

Final Report

St. Louis Metropolitan Area
Recycling Economic Information Study
(SLMAREIS)

Prepared for the
St. Louis - Jefferson Solid Waste Management
District

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December 16, 2002



Acknowledgments and Disclaimer

The St. Louis Metro Area Recycling Economic Information Study (SLMAREIS) was commissioned and funded by the St. Louis - Jefferson Solid Waste Management District, and it was conducted by the University of Missouri - St. Louis and the Business Research and Information Development Group (BRIDGE)/Entrepreneurial University of Missouri Outreach and Extension. The researchers acknowledge the essential role that the U.S. Recycling Economic Information Study played in guiding their efforts and providing important sources of information. The researchers would like to thank the National Recycling Coalition Inc. for commissioning that study and for making it widely available for use.

The researchers were like to give special thanks to Ms. Dena Will for her tireless work in managing the survey mailings, remailings, address searches, and phone calls for information verification. Her work was invaluable in completing this study in a timely manner.

This report has been prepared specifically for the St. Louis - Jefferson Solid Waste Management District. The conclusions, observations, and recommendations contained herein represent the opinions of the researchers, and not necessarily those of the St. Louis - Jefferson Solid Waste Management District. The researchers relied on numerous sources of information in preparing this report, and have assumed these to be reasonably accurate, but no assurances are given and no representations or warranties are made.

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EXECUTIVE SUMMARY

This study was undertaken to determine the size of recycling, remanufacturing, and reuse (RRR) industries in the St. Louis Metropolitan Area (SLMA). The study was modeled after the U.S. Recycling Economic Information Study (USREIS) that was performed by R. W. Beck for the National Recycling Coalition, Inc., published in July 2001. To a large extent this study attempted to duplicate the USREIS methodology for estimating the number of establishments, employment, annual payroll, and annual receipts associated with recycling, remanufacturing, and reuse industries in the SLMA, but the study differs from the USREIS in several ways that are described below.

Goals and Intended Uses of the Study

The primary goals of this study was to measure and document the size of the RRR industries in the SLMA by determining direct economic information for each of 26 categories of recycling, remanufacturing, and reuse establishments. The direct economic values that were measured were

- Number of establishments with RRR activity
- Employment devoted to RRR activities
- Annual payroll devoted to RRR activities
- Annual receipts from RRR activities

The USREIS also estimated broader economic effects of the RRR industries by estimating the indirect economic values (interindustry linkages as measured by purchases of intermediate commodities within the SLMA) and induced economic values (personal spending by employees of direct and indirect establishments from establishments within the SLMA). Well-developed models exist for making such estimates at the national level, but at the local level, it is very difficult to make these estimates (it is quite difficult to determine how much of a company's inputs are purchased locally and how much of a person's consumption expenditures are local) and any estimates have a large degree of uncertainty. We have attempted to estimate the indirect and induced economic values using somewhat crude methods, so they should be recognized as being very rough estimates. The USREIS also estimated the annual throughput and tax revenues attributable to the RRR industries. We have not attempted to estimate either quantity, although reasonably good estimates of the former could probably be obtained by prorating the USREIS throughput values based on the employment or receipts estimates in this study for the SLMA.

This study shows that RRR businesses make a significant contribution to the SLMA economy and provide a number of economic benefits, including job creation for workers with a wide range of skills. As such the economic information contained in this study may be used:

- By development agencies, entrepreneurs, and financiers to understand and evaluate opportunities in the RRR industries;
- By lawmakers to assist them in devising and evaluating legislation that would affect the RRR industries;
- As a tool for recycling advocates to educate the public and to promote awareness of recycling, remanufacturing, and reuse as possible sources of economic growth;
- As a baseline of economic information to help measure and document future growth or decline of the RRR industries.

Summary of Methodology

This study attempted to duplicate the USREIS methodology for estimating the number of establishments, employment, annual payroll, and annual receipts in each of the 26 industry categories, but the methodology differed from the USREIS in two major ways. First, final estimates were made using a “triangularization” approach. Specifically, for each industry typically at least three different methods were used to estimate the desired quantities. One reason for this is that in many cases the USREIS methodology could not be duplicated at the SLMA level due to a lack of information. For example, many of the USREIS estimates relied on national data from the 1997 economic census, but at the metropolitan level those data are not always reported due to the small number of companies in the SLMA in some industries, and the consequent need to maintain individual company confidentiality. In other cases the USREIS sometimes used data to which we did not have access. Finally, the USREIS used surveys to obtain data for some industry estimates, but because of the limited number of companies in the SLMA the number of survey responses was not always sufficient to make sound estimates. This meant that in some cases we were forced to develop alternative estimating methods or to combine methods. For each industry we began with a “baseline” estimate in which we simply allocated the USREIS estimates to the SLMA proportionally based on population (i.e., the SLMA makes up 0.925% of the U.S. population, so the USREIS estimates were multiplied by 0.00925). This had three purposes. First, it gave a baseline against which our final estimates could be compared to determine whether the RRR economic activity in the SLMA is larger or smaller than the national rate for that industry. Second, it provided a “face validity” check to make sure estimates obtained from other methods made sense; if the other estimates deviated substantially from these baseline values, there had to be a good identifiable justification. Third, when no other method provided what we considered to be a sound estimate, the baseline estimates were used as default estimates.

In addition to the baseline estimates, estimates were usually made: (1) by duplicating as exactly as possible the USREIS methodology, but using data specific to the SLMA; (2) by using economic census data specific to the SLMA (this was often the same as the previous method, but not always); and (3) by using data from a survey developed specifically for this study which attempted to use the same survey methodology as the USREIS. In addition, other information sources and methods were used where necessary, including data from a previous survey by University of Missouri Outreach and Extension of local governments dealing with recycled material collection, *Sorkins Directory of Business and Government 2002 Edition for St. Louis*, the *St. Louis Business Journal*, information from industry and company web pages, and in some cases, direct phone calls to businesses. By using these different methods, we were able to select the one method that we felt most accurately measured the desired quantities for each industry. This approach also strengthened our confidence in our estimates because in many cases the different estimation methods resulted in very similar results. In addition, some of the estimation methods could be determined as methods for establishing upper or lower bounds on the exact values, and so they further provided both confidence in the approximate accuracy of the final estimates and estimate intervals that were smaller and more defensible than standard statistical confidence intervals.

The second major methodological or philosophical difference was that because of the paucity of information in some industries, we took a more conservative approach in our estimates than was typically used in the USREIS. We were especially conservative in the use of our estimates based on survey data. The USREIS typically assumed that companies responding to surveys in an industry were representative of all the companies in that industry, and so their recycling activity was projected to the industry as a whole. We found this assumption to be counterintuitive for some industries, and our survey experiences indicated that this was probably not true in some industries, so except where we could conclude otherwise, we typically assumed that companies in an industry that did not return surveys, probably had less recycling activity occurring. The specific assumptions varied from industry to industry and are explained in the detail results.

Summary Results

The study found that in the SLMA there are 1458 establishments performing recycling, remanufacturing, or reuse activities as an integral part of the organization's operations. Those establishments have an employment of 15,776 (including over 900 sole proprietors), annual payroll of \$639,910,000, and annual receipts of \$4,911,458,000 that are directly related to, or dependent on, recycling, remanufacturing, or reuse of materials and products. Including the indirect and induced economic effects, the total economic values of the RRR industries are 39,963 jobs, \$1,517,468,000 in annual payroll, and annual receipts of \$8,146,101,000 Table ES-1 compares the economic values of the RRR industries to those of other industries in the SLMA. The values for the other industries are from the 1997 economic census, with inflationary adjustments to payroll and receipts comparable to those used for the RRR industries. Notice that

the direct contributions of RRR to the SLMA economy are larger than those of the utilities industry (electricity, gas, water and sewage combined), the food, beverage, and tobacco manufacturing industries combined, computer and electronic products manufacturing, primary metals manufacturing, and the printing industry, and they are about the same size as chemical manufacturing and machinery manufacturing. Clearly the recycling, remanufacturing and reuse industries are an important part of the SLMA economy.

