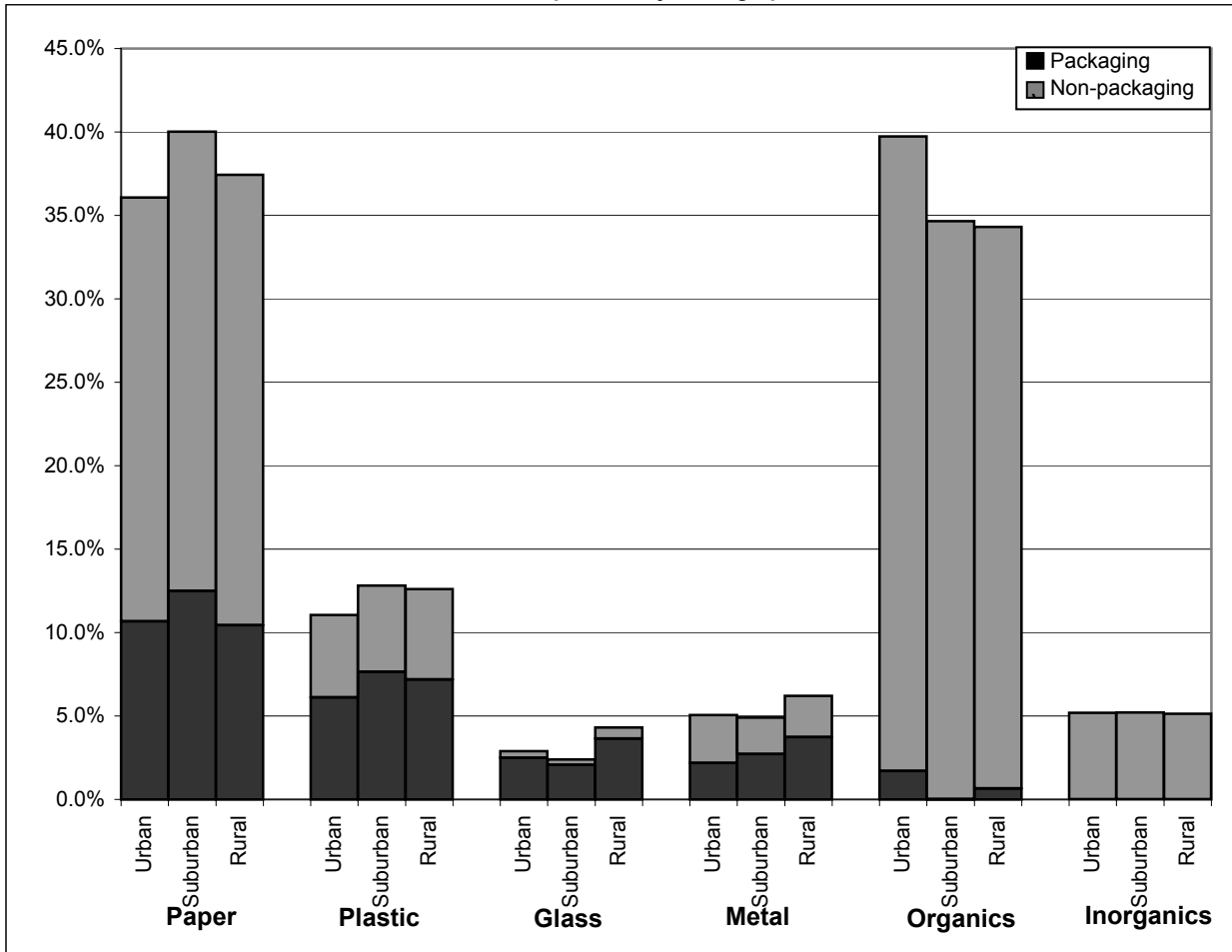


Table 3
Residential Composition by Demographic Area

Material Group		Urban			Suburban			Rural		
		Mean (%)	Confidence Interval Lower	Confidence Interval Upper	Mean (%)	Confidence Interval Lower	Confidence Interval Upper	Mean (%)	Confidence Interval Lower	Confidence Interval Upper
Paper	Packaging	10.7%	9.3%	12.1%	12.5%	10.1%	15.1%	10.4%	9.1%	11.9%
	Non-packaging	25.4%	21.9%	29.0%	27.5%	23.6%	31.7%	27.0%	23.9%	30.2%
Plastic	Packaging	6.1%	5.4%	6.8%	7.6%	6.1%	9.4%	7.2%	6.3%	8.1%
	Non-packaging	4.9%	4.2%	5.8%	5.2%	4.4%	6.0%	5.4%	4.3%	6.6%
Glass	Packaging	2.5%	1.9%	3.2%	2.1%	1.4%	2.8%	3.6%	2.8%	4.5%
	Non-packaging	0.4%	0.2%	0.6%	0.3%	0.2%	0.5%	0.7%	0.4%	1.1%
Metal	Packaging	2.2%	1.8%	2.6%	2.7%	2.1%	3.4%	3.7%	3.0%	4.5%
	Non-packaging	2.9%	1.8%	4.2%	2.2%	1.2%	3.4%	2.5%	1.6%	3.5%
Organics	Packaging	1.7%	0.8%	2.9%	0.0%	0.0%	0.0%	0.6%	0.3%	1.1%