Table ES-1
Comparison of Direct Economic Activity of RRR to other SLMA Industries

Industry	Employment	Annual Payroll	Annual Receipts
RRR	15,776	\$639,910,000	\$4,911,458,000
Utilities	8,152	\$519,131,000	\$3,103,745,000
Food Mfg.	9,139	\$308,826,000	\$2,754,972,000
Beverage & Tobacco Product Mfg.	3,531	\$222,994,000	\$2,132,240,000
Computer & Electronic Products Mfg	6,641	\$295,197,000	\$1,804,060,000
Chemical Mfg.	12,530	\$615,617,000	\$5,488,475,000
Primary metals Mfg.	12,466	\$598,880,000	\$3,680,607,000
Machinery Manufacturing	16,166	\$687,262,000	\$2,917,277,000
Printing & Related Support Activities	10,959	\$446,994,000	\$1,342,784,000

Comparison of the RRR Sectors

The USREIS grouped the 26 RRR industries into four groups: (1) Recycling Collection (primary collection of recyclable materials); (2) Recycling Processing (sorting, densifying, and brokering of recyclable materials); (3) Recycling Manufacturing (manufacturing of products from recycled materials); (4) Remanufacturing and Reuse (cleaning, repairing, reconditioning and reselling of manufactured goods). The economic activity and contribution of each sector are given in Table ES-2.

Table ES-2
Summary of Direct Economic Activity by Sector

	Sector Industry				RRR Industry Total
	Recycling Collection	Recycling Processing	Recycling Manufacturing	Remanufacturing and Reuse	
Establishments	29	221	107	1,101	1,458
Employment	354	2,305	10,406	2,711	15,776
Annual Payroll	\$12,453,000	\$90,474,000	\$486,907,000	\$50,076,000	\$639,910,000
Annual Receipts	\$25,892,000	\$2,437,984,000	\$2,257,944,000	\$189,638,000	\$4,911,458,000

Table ES-2 shows that recycling manufacturing makes up over 65% of the employment and over 75% of the payroll in the RRR industries. This is quite consistent with the results of the USREIS. The industries in the manufacturing sector are made up of high value-adding businesses (converting raw materials into valuable intermediate or finished products), which require highly skilled and highly paid labor (an average annual pay per worker of almost \$50,000). The receipts for this sector, however, are less than 50% of the total because of the very large receipts for recyclables wholesaling/brokering in the SLMA. The collection sector is made up of primarily low-skilled waste collectors (however, their average annual pay is over \$35,000, due to both the high physical demands of the job and probably the unionization of many of the workers). The recycling processing and remanufacturing and reuse sectors are quite heterogeneous, so making statements based on the aggregated values for these sectors can be dangerous. Within the recycling processing sector there are many low-skill, low-paying jobs involved with sorting and densifying recyclables. But this sector also includes highly skilled material wholesalers/brokers. The SLMA is a major center of recyclables wholesaling, with some very large wholesaling companies, and 60 sole proprietors. The very large receipt for this industry, relative to employment, distorts the relative receipts of the four sectors. The remanufacturing and reuse sector is similarly heterogeneous. 90% of these establishments are retailers of used merchandise, such as clothes, books, and furniture, and the pay per worker is at or near the minimum wage. This industry is also dominated by sole proprietors, which we have included in our study, but the USREIS did not include. On the other hand, there is some moderately skilled remanufacturing of electronics products and retreading of tires, which pay substantially more (an average of \$24,000-30,000 per year).

Although the recycling collection sector is economically small and appears insignificant, it probably plays a major role in the vitality of the processing and manufacturing sectors. Without the above average rate of recyclables collection (compared to the national rate), the SLMA probably would not have become a center of wholesaling/brokering, and having large local supplies of recyclables has probably helped to make the SLMA more attractive to recycling manufacturers.

Comparison of RRR in the SLMA to National Averages

Comparing the SLMA industry-by-industry estimates to the USREIS national values indicates that the RRR industries appear to make up a larger part of the SLMA economy than they do at the national level. Table ES-3 compares the RRR industry sector values to those that would result if the SLMA had RRR activity equal to the national average. (The USREIS national values were multiplied by the population of the SLMA divided by the national population, based on the 2000 census, and adjusted for inflation to be consistent with our SLMA estimates. Throughout the report these are referred to as baseline estimates.)

Table ES-3
Comparison of SLMA to Values Based on National Averages by Sector
 Annual payroll is in thousands of dollars; receipts are in millions of dollars

	Sector Industry								RRR Industry Total	
	Recycling Collection		Recycling Processing		Recycling Manufacturing		Reuse and Remanufacturing			
	SLMA	Baseline	SLMA	Baseline	SLMA	Baseline	SLMA	Baseline	SLMA	Baseline
Establishments	29	85	221	166	107	74	1,101	1,053	1458	1378
Employment	354	296	2,305	1,543	10,406	7027	2,711	2,369	15,776	11,235
Annual Payroll	12,453	10,648	90,474	45,809	486,907	312,711	50,076	41,761	639,910	410,929
Annual Receipts	25.9	18.3	2438.0	425.2	2257.9	1721.7	189.6	164.8	4911.5	2330.0

The rates of collection and processing of recyclables in the SLMA are above the national average, based on the USREIS. This high rate of collection and processing may be the impetus for the SLMA being a major center of wholesale trading and brokering of recyclable materials, employing over 1650 people with an annual payroll of almost \$75 million, and resulting in the SLMA being a leading exporter of recyclable materials. Somewhat surprisingly, the SLMA is also above the national average in recycling-based manufacturing (using recycled materials directly in manufacturing), and in the remanufacturing and reuse of products. However, this above average performance in recycling manufacturing is quite tenuous because it is due to two large manufacturers, one in the steel industry and one in nonferrous materials. Recent closings of two other recycling-based manufacturers, the Laclede Steel mill and the Smurfit-Stone paperboard mill in Alton, show how vulnerable these basic industries are to economic downturns, but they also show opportunities that exist for expanding recycling-based industries and employment. It should be noted that all four of these companies, as well as many of the other recycling manufacturers are located in Illinois. Although an explicit geographical analysis of the results was not performed, it appears that the Illinois side of the SLMA accounts for a large majority of the recycling

manufacturing sector, whereas the Missouri side of the SLMA makes the larger contribution to the other three RRR sectors. This shows how economically interrelated the two sides of the river are in the SLMA, especially in RRR industries

The estimates of above-average RRR activity, relative to those reported by the USREIS, was somewhat surprising because we used more conservative estimation procedures than the USREIS. This may be partially due to the fact that we know the SLMA well, so we could uncover a more extensive and accurate list of companies in the RRR industries than the USREIS researchers could do nationally. Based on our own experiences, we found that relying simply on standard databases, such as the USREIS did, misses many companies, especially the smaller and newer companies. During our research we were constantly discovering RRR companies through various sources, including word-of-mouth, articles in local publications, or even seeing trucks on the highway that were carrying recyclables.

Largest Contributors by Industry

Of the 15,776 people employed nearly 80% of them work in seven RRR industries:

1. Steel mills (3040 workers)
2. Nonferrous product producers (1869 workers)
3. Recyclable material wholesalers (1652 workers)
4. Plastics converters (1630 workers)
5. Retail used merchandise (1611 workers)
6. Iron and steel foundries (1490 workers)
7. Nonferrous foundries (1300 workers)

Although it was one of the smallest industries (221 workers), a surprising bright spot was the electronics remanufacturing and resale industry. Because it is small it has been “operating below the radar screen,” but it appears to be growing rapidly in the SLMA, and its activity is well above the national average for this industry.

Summary

The recycling, remanufacturing, and reuse industries play an important economic role in the SLMA economy, providing over 1% of the area’s jobs through direct employment and supporting another 2% through indirect and induced employment. These industries provide a broad mix of employment opportunities, from very low skill jobs to very high skill, high paying ones. Although some companies are quite large, requiring substantial capital resources, an overwhelming majority of the enterprises (probably over 90%) are of small to moderate size with relatively low barriers to entry. In fact, the RRR industries provide many opportunities for entrepreneurs to start sole proprietor businesses, especially in the collection, and remanufacturing and reuse sectors.

SECTION 1 INTRODUCTION

1.1 OVERVIEW

This study was undertaken to determine the size of the recycling, remanufacturing, and reuse (RRR) industries in the St. Louis Metropolitan Area (SLMA). The study was modeled after the U.S. Recycling Economic Information Study (USREIS) that was performed by R. W. Beck for the National Recycling Coalition, Inc., published in July, 2001. This study attempted to duplicate the USREIS methodology for estimating economic measures of RRR activity, but for many industries alternative estimation procedures had to be used.

The primary goal of this study was to measure and document direct economic information for each of 26 categories of recycling, remanufacturing, and reuse establishments. The direct economic values measured were

- Number of establishments with RRR activity;
- Employment devoted to RRR activities;
- Annual payroll devoted to RRR activities;
- Annual receipts from RRR activities;

The USREIS also estimated broader economic effects of the RRR industries by estimating the indirect economic values (interindustry linkages as measured by purchases of intermediate commodities within the SLMA) and induced economic values (personal spending by employees of direct and indirect establishments within the SLMA). Well-developed models exist for making such estimates at the national level, but at the local level it is very difficult to make such estimates because few companies track the amount of their purchases and sales within the metropolitan area. We have attempted to estimate the indirect and induced economic values using somewhat crude methods, so they should be recognized as being very rough estimates. The USREIS also estimated the annual throughput and tax revenues attributable to the RRR industries. We have not attempted to estimate either quantity, although reasonably good estimates of the former could probably be obtained by prorating the USREIS throughput values based on the employment or receipts estimates in this study for the SLMA.

1.2 INTENDED USES FOR THE STUDY

This study shows that RRR businesses make a significant contribution to the SLMA economy and provide a number of economic benefits, including job creation for workers with a wide range of skills. As such the economic information contained in this study may be used:

- By development agencies, entrepreneurs, and financiers to understand and evaluate opportunities in the RRR industries;
- By lawmakers to assist them in devising and evaluating legislation that would affect the RRR industries;
- As a tool for recycling advocates to educate the public and to promote awareness of recycling, remanufacturing, and reuse as possible sources of economic growth;
- As a baseline of economic information to help measure and document future growth or decline of the RRR industries.

1.3 REPORT ORGANIZATION

The remainder of this report is organized into the following sections:

Section 2: Data Characterization: This section describes the boundaries of the study and explains the types of RRR activities captured by the study and which activities are specifically not included. It also defines the business categories used and the types of economic information that are developed.

Section 3: General Methodology: This section describes in general terms the methodologies used in deriving estimates for the economic measures. Detailed descriptions of the specific methodologies used for each industry are given in Appendix B.

Section 4: Study Results: This section presents detailed data tables, comparisons, and explanations of the economic values that were estimated.

Section 5: Conclusions and Recommendations for Future Studies: This section presents general conclusions from the study, and it provides suggestions for improving future REIS studies, as well as suggestions for additional areas of study.

SECTION 2 DATA CHARACTERIZATION

2.1 STUDY BOUNDARIES

Defining the Recycling, Remanufacturing, and Reuse (RRR) industry is complex. Some businesses are clearly totally involved in RRR activities, such as establishments that only sort and densify recycled materials (so-called material recovery facilities), or those that buy, refurbish and then resell electronic equipment or furniture. Similarly, a paperboard mill that uses only recycled fiber as its feedstock or a primary steel mill that uses only scrap metal as its feedstock are totally dependent on recycling and should be considered to be in the RRR industry. But many establishments perform a variety of processing, manufacturing, and/or distributing activities, only some of which are related to or dependent upon recycling, remanufacturing, or reuse of materials or products. Especially challenging are situations where a manufacturer can utilize recovered as well as virgin feedstocks or makes intermediate products as well as converts those intermediate products into end products within the same facility. So the question becomes whether the establishment should be considered to be in the RRR industry and included in this study, and if so, what portion of the establishment's economic activities (employment, payroll, receipts), should be attributed to RRR.

This study has attempted to be consistent with the U.S. Recycling Economic Information Study (USREIS) and corresponding state studies in its definition of "covered activities" (i.e., those activities to be considered part of the RRR industry and measured by this study). Quoting the USREIS (page 2-1):

"The study boundaries:

- Include all "supply side" activities involved in recovering and preparing materials and used products for resale;
- Include "demand side" activities up to the first point at which the recovered materials or used products have successfully competed directly against their respective primary, or virgin equivalents;
- Exclude the activities of non-business entities such as individuals, and or advocacy, education, or other organizations which do not directly add value to recovered materials and used products, or directly support such activities; and,
- Exclude activities involving incineration or use of materials as fuel."

The third item is intended to exclude individuals or groups that, for example, set up collection sites or temporary collection programs, such as the Boy Scouts or school groups, to fund their

activities or simply as an environmental program. Although not stated, the study also excludes resources expended by establishments, such as grocery stores, to collect materials such as plastic bags for recycling. This study does, however, explicitly include sole proprietor businesses involved with RRR activities (these are almost exclusively in the recyclable materials wholesaling and used merchandise retailing industries).

The RRR activities specifically included in the study, and referred to as “covered activities” are (again quoting from the USREIS, page 2-1):

- “Collecting materials or used products for the purposes of intermediate processing, manufacturing, and/or distribution by reuse sales establishments;
- Intermediate processing of recovered materials or used products including sorting, cleaning, consolidating, treating, disassembling, densifying, and/or transferring ownership for use in processing, product manufacturing, and/or for distribution by reuse sales establishments;
- Reclaiming of recovered materials or used products to produce refined raw materials and/or reusable products meeting the specifications of manufacturers, reuse sales establishments or other end-users;
- Manufacturing of “first-stage” products containing recycled materials or used products;
- Operating wholesale or retail sales establishments that offer, largely or exclusively, used products prepared for reuse; and,
- Intimately supporting the above activities through research, equipment development and sales, consulting, engineering, brokering, and exchange services.

The end-point of recycling is considered to be the “first-stage” manufactured product. “First-stage” refers to the first product produced from recycled materials, such as a roll of paper, sheet of plastic, glass bottle, or metal billet. First-stage products are often converted into finished products (e.g., envelopes, plastic bottles, or metal parts), sometimes at the same facility. Only production of the first-stage products is intended to be included in this definition. At this stage, the recycled material has successfully competed against virgin material and is often indistinguishable from other first-stage products that are made from those virgin materials.”

As with the USREIS this study attempted to exclude economic activity associated with further conversion within the same facility, but this was often difficult to do without specific information from the establishment. In many cases, we had to rely on the judgment and interpretation of those who returned surveys to make this determination, or rely on the findings of the USREIS for given industries nationally.

2.2 BUSINESS CATEGORIES

This report presents RRR industry data for 26 business categories, which are listed and briefly defined in Table 2-1 (more detailed definitions are given in Appendix A). The 26 business categories are grouped into four sectors:

Recycling Collection (Categories 1-2): Includes only residential collection of recyclable materials. (We found from our surveys that there is considerable collection of recyclable materials from commercial customers, but to be consistent with the USREIS and its estimation methods, this study did not include collection from commercial sites.)

Recycling Processing (Categories 3-5): Includes sorting, recovering, consolidating, densifying, and brokering of recyclable materials, and the production of compost, mulch, or bedding from yard or other organic wastes.

Recycling Manufacturing (Categories 6-19): Includes manufacturing of first-stage products from recycled inputs.

Remanufacturing and Reuse (Categories 20-26): Includes remanufacturing of used or broken equipment and preparation of materials for reuse and resale.

The USREIS also included three support businesses explicitly (recycling and reuse equipment manufacturers, consulting/engineering firms, and transporters). This study did not consider these specifically, but it attempted to capture them as part of the estimates of indirect economic effects.