	Non-packaging	38.0%	34.4%	41.7%	34.6%	30.1%	39.3%	33.7%	29.3%	38.2%
Inorganics	Packaging	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Non-packaging	5.2%	3.7%	6.9%	5.2%	3.5%	7.2%	5.1%	3.7%	6.8%
Total Packaging		23.2%			24.9%			25.6%		
Total Non-packaging		76.8%			75.1%			74.4%		
Total		100.0%			100.0%			100.0%		

Section 5

Figure 5

Commercial Composition by Material Group

Material Group		Mean	Confidence Interval	
		(%)	Lower	Upper
Paper	Packaging	14.9%	12.6%	17.4%
	Non-packaging	24.9%	21.5%	28.5%
Plastic	Packaging	6.8%	5.8%	7.8%
	Non-packaging	6.4%	5.4%	7.5%
Glass	Packaging	1.6%	1.3%	2.0%
	Non-packaging	0.2%	0.2%	0.3%
Metal	Packaging	1.8%	1.5%	2.2%
	Non-packaging	3.0%	2.2%	3.9%
Organics	Packaging	2.0%	1.3%	2.9%
	Non-packaging	30.3%	26.8%	33.9%
Inorganics	Packaging	0.0%	0.0%	0.0%
	Non-packaging	8.0%	6.0%	10.2%
Total Packaging		27.1%		
Total Non-packaging		72.9%		
Total		100.0%		