**Table 2-1
Business Category Definitions**

Business Category	Definition
Recycling Collection Sector	
1. Government Staffed Residential Curbside Collection	Recyclables collection using government employees
2. Private Staffed Residential Curbside Collection	Private collection of recyclables, including contract collection on behalf of municipalities

Recycling Processing Sector	
3. Compost and Miscellaneous Organics Producers	Produce compost, mulch, bark, or bedding from yard and wood waste, biosolids, or other organics; includes vermiculture
4. Materials Recovery Facilities	Process commingled or recovered materials, usually from curbside/drop-off collection or recyclables separated from solid waste
5. Recyclable Material Wholesalers	Paper stock dealers, scrap metal processors, and other establishments that sort, remove contaminants, and densify recovered materials and brokers of recovered materials
Recycling Manufacturing Sector	
6. Glass Container Manufacturing Plants	Produce finished glass containers
7. Glass product Producers (other recycled uses)	Produce glass products other than containers
8. Nonferrous Secondary Smelting and Refining Mills	Recycling and alloying of nonferrous metals, primary products include billets, ingots, and other basic shapes
9. Nonferrous Product Producers	Produce nonferrous products through extrusion, rolling, or drawing processes
10. Nonferrous Foundries	Produce castings from nonferrous metals
11. Paper, Paperboard, and Deinked Market Pulp Mills	Produce paper and paperboard products from recovered paper or market pulp and/or deink recovered paper and sell pulp
12. Paper-Based Product Manufacturers	Produce cellulose-based products from recovered paper or paperboard (e.g., cellulose insulation, hydro-seeding, animal bedding)
13. Pavement Mix Producers (asphalt and aggregate)	Produce asphalt paving mix from recycled materials such as crumb rubber, aggregates, glass

14. Plastics Reclaimers	Transform recovered plastics directly into products (e.g. plastic lumber) or raw materials ready for remanufacture
15. Plastics Converters	Convert a recycled plastic clean flake or pellet into intermediate or end product
16. Rubber Product Manufacturers	Manufacture products using crumb rubber or cut rubber shapes and stampings as feedstock
17. Steel Mills	Produce iron and steel slabs, billets, bar, plate, and sheet from scrap and/or raw materials
18. Iron and Steel Foundries	Produce cast iron and steel products
19. Other Recycling Processors/ Manufacturers	Other processors and manufacturers not elsewhere classified, using ash, sludge, engineering application of tires or other recovered materials.
Remanufacturing and Reuse Sector	
20. Computer and Electronic Appliance Re- and De-Manufacturers	Sort, grade, dismantle and/or rebuild used electronic appliances
21. Motor Vehicle Parts (used)	Clean, sort, inspect, and remanufacture used automobile parts
22. Retail Used Merchandise Sales	Retail thrift stores, antique shops, reuse centers, and other shops dedicated to selling used merchandise (but not pawn shops)
23. Tire Retreaders	Remove old tread from worn tires and add new tread
24. Wood Reuse	Process used wood for reuse (e.g., pallet rebuilders, construction materials)
25. Materials Exchange Services	Facilitate the reuse of products and materials by commercial and industrial establishments
26. Other Reuse	Other reuse or remanufacturing, not elsewhere classified (NEC)

2.3 TYPES OF INFORMATION DEVELOPED

This study focused on collecting and estimating four direct measures of economic activity related to RRR industries.

- **Number of Establishments:** An establishment is a single location where business is conducted or where services or industrial operations are performed. The number of establishments reported is the number estimated to be performing at least some amount of “covered activities.”
- **Employment:** Consists of full and part-time employees, including salaried officers and executives of corporations. This study also included sole proprietors in the recyclable material wholesaling and the retail used merchandise industries. For industries not devoted completely or almost completely to covered activities, the employment was adjusted according to the proportion of labor reported to be devoted to covered activities.
- **Annual Payroll:** Includes all forms of compensation, such as salaries, wages, commissions, bonuses, vacation allowances, sick-leave pay, and the value of payments in kind paid during the year to all employees, plus income of sole proprietors for those industries where they are included. For industries not devoted completely or almost completely to covered activities, annual payroll was adjusted according to the proportion of labor reported to be devoted to covered activities.
- **Annual Receipts:** Revenue from goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest dividends, and royalties. Excludes all revenue collected for local, state, and federal taxes.
- For industries not devoted completely or almost completely to covered activities, annual receipts were adjusted according to the proportion of receipts reported to be due to covered activities.

Two additional types of economic values were computed for employment, payroll, and receipts:

- **Indirect Economic Values:** these measures the economic activity accrued by other establishments (suppliers and customers) in the SLMA as a result of the activities of the RRR businesses.
- **Induced Economic Values:** These measure the economic activity accrued by retail and other establishments in the SLMA because of the personal purchases by those employed in the RRR industries and by indirect establishment employees.

The two sets of values were computed using multipliers that represent the ratio of total values (direct + indirect) or (direct + indirect + induced) to direct values.

SECTION 3 STUDY METHODOLOGY

3.1 OVERVIEW

This section provides a description of the general philosophy and methodologies used to develop the economic activity estimates reported in Sections 4 and 5. It discusses the problems encountered in attempting to duplicate exactly the USREIS methodologies for the SLMA, and explains how alternative approaches were developed to overcome these problems and to produce estimates in which we could have reasonable confidence. It includes general descriptions of the data sources utilized and the methodology used to survey companies. Details of the specific estimation methodologies used for each business category are given in Appendix B.

3.2 THE USREIS APPROACHES TO DIRECT DATA DEVELOPMENT

The USREIS used three approaches to derive direct estimates of economic activity for the 26 RRR business categories. For the two categories in the Recycling Collection Sector, the USREIS developed formulas for deriving the employment, payroll, and receipts from information it obtained from various sources (and assumptions it made) related to the number of households receiving curbside collection of recyclables and yard waste, the size of collection crews, the work rate of crews, absenteeism rates, and collection costs per household. Of the remaining 24 categories, the USREIS based its estimates on “existing data” for 13 of them and on survey data for the other 11. The existing data it used were primarily from the 1997 Economic Census, but in a couple cases, existing industry data were used. The survey data were from surveys of companies in states for which individual state or regional REIS studies had been done, and a separate survey of companies in the other 34 states for which REIS studies had not been previously done.

The economic census data were drawn from those industry categories in which it was believed RRR activity may be occurring. The economic census data were originally developed using the Standard Industrial Classification (SIC) system, but the Census Bureau began phasing out the SIC system in 1997 and is replacing it by the North American Industrial Classification System (NAICS). The 1997 economic census data are reported in both forms, but the NAICS typically provides more refined classification of industries.

3.3 THE APPROACHES TO DIRECT DATA DEVELOPMENT OF THIS STUDY

It was the initial intent of this study to duplicate the USREIS methodology for estimating direct economic values for each business category, but using data specific to the SLMA. For some business categories this was possible, and the USREIS methodology was used; however, for most business categories this was not possible. Counter to intuition, for many industries it is more

difficult to make these estimates for smaller geographic regions than for larger ones: (1) For the SLMA there may only be one or a few establishments in an industry, in which case economic census data by industry are not generally reported by the US Census Bureau so as not to reveal individual establishment data; (2) The small number of establishments makes it difficult to obtain a sufficiently large number of survey respondents within any specific industry to obtain statistically meaningful results (if we assume a 10% response rate, which is quite good, we would need at least 300 establishments in the industry to achieve the desired minimum of 30 respondents); (3) The small number of firms in some industries seemed to discourage companies from responding to the surveys, because even with assurances of confidentiality, they seemed concerned that their data would be revealed or someone would be able to deduce their data from reported totals. This concern seemed to be reflected in the fact that many companies were willing to provide employment ranges, but not payroll or receipts information. For these reasons it was necessary to develop alternative methods of estimation.

The overall approach we used was a “triangularization” approach. For almost every industry at least three different methods were used to estimate the desired quantities. We then selected the estimate that we felt was most accurate and defensible for that industry. This approach not only provided us with what we believed to be the most accurate estimates, it also strengthened our confidence in the accuracy of our estimates because for many industries the different estimation methods produced very similar results. In addition, estimates from some of the estimation methods could be determined to be upper or lower bounds on the exact values, and so they provided additional confidence in the approximate accuracy of the final estimates and created estimate intervals that were smaller and more defensible than standard statistical confidence intervals.

For almost all industries, the same general estimation procedures and data sources were used, but the amount, type, and quality of information that was available for each industry was often unique to that industry, so these methods often had to be customized for each industry. The following are the general estimation methods most commonly used.

1. USREIS Baseline Estimate: For each industry we began by computing a “baseline” estimate in which we simply allocated the USREIS estimates to the SLMA proportionally based on population (i.e., the SLMA makes up 0.925% of the U.S. population, so the USREIS estimates were multiplied by 0.00925). This had three purposes. First, it gave a baseline against which our final estimates could be compared to determine whether the recycling economic activity in the SLMA is larger or smaller than the national rate for that industry. Second, it provided a “face validity” check to make sure estimates obtained from other methods made sense; if the other estimates deviated substantially from these baseline values, there had to be a good identifiable justification. Third, when no other method provided what we considered to be a sound estimate, the baseline estimates were used as default estimates.

2. USREIS Methodology Estimate: Wherever possible we made estimates using exactly the same methodology as that used in the USREIS for the industry, but using data specific to the SLMA.

3. SLMA Economic Census Data Estimate: For most industries 1997 economic census data specific to the SLMA were used to make estimates. For some industries, this methodology was the same as the previous method (i.e., in those cases where the USREIS used economic census data directly for its estimates). In other cases the census data were used in various ways to derive as accurate an estimate as possible. Whenever economic census data were used, the 1997 payroll and receipts data were adjusted for inflation using an inflation factor based on the change in wages and prices from September 1997 through September 2002: 1.203 for payroll (based on the U.S. compensation index), 1.054 for receipts (based on the producer price index for finished goods), except retail used merchandise was adjusted by 1.123 (based on the consumer price index).

4. Survey Data Estimate: Surveys were sent to establishments in all 26 industries, and there was at least one survey response for almost every industry (the number returned in each industry varied from 1 to 35). (Details about the survey are given later in this section.) The survey data were used in various ways to make estimates. In some cases the survey responses were used to determine average establishment values, which were then used to estimate the entire industry's values. More often, the survey data were used to confirm or support the reasonableness of the estimates from the previous three methods or to establish bounds on the estimates. In some cases the survey data were also combined with information from the previous methods to derive what we thought would be more accurate estimates.

5. Other Data Sources and Methods: In some cases we obtained data from the *Sorkins Directory of Business and Government 2002 Edition for St. Louis*, the *St. Louis Business Journal*, industry or company web pages, and in some cases direct phone calls to companies. These data were usually used in conjunction with, or to verify, census or survey data as part of an estimation procedure.

Two driving forces in constructing and selecting estimation methods were to develop methods that were as accurate as possible, within the resources available, and to error on the side of being conservative whenever there was doubt. In general, the estimates reported here are based on methods that make either the same assumptions or more conservative assumptions than those used in the USREIS.

3.4 SURVEY METHODOLOGY

The USREIS collected survey data for only 11 of the 26 industries because it had accurate existing data for the remaining 15. Because such data did not always exist for those 15 industries for the SLMA, we sent surveys to companies in all 26 industries. In several cases the survey data became an important part of the estimation procedures. Even in those industries for which survey data

were not used to obtain the final estimates, the surveys often helped us to understand the industry better and to either increase our confidence in other estimation methods or to help us construct estimation intervals.

3.4.1 THE SURVEY DATABASE AND SURVEY SAMPLE

Initially a database of over 7200 establishments in the SLMA was created based on several sources. This was pruned to 4400 establishments based on the SICs used in the USREIS and the additional elimination of companies that did not seem suitable (e.g., trucking and moving, storage, passenger transport companies, pawn shops, etc.). Surveys were then sent to 1888 establishments. (Initially surveys were sent to 1700 establishments. Additional surveys were sent later for those industries where additional survey returns were needed, and when new relevant establishments were identified.) When surveys were returned as being undeliverable, usually due to the company no longer being at the mailing address, electronic and paper telephone books were consulted to determine if there was a new address. When a new address was found (which was true in about one-third of the cases), surveys were resent to the establishment. Of the 1888 surveys originally mailed 1754 of the establishments were determined to still be in business and at known addresses.

A stratified sampling approach was used: in those industries with less than 120 establishments in the SLMA all establishments were surveyed; in industries with more than 120 establishments surveys were sent to a random sample of establishments (there was one industry that was accidentally under sampled, but this was not a problem because the census data were very good for this one). Phone call follow-ups were made to a small set of companies who had not returned surveys in those industries considered to be of high priority. Unfortunately the phone surveys did not produce many useful returns. A total of 160 completed surveys were returned, of which approximately 110-120 provided sufficient data to be usable (many were unwilling or unable to indicate payroll, receipts, or percentage of covered activities).

To put these numbers in perspective, the USREIS had 6574 establishments in its database for the 34 states that had not commissioned state or regional REI studies. It sent surveys to 627 establishments and had 212 returns after three telephone follow-ups to all nonresponding companies. (How many of the 212 returns provided fully usable data was not reported.)

3.4.2 SURVEY DESIGN

Three different surveys were used to collect the survey data (copies of the surveys are contained in Appendix C). One survey was customized for recyclable material collectors and processors; one for reuse and resale businesses; and the third was for any business, but especially manufacturers and remanufacturers. The surveys were based on the USREIS survey, but they were modified in an attempt to make them easier to understand and complete. The three surveys are very similar, and ask for the same types of information. The first questions simply attempted to confirm or correct

the establishment name, mailing address, physical location, and name and phone number of a contact person. The survey then solicited responses to the following questions:

1. Classify the establishment according to the business categories defined for the study. Respondents could check more than one category, but they were then asked to identify the single category that was most representative of the RRR-related operations for the establishment.
2. Give estimates of establishment size in terms of number of employees, total annual payroll, and total annual receipts. Checkboxes with associated ranges (e.g., 0-9 employees, \$50,000-\$99,999 total payroll) were used because it was anticipated that using responses in ranges for such sensitive data, rather than exact numbers, would increase response rates.
3. Estimate the percentages of labor and receipts considered to be “covered” recycling, remanufacturing, or reuse activities. (Covered activities are defined on the survey, as described in section 2.1).
4. Estimate the amounts, by type, of recycled materials processed.
5. Estimate the percentage of recycled /reused inputs purchased from sources within the SLMA, and the percentage of recycled/reused materials or products sold by the facility to customers within the SLMA.

The main differences among the three surveys were

1. The collectors and processors survey contained only industry categories related to collection and processing (with an “other” category and room to describe the business), rather than containing all 36 category options that were on the general survey. The reuse and resale survey was similarly restricted to just a few reuse and resale industry categories.
2. The reuse and resale survey did not ask for the amounts of materials recycled or processed.

The primary purpose for using three surveys rather than one, was that there was concern that when possible respondents saw the 36 different industry options, they would be intimidated by the complexity and would not be as likely to complete the survey. So it was conjectured that by making some of the surveys simpler, the response rate would be higher. To check this hypothesis some establishments in the collectors and processors and reuse and resale category were sent the customized surveys and some were sent the general surveys. The results of this experiment are discussed in the results section.

3.4.3 VALIDATION OF SURVEY RESPONSES

All completed surveys were reviewed by the researchers to verify that the responses were reasonable and consistent. In a few cases it was clear from the responses that the company misunderstood the industry categories. In those cases the researchers assigned the company to a more appropriate primary business category. A more common problem was companies misunderstanding the definitions of covered activities, and overstating the extent of their covered activities. In these cases the researchers tried to more accurately reflect the covered activities, or simply did not include those responses in any final estimates. When answers appeared odd, such as the size of receipts not matching the number of employees, the researchers consulted other sources, such as *Sorkins*, or in some cases contacted the contact person to verify or correct the information. In addition, for some establishments that had missing data (mainly receipts), data were obtained from *Sorkins* when possible.

3.5 METHODOLOGY FOR INDIRECT AND INDUCED ECONOMIC VALUES

The USREIS used a variety of economic models to estimate indirect economic values (economic activity accrued by other establishments in the U.S. as a result of the activities of the RRR businesses) and induced economic values (economic activity accrued by retail and other establishments in the U.S. because of the personal purchases by those employed in the RRR businesses and by indirect establishments due to RRR activities). At the national level well-developed, accurate input-output models exist for making these estimates, but input-output economic multipliers to estimate indirect and induced economic values are far less accurate at local levels (it is possible to track economic flows into and out of the entire U.S. reasonably well, but it is quite difficult to determine how much of a company's purchases and sales are within the SLMA and how much of a person's consumption expenditures are local) and any resulting estimates have a large degree of uncertainty. (It should also be mentioned that estimating indirect and induced values is further complicated by the fact that many of the 26 RRR industries studied are either combinations of other industries or are one segment of larger industries, so that multipliers computed for standard industries often cannot be used; multipliers need to be computed specifically for these specially defined industries.) This study attempted to get some measure of this from the final two questions on the surveys, but the responses confirmed that few companies keep this information or have it readily available.