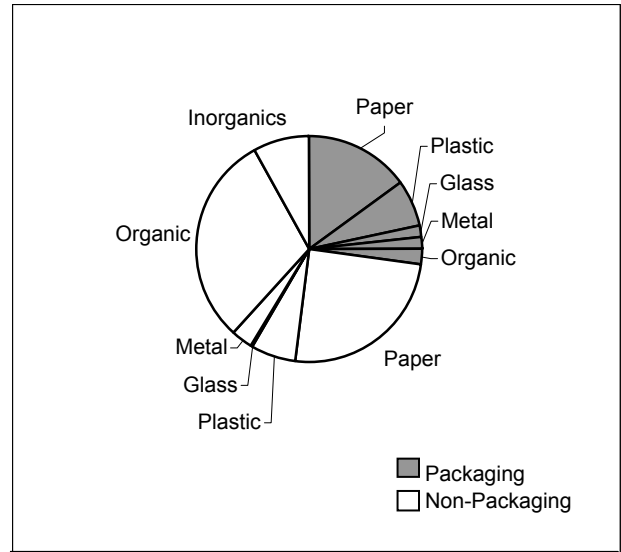


Figure 6

Top 5 Packaging Materials

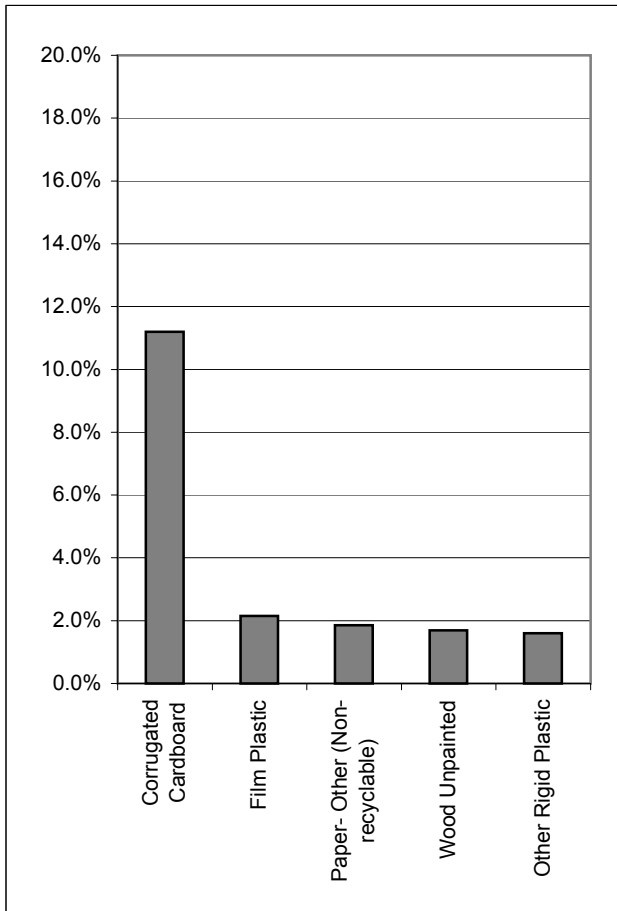


Figure 7

Top 5 Non-packaging Materials

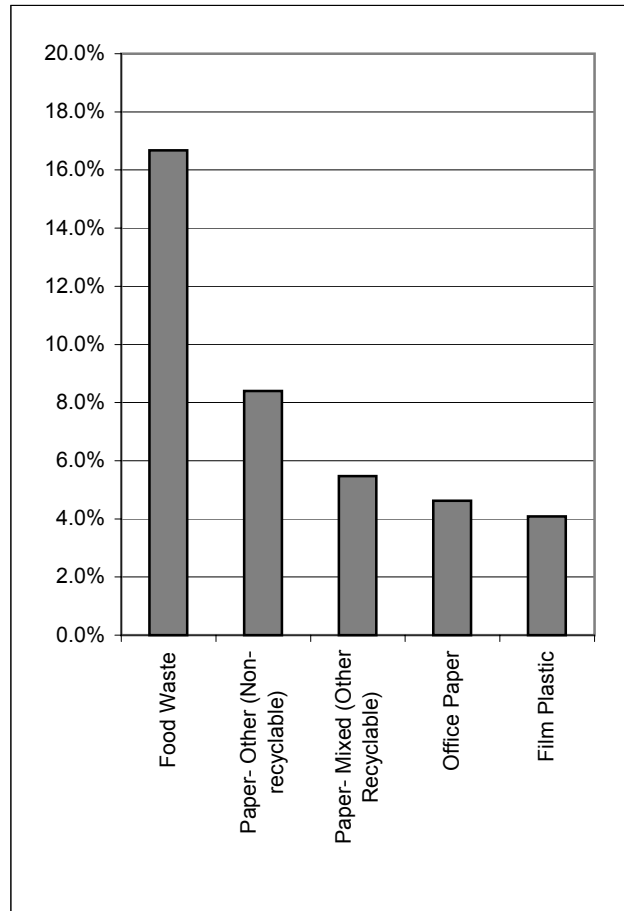


Figure 8
Commercial Composition by Demographic Area

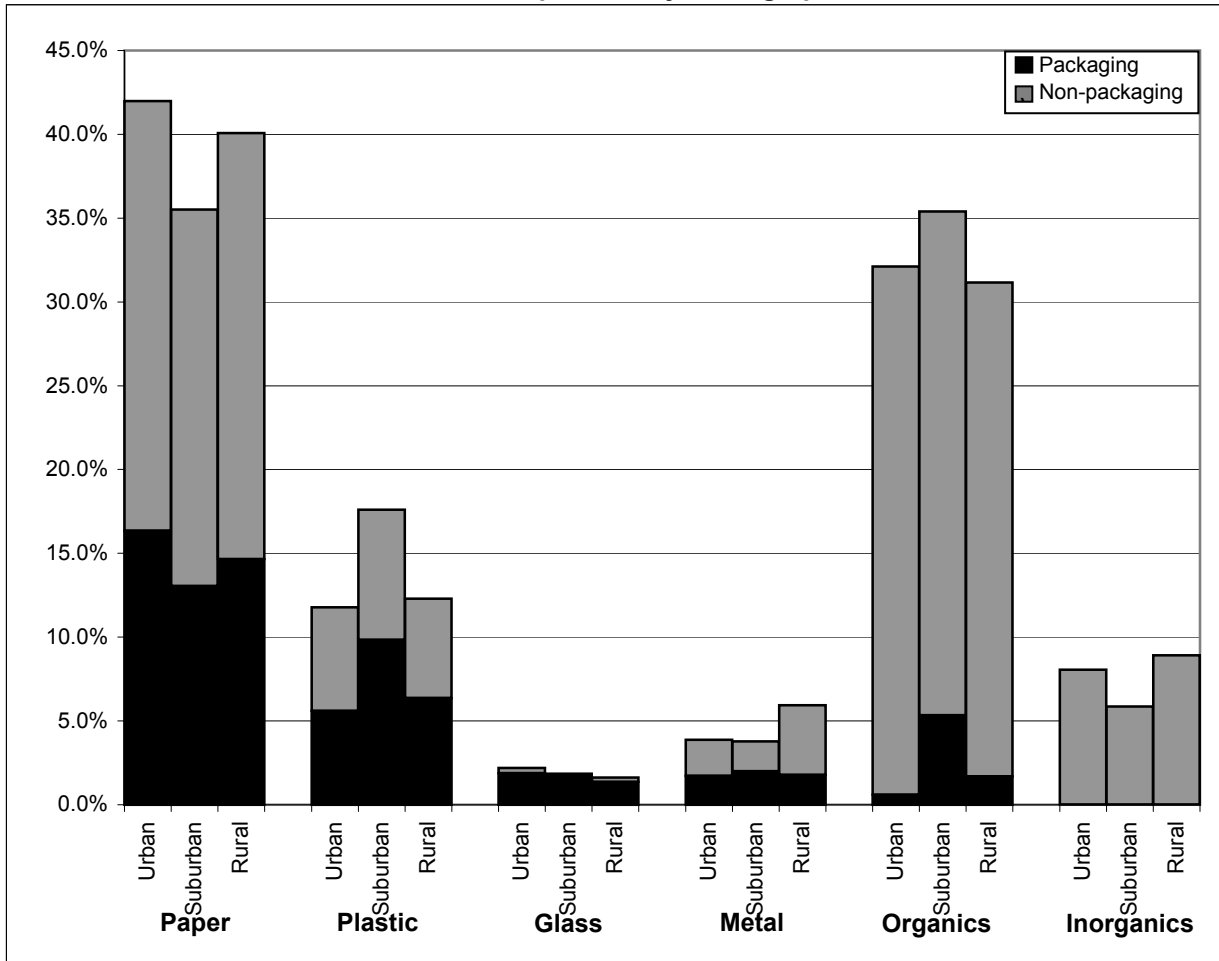


Table 4
Commercial Composition by Demographic Area

Material Group		Urban			Suburban			Rural		
		Mean	Confidence Interval		Mean	Confidence Interval		Mean	Confidence Interval	
		(%)	Lower	Upper	(%)	Lower	Upper	(%)	Lower	Upper
Paper	Packaging	16.4%	12.4%	20.8%	13.0%	9.2%	17.4%	14.7%	11.0%	18.8%
	Non-packaging	25.6%	21.1%	30.4%	22.5%	17.3%	28.1%	25.4%	19.1%	32.3%