This study has attempted to estimate the indirect and induced economic values using a somewhat crude method, so they should be recognized as being very rough estimates. Multipliers for six individual states (Florida, Indiana, Ohio, Massachusetts, Delaware, and Pennsylvania) were taken from state or regional REI studies and averaged and then applied to the direct economic values computed. There are obvious flaws in using this method. First, industries in each state are different and each state has different multipliers. Second, these are state multipliers, whereas this study should use a bi-state multiplier. Third, larger states with more industrial development should have

larger multipliers than smaller, and less industrialized geographical units because they are more likely to be buying inputs and selling outputs within their state. However, upon closer inspection and thought, one can conclude that the multipliers used in this study are probably not excessively inaccurate, and at worst, probably overstate the indirect and induced effects to the SLMA economy by no more than 10-20%. The reasons for this are as follows:

1. Almost all of the economic activity measured by the state multipliers is due to activity that stays totally within metropolitan areas. Specifically, if a company buys equipment, legal services, or utilities from sources within the state, it is very likely that those sources are within the same metropolitan area. To an even greater extent, workers in a metropolitan area who spend their money in the state are probably spending a large majority of it within their metro area. Therefore, if the metro area is entirely within one state (e.g., Cleveland or Miami) the metro area multipliers are probably at least 70-90% of the state multiplier values.
2. There is a very large degree of economic integration among companies on the Missouri and Illinois sides of the SLMA, and a moderately large flow of consumers and consumer spending between the two states. In fact, it is likely that companies and consumers on the Missouri side of the SLMA buy as much or more goods and services from Illinois sources as they do from suppliers in Missouri, but outside the SLMA. Similarly, Illinois companies and consumers probably buy more goods and services from Missouri SLMA companies, than from Illinois sources outside the SLMA. If this is true, then the SLMA multipliers are actually larger than the State of Missouri multipliers, and using state multipliers would actually underestimate economic activity rather than overestimating it. (It is not unusual for bi-state or tri-state metro areas to have larger multipliers than their individual state multipliers).
3. For many individual industries, the state multipliers were very similar in value and almost independent of the size and level of industry of the state. For example, the indirect jobs multiplier for government collection ranged from 1.05 to 1.28 with four states being between 1.05 and 1.08. Similarly, for plastics converters the indirect jobs multipliers ranged from 1.60 to 1.92.

Therefore, given that the SLMA is very industrialized, Missouri is comparable to or larger in size than three of the six states, and that the multipliers for the SLMA may be larger than those for Missouri as a whole, using the average of the six state multipliers is not unreasonable, although it is worth repeating, that these values should be treated as being very approximate (as should indirect or induced economic values derived for any local area).

SECTION 4 STUDY RESULTS

This section presents detailed results, explanations, and comparisons of economic value estimates for RRR business categories and sectors. Detailed explanations of how these estimates were derived are presented in Appendix B.

4.1 ESTIMATES OF DIRECT ECONOMIC VALUES

4.1.1 ESTIMATES AND CONTRIBUTIONS BY BUSINESS CATEGORY

Table 4-1 gives the estimates that were derived for the number of establishments, employment, annual payroll, and annual receipts for each of the 26 RRR business categories in the SLMA, and the totals for each industry sector. For the 26 categories in total, it is estimated that there are 1458 establishments performing covered RRR activities, of which 904 are nonemployers (mostly sole proprietors). These establishments devote 15,776 workers to covered RRR activities, with an estimated annual payroll of \$639,910,000 and generating annual receipts of \$4,911,458,000.

Of the 15,776 people employed nearly 80% of them work in seven RRR industries:

Largest RRR Business Categories

1. Steel mills (3040 workers)
2. Nonferrous product producers (1869 workers)
3. Recyclable material wholesalers (1652 workers)
4. Plastics converters (1630 workers)
5. Retail used merchandise (1611 workers)
6. Iron and steel foundries (1490 workers)
7. Nonferrous foundries (1300 workers)

Five of these seven are manufacturers that use recycled materials as feedstock to their production processes. These five manufacturing categories employ 9329 workers in covered activities, which is nearly 60% of all RRR employment in the SLMA. A majority of these activities and workers are employed on the Illinois side of the SLMA. The other two large employers are retail used merchandise sales and recyclable materials wholesalers/brokers. The large number of workers in the retail used merchandise category is neither surprising nor abnormal compared to the rest of the country. There has been a general proliferation of used merchandise stores around the nation, and it is a very low-skill, labor-intensive, capital-nonintensive business. Wages tend to be at or near minimum wage levels and receipts per worker are low, which explains why this category makes up over 10% of the RRR employment but only 3.4% of payroll and 1.3% of receipts.

Table 4-1
Estimates of Direct Economic Values for RRR Industries in the SLMA

Recycling Industry Activity	Establishments	Employment	Payroll <i>in (000)</i>	Receipts <i>in (000)</i>
1. Govt. Staffed Residential Collection	11	116	\$4,081	\$6,526
2. Private Staffed Collection	18	238	\$8,372	\$19,366
Total Recycling Collection	29	354	\$12,453	\$25,892
3. Compost & Organics Prod.	21	293	\$3,059	\$17,630
4. Material Recovery Facilities	29	360	\$12,916	\$32,799
5. Recyclable Material Wholesalers	171	1652	\$74,499	\$2,387,555
Total Recycling Processing	221	2305	\$90,474	\$2,437,984
6. Glass Container Mfg. Plants	1	225	\$10,285	\$45,000
7. Glass Products (other uses)	2	22	\$430	\$2,093
8. Nonferrous Sec. Smelting & Refining	2	491	\$20,503	\$194,750
9. Nonferrous Product Producers	5	1869	\$94,728	\$717,517
10. Nonferrous Foundries	16	1300	\$44,465	\$151,118
11. Paper & Paperboard Mills	0	0	\$0	\$0
12. Paper-based Product Mfg	9	98	\$2,385	\$13,081
13. Pavement Mix Producers	4	32	\$1,257	\$7,695
14. Plastics Reclaimers	1	18	\$621	\$1,513
15. Plastics Converters	25	1630	\$60,450	\$269,312
16. Rubber Product Manufacturers	2	35	\$586	\$4,387
17. Steel Mills	1	3040	\$190,373	\$665,000
18. Iron and Steel Foundries	15	1490	\$56,516	\$165,408
19. Other Recycling Processing/Mfging	24	156	\$4,308	\$21,070
Total Recycling Manufacturing	107	10406	\$486,907	\$2,257,944
Total Recycling Industries	357	13065	\$589,834	\$4,721,820
20. Computer & Electronic Demanufact.	28	221	\$5,368	\$25,060
21. Motor Vehicle parts	66	424	\$10,814	\$51,400
22. Retail used merchandise	990	1611	\$21,654	\$65,553
23. Tire Retreaders	10	304	\$9,050	\$34,181
24. Wood reuse	5	84	\$1,740	\$8,389
25. Materials exchange services	0	0	\$0	\$0
26. Other Remanufacturing & Reuse	2	67	\$1,450	\$5,055
Total Remanufacturing & Reuse	1101	2711	\$50,076	\$189,638
Total All Industries	1458	15776	\$639,910	\$4,911,458

The recyclable materials wholesalers/brokers industry is quite large in the SLMA. The SLMA is a leading exporter of recyclables, and it is the home for several of the nation's largest recyclables wholesaling/brokering businesses. Some of these brokers have annual sales in the hundreds of millions of dollars, and the recyclable materials wholesalers' category as a whole has nearly \$2.4 billion in annual sales. Although this was not measured as part of the study, the amount of

recyclables being exported from the SLMA has probably increased substantially in recent years (probably to the detriment of the local economy) because two large users of recyclables, the Laclede Steel mill and the Smurfit-Stone paperboard mill, closed in the past couple years. Locally, there are now no large users of recycled paper and paperboard (comparable to the Smurfit-Stone mill), and local manufacturing demand for scrap steel dropped dramatically with the closing of Laclede Steel.

The collection and material recovery facilities categories are relatively small in employment (less than 5% of the RRR total), payroll, and receipts (just over 1% of the RRR total), but they may play an important role in the RRR industry as a whole. The above average rate of recyclables collection and the high rate of materials processing and recovery provide plentiful supplies of recyclable materials for local manufacturers and large sources of supplies for wholesalers/brokers to sell and ship. Unfortunately, for many manufacturing industries raw materials represent a relatively small portion of production costs, and so local price advantages due to plentiful supplies of recycled raw materials (steel, paper, plastic) does not always translate into making the SLMA the most economical location for recycling manufacturers.