Plastic	Packaging	5.6%	4.5%	6.8%	9.8%	7.2%	12.9%	6.4%	4.8%	8.1%
	Non-packaging	6.2%	4.6%	7.9%	7.8%	5.2%	10.8%	5.9%	4.5%	7.6%
Glass	Packaging	1.9%	1.3%	2.6%	1.8%	0.9%	2.9%	1.4%	0.9%	1.9%
	Non-packaging	0.3%	0.2%	0.5%	0.1%	0.0%	0.2%	0.3%	0.1%	0.4%
Metal	Packaging	1.7%	1.3%	2.3%	2.0%	1.3%	2.7%	1.8%	1.2%	2.4%
	Non-packaging	2.1%	1.3%	3.2%	1.8%	0.8%	3.2%	4.2%	2.5%	6.2%
Organics	Packaging	0.6%	0.3%	1.0%	5.3%	1.2%	12.0%	1.7%	0.9%	2.8%
	Non-packaging	31.5%	26.0%	37.3%	30.1%	22.2%	38.5%	29.5%	24.1%	35.2%
Inorganics	Packaging	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Non-packaging	8.1%	5.0%	11.7%	5.9%	2.6%	10.2%	8.9%	5.6%	12.9%
Total Packaging		26.1%			31.9%			25.8%		
Total Non-packaging		73.9%			68.1%			74.2%		
Total		100.0%			100.0%			100.0%		

Section 5

Figure 9

Self-haul Composition by Material Group

Material Group		Mean	Confidence Interval	
		(%)	Lower	Upper
Paper	Packaging	5.6%	2.8%	9.2%
	Non-packaging	11.4%	5.0%	20.0%
Plastic	Packaging	4.1%	1.9%	7.1%
	Non-packaging	5.3%	2.9%	8.5%
Glass	Packaging	2.1%	0.8%	4.0%
	Non-packaging	2.6%	0.9%	5.2%
Metal	Packaging	1.4%	0.6%	2.6%
	Non-packaging	10.0%	3.6%	19.2%
Organics	Packaging	4.0%	1.2%	8.4%
	Non-packaging	34.8%	26.4%	43.7%
Inorganics	Packaging	0.0%	0.0%	0.0%
	Non-packaging	18.6%	9.8%	29.3%
Total Packaging		17.3%		
Total Non-packaging		82.7%		
Total		100.0%		