One surprising bright spot was the electronics remanufacturing and resale industry. Because it is small (221 workers), it has been “operating below the radar screen,” but it appears to be growing rapidly in the SLMA, and its activity is well above the national average for this industry. Remanufacturing in general may be a potential area of employment growth.

4.1.2 COMPARISON OF THE RRR SECTORS

The USREIS grouped the 26 RRR industries into four groups: (1) Recycling Collection (primary collection of recyclable materials); (2) Recycling Processing (sorting, densifying, and brokering of recyclable materials); (3) Recycling Manufacturing (manufacturing of products from recycled materials); (4) Remanufacturing and Reuse (cleaning, repairing, reconditioning and reselling of manufactured goods). The economic activity and contribution of each sector are summarized in Table 4-2, Summary of Direct Economic Activity by Sector.

**Table 4-2
Summary of Direct Economic Activity by Sector**

	Sector Industry				RRR Industry Total
	Recycling Collection	Recycling Processing	Recycling Manufacturing	Remanufacturing and Reuse	
Establishments	29	221	107	1,101	1,458
Employment	354	2,305	10,406	2,711	15,776
Annual Payroll	\$12,453,000	\$90,474,000	\$486,907,000	\$50,076,000	\$639,910,000
Annual Receipts	\$25,892,000	\$2,437,984,000	\$2,257,944,000	\$189,638,000	\$4,911,458,000

Table 4-3 shows that almost 66% of the employment is due to recycling manufacturing, and this sector represents just over 76% of the payroll in the RRR industries. This is quite consistent with the results of the USREIS: at the national level the USREIS found that recycling manufacturing contributed almost 63% of the total employment and 76% of the payroll. The industries in the manufacturing sector are made up of high value-adding businesses (converting raw materials into valuable intermediate or finished products), which require highly skilled and highly paid labor (an average annual payroll per worker of almost \$50,000). In the SLMA the receipts for this sector, however, are only 46% of the total, compared to nearly 74% at the national level. This is due to the very large receipts for the recyclables wholesaling/brokering category in the SLMA. The recycling manufacturing sector was even larger a couple years ago, but the closures of the Laclede Steel mill and the Smurfit-Stone paperboard mill in Alton eliminated over 1000 jobs and \$200-300 million in annual receipts. This indicates how dependent RRR manufacturing activities are on large employers. Two existing establishments (Granite City Steel and Olin Corp.) account for nearly half of the recycling manufacturing employment and over half the recycling manufacturing payroll in the SLMA. This highlights the importance of local and state governments providing whatever support is possible to keep these businesses operating in the SLMA.

The collection sector represents only 2% of the total RRR employment and payroll and 0.5% of annual receipts. This sector is made up primarily of low-skilled waste collectors (however, their average annual pay is over \$35,000, due to both the high physical demands of the job and probably the unionization of many of the workers). Although the recycling collection sector is economically small and appears insignificant, it probably plays a major role in the vitality of the processing and manufacturing sectors. Without the above average rate of recyclables collection (compared to the national rate), the SLMA probably would not have become a center of wholesaling/brokering, and having large local supplies of recyclables has probably helped to make the SLMA more attractive to recycling manufacturers.

The recycling processing and remanufacturing/reuse sectors are quite heterogeneous, so making statements based on the aggregated values for these sectors can be dangerous. Within the recycling processing sector there are many low-skill, low-paying jobs involved with sorting and densifying recyclables. But this sector also includes highly skilled material wholesalers/brokers. The SLMA is a major center of recyclables wholesaling, with some very large wholesaling companies, and 60 sole proprietors. The very large receipt for this industry, relative to employment, distorts the relative receipts of the four sectors. The remanufacturing and reuse sector is similarly heterogeneous. 90% of these establishments are retailers of used merchandise, such as clothes, books, and furniture, and the pay per worker is at or near the minimum wage. Sole proprietors also dominate this industry. On the other hand, there is some moderately skilled remanufacturing of electronics products and retreading of tires, which pay substantially more (an average of \$24,000-30,000 per year).

4.1.3 COMPARISON OF RRR IN THE SLMA TO NATIONAL AVERAGES

Comparing the SLMA business category estimates to the USREIS national values indicates that the RRR industries appear to make up a larger part of the SLMA economy than they do at the national level. Table 4-3 compares the RRR business category and sector values to those that would result if the SLMA had RRR activity equal to the national average.

**Table 4-3
Comparison of SLMA Estimates to USREIS Estimates Based on National Averages**

<i>Recycling Industry Activity</i>	<i>Establishments</i>		<i>Employment</i>		<i>Payroll in (\$000)</i>		<i>Receipts in (\$000)</i>	
	SLMA	Base	SLMA	Base	SLMA	Base	SLMA	Base
1. Govt. Staffed Residential. Collection	11	28	116	98	4081	3513	6526	6027
2. Private Staffed Collection	18	57	238	198	8372	7135	19366	12237
Total Recycling Collection	29	85	354	296	12453	10648	25892	18264
3. Compost & Organics Prod.	21	21	293	293	3059	3059	17630	17630
4. Material Recovery Facilities	29	6	360	131	12916	2466	32799	10168
5. Recyclable Materials Wholesalers	171	139	1652	1119	74499	40284	2387555	397410
Total Recycling Processing	221	166	2305	1543	90474	45809	2437984	425208
6. Glass Container Mfg. Plants	1	1	225	176	10285	8420	45000	36837
7. Glass Products (other uses)	2	1	22	44	430	859	2093	4185
8. Nonferrous Sec. Smelting & Refining	2	2	491	118	20503	4940	194750	64446
9. Nonferrous Product Producers	5	2	1869	336	94728	15380	717517	126214
10. Nonferrous Foundries	16	13	1300	641	44465	23897	151118	83504
11. Paper & Paperboard Mills	0	4	0	1289	0	76679	0	476001
12. Paper-based Product Mfg	9	2	98	119	2385	2893	13081	15872
13. Pavement Mix Producers	4	1	32	32	1257	1257	7695	7695
14. Plastics Reclaimers	1	7	18	180	621	6209	1513	15125
15. Plastics Converters	25	23	1630	1653	60450	49530	269312	258548
16. Rubber Product Manufacturers	2	1	35	36	586	846	4387	3491
17. Steel Mills	1	1	3040	1097	190373	68697	665000	448520
18. Iron and Steel Foundries	15	11	1490	1168	56516	49298	165408	162691
19. Other Recycling Processing/Mfging	24	5	156	138	4308	3806	21070	18616
Total Recycling Manufacturing	107	74	10406	7027	486907	312711	2257944	1721745
Total Recycling Industries	357	325	13065	8866	589834	369168	4721820	2165217
20. Computer & Electronic Demanufact.	28	2	221	35	5368	863	25060	4028
21. Motor Vehicle parts	66	66	424	424	10814	10814	51400	51400
22. Retail used merchandise*	990	972	1611	1711	21654	25293	65553	86350
23. Tire Retreaders	10	7	304	73	9050	2141	34181	9580
24. Wood reuse	5	5	84	84	1740	1740	8389	8389
25. Materials exchange services	0	0	0	2	0	41	0	157
26. Other Remanufacturing & Reuse	2	1	67	40	1450	869	5055	4855
Total Remanufacturing & Reuse	1101	1053	2711	2369	50076	41761	189638	164759
Total All Industries	1458	1378	15776	11235	639910	410929	4911458	2329976

(In Table 4-3 the “baseline estimates” were obtained by multiplying the USREIS national values by the population of the SLMA and then dividing by the national population, based on the 2000 census, and adjusting for inflation to be consistent with our SLMA estimates.)