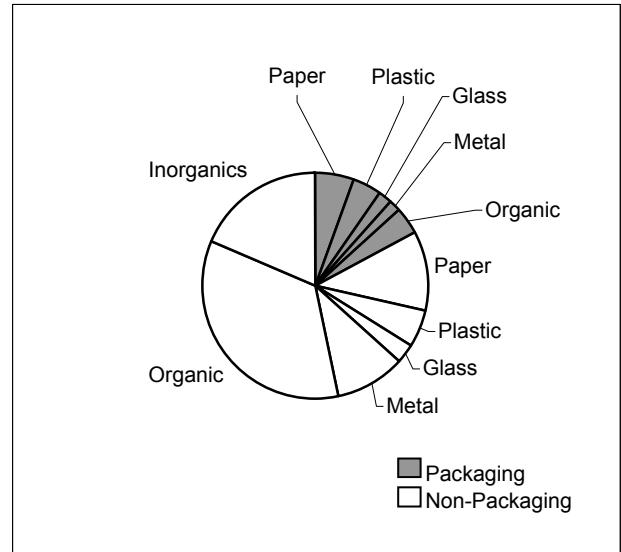


Figure 10

Top 5 Packaging Materials

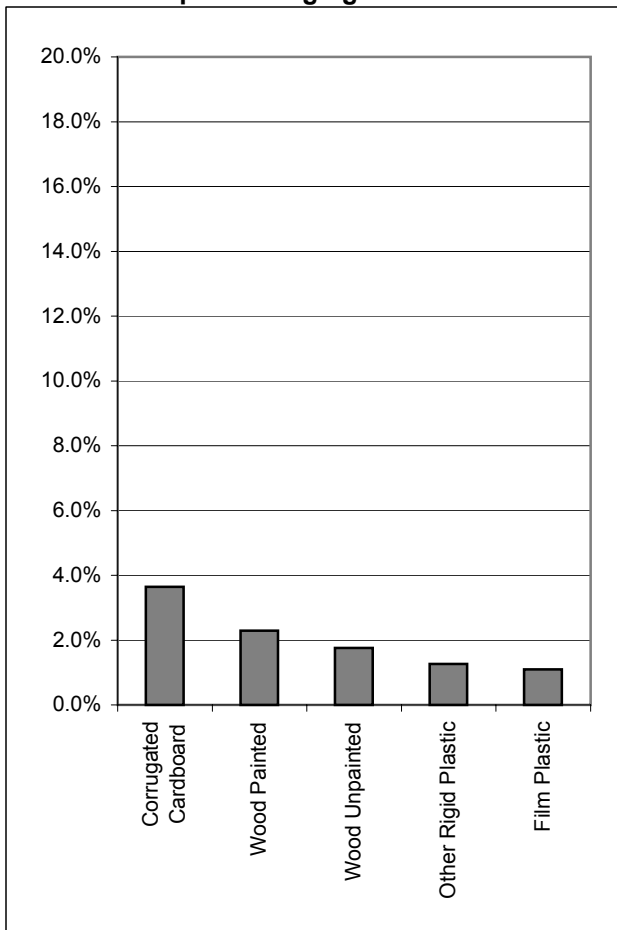
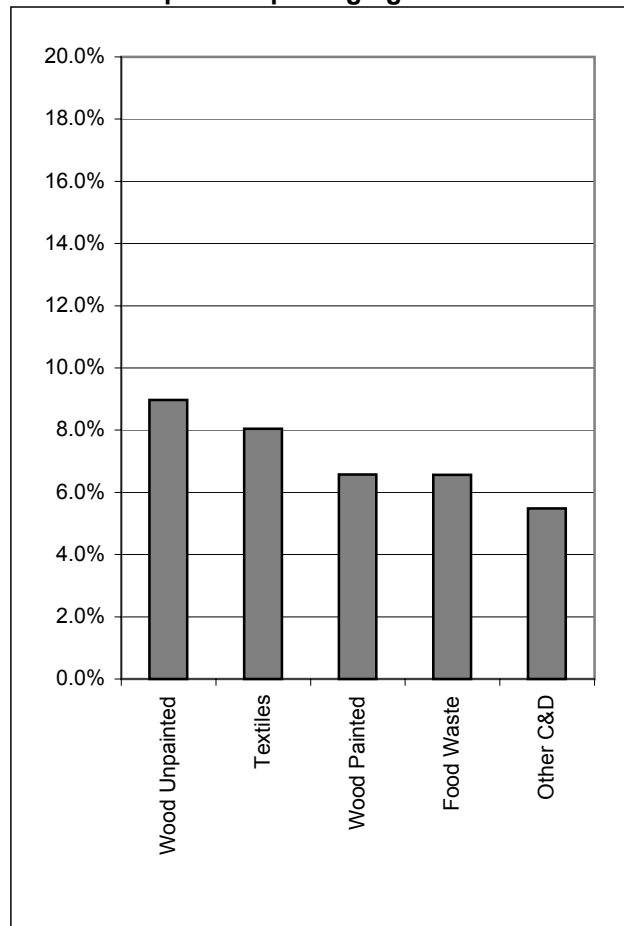


Figure 11

Top 5 Non-packaging Materials



Packaging Analysis

Figure 12
Self-haul Composition by Generator Sector

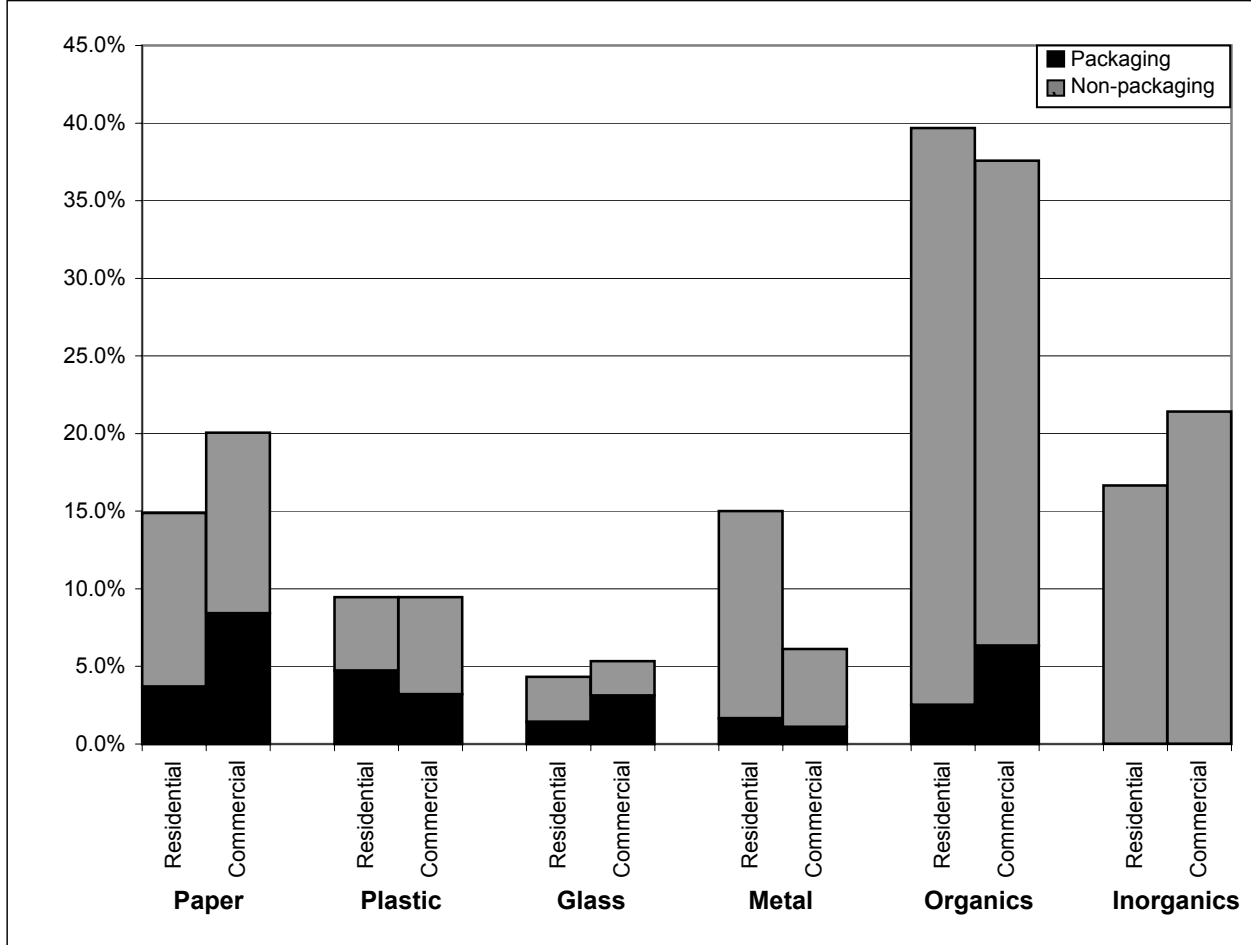


Table 5
Self-haul Composition by Generator Sector

		Residential			Commercial		
		Mean (%)	Confidence Interval		Mean (%)	Confidence Interval	
Material Group		(%)	Lower	Upper	(%)	Lower	Upper
Paper	Packaging	3.7%	1.5%	6.9%	8.4%	2.0%	18.6%
	Non-packaging	11.2%	3.0%	23.7%	11.7%	2.1%	27.5%
Plastic	Packaging	4.7%	1.3%	10.0%	3.2%	0.8%	7.1%
	Non-packaging	4.7%	2.1%	8.4%	6.3%	1.5%	13.9%
Glass	Packaging	1.4%	0.4%	3.2%	3.1%	0.2%	9.0%
	Non-packaging	2.9%	0.7%	6.5%	2.2%	0.0%	7.6%
Metal	Packaging	1.6%	0.4%	3.6%	1.1%	0.2%	2.7%
	Non-packaging	13.4%	2.6%	30.6%	5.0%	1.0%	11.9%
Organics	Packaging	2.5%	0.4%	6.4%	6.3%	0.2%	19.7%
	Non-packaging	37.2%	25.2%	49.9%	31.3%	18.4%	45.8%
Inorganics	Packaging	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Non-packaging	16.7%	7.3%	28.9%	21.4%	4.4%	46.5%
Total Packaging		14.0%			22.1%		
Total Non-packaging		86.0%			77.9%		
Total		100.0%			100.0%		