The rates of collection and processing of recyclables in the SLMA are above the national average, based on the USREIS. This high rate of collection and processing may be the impetus for the SLMA being a major center of wholesale trading and brokering of recyclable materials. Somewhat surprisingly, the SLMA is also above the national average in recycling-based manufacturing (using recycled materials directly in manufacturing), and in the remanufacturing and reuse of products. Although the SLMA is above the national average in all four RRR sectors, it is not above average in every business category. Based on employment, the SLMA is well above the national average in the following 13 categories:

Business Categories with Employment Well Above the National Average (% above)

1. Government Staffed Residential Collection (18%)
2. Private Staffed Residential Collection (20%)
4. Material Recovery Facilities (175%)
5. Recyclable Material Wholesalers/Brokers (48%)
6. Glass Container Manufacturers (28%)
8. Nonferrous Secondary Smelters and Refiners (316%)
9. Nonferrous Product Producers (456%)
10. Nonferrous Foundries (103%)
17. Steel Mills (177%)
18. Iron and Steel Foundries (28%)
20. Computer and Electronics Re/Demanufacturing (531%)
23. Tire Retreaders (316%)
26. Other Remanufacturing/Reuse (68%)

It should be noted that the well above average performance in several of the categories is due to only one or two dominant establishments in those industries. Specifically, removing just one establishment from the glass container, nonferrous product producers, steel mills, or “other remanufacturing and reuse” categories would put those industries well below the national average (and in two cases, employment would be zero). More generally, the above average performance in recycling manufacturing as a whole is quite tenuous because it is due to two large manufacturers, one in the steel industry (Granite City Steel) and one in nonferrous materials (Olin Corp.). Recent closings of two other recycling-based manufacturers, the Laclede Steel mill and the Smurfit-Stone paperboard mill in Alton, show how vulnerable these basic industries are to economic downturns, but they also show opportunities that exist for expanding recycling-based industries and employment.

Again based on employment, the SLMA is well below the national average in the following five business categories.

Business Categories with Employment Well Below the National Average (% below)

- 7. Glass Products (other uses) (50%)
- 11. Paper and Paperboard Mills (100%)
- 12. Paper-based Products Manufacturing (18%)
- 14. Plastics Reclaimers (90%)
- 25. Materials Exchange Services (100%)

Two of these industries are quite small nationally, glass products (other uses) and materials exchange services, so below average employment in these has little effect.

In the remaining eight RRR business categories employment in the SLMA is within 15% of the national averages.

The estimates of above-average RRR activity overall, relative to those reported nationally by the USREIS, was somewhat surprising because this study used more conservative estimation procedures than the USREIS. This may be partially due to the fact that we know the SLMA well, so we could uncover a more extensive and accurate list of companies in the RRR industries than the USREIS researchers could do nationally. Based on our own experiences, we found that relying simply on standard databases, such as the USREIS did, misses many companies, especially the smaller and newer companies. During our research we were constantly discovering RRR companies through various sources, including word-of-mouth, articles in local publications, or even seeing trucks on the highway that were carrying recyclables.

4.1.4 COMPARISON OF THE RRR INDUSTRY TO OTHER SLMA INDUSTRIES

To put the extent and size of the RRR industry in perspective, Table 4-4 compares the direct economic values of the RRR industries to those of other industries in the SLMA. The values for the other industries are from the 1997 economic census, with inflationary adjustments to payroll and receipts comparable to those used for the RRR industries. Notice that the direct contributions of RRR to the SLMA economy are larger than those of the utilities industry (electricity, gas, water and sewage combined), the food, beverage, and tobacco manufacturing industries combined, computer and electronic products manufacturing, primary metals manufacturing, and the printing industry, and they are about the same size as chemical manufacturing and machinery manufacturing. Clearly the recycling, remanufacturing and reuse industries are an important part of the SLMA economy.

Table 4-4
Comparison of Direct Economic Activity of RRR to other SLMA Industries

Industry	Employment	Annual Payroll	Annual Receipts
RRR	15,776	\$639,910,000	\$4,911,458,000
Utilities	8,152	\$519,131,000	\$3,103,745,000
Food Mfg.	9,139	\$308,826,000	\$2,754,972,000
Beverage & Tobacco Product Mfg.	3,531	\$222,994,000	\$2,132,240,000
Computer & Electronic Products Mfg	6,641	\$295,197,000	\$1,804,060,000
Chemical Mfg.	12,530	\$615,617,000	\$5,488,475,000
Primary Metals Mfg.	12,466	\$598,880,000	\$3,680,607,000
Machinery Manufacturing	16,166	\$687,262,000	\$2,917,277,000
Printing & Related Support Activities	10,959	\$446,994,000	\$1,342,784,000

4.2 ESTIMATES OF INDIRECT AND INDUCED ECONOMIC VALUES

In addition to the direct economic benefits measured above, when establishments in the RRR industries buy goods and services from suppliers in the SLMA, they create additional jobs and economic value in the SLMA. The additional employment, payroll, and receipts that result from these purchases are referred to here as “indirect economic values” for the SLMA. The economic activity accrued to retail and other establishments in the SLMA that result from purchases by those employed directly in the RRR industries and by indirect establishments due to RRR activities, are referred to as “induced economic values.” Indirect and induced economic values were estimated for each RRR business category using the methodology described in Section 3.5. Tables 4-5A, 4-5B, and 4-5C list the direct, indirect, induced, and total values for employment (Table 4-5A), payroll/personal income (Table 4-5B), receipts/value-of-output (Table 4-5C). In each table the multipliers (derived using the methodology in Section 3-5) are also reported.

Table 4-5A
SLMA Indirect and Induced Employment Values

RRR Industry	Employment				Jobs Multipliers	
	Direct	Indirect	Induced	Total	Indirect	Induced
1. Govt. Staffed Residential Collection	116	14	37	167	1.12	1.44
2. Private Staffed Collection	238	38	76	352	1.16	1.48
Total Recycling Collection	354	52	113	519	1.15	1.47
3. Compost & Organics Prod.	293	120	170	583	1.41	1.99
4. Material Recovery Facilities	360	126	173	659	1.35	1.83
5. Recyclable Mat'l Wholesalers	1652	727	1371	3750	1.44	2.27
Total Recycling Processing	2305	973	1714	4992	1.42	2.17
6. Glass Container Mfg. Plants	225	151	178	554	1.67	2.46
7. Glass Products (other uses)	22	4	7	33	1.17	1.48
8. Nonferrous Sec. Smelting & Refining	491	820	609	1920	2.67	3.91
9. Nonferrous Product Producers	1869	2561	2037	6467	2.37	3.46
10. Nonferrous Foundries	1300	559	728	2587	1.43	1.99
11. Paper & Paperboard Mills	0	0	0	0	1.95	2.88
12. Paper-based Product Mfg	98	35	47	180	1.36	1.84
13. Pavement Mix Producers	32	26	27	85	1.82	2.67
14. Plastics Reclaimers	18	12	10	40	1.67	2.22
15. Plastics Converters	1630	1271	1043	3945	1.78	2.42
16. Rubber Product Manufacturers	35	12	15	63	1.35	1.79
17. Steel Mills	3040	4013	3587	10640	2.32	3.50
18. Iron and Steel Foundries	1490	671	1013	3174	1.45	2.13
19. Other Recycling Proc/Mfging	156	53	86	295	1.34	1.89
Total Recycling Manufacturing	10406	10188	9388	29981	1.98	2.88
Total Recycling Industries	13065	11213	11215	35492	1.86	2.72
20. Computer & Electronic Demfg	221	95	102	418	1.43	1.89
21. Motor Vehicle parts	424	165	183	772	1.39	1.82
22. Retail used merchandise	1611	277	477	2365	1.17	1.47
23. Tire Retreaders	304	124	146	574	1.41	1.89
24. Wood reuse	84	50	44	178	1.60	2.12
25. Materials exchange services	0	0	0	0	1.45	2.04
26. Other Reuse	67	51	46	165	1.77	2.46
Total Remanufacturing & Reuse	2711	762	998	4471	1.28	1.65
Total All RRR Industries	15776	11975	12212	39963	1.76	2.53

Table 4-5B
SLMA Indirect and Induced Personal Income Values

	Personal Income (\$000)				Income Multipliers	
	Direct	Indirect	Induced	Total	Indirect	Induced
1. Govt. Staffed Residential Collection	4081	612	1265	5958	1.15	1.46
2. Private Staffed Collection	8372	1674	2679	12725	1.20	1.52
Total Recycling Collection	12453	2287	3944	18684	1.18	1.50
3. Compost & Organics Prod.	3059	918	1254	5231	1.30	1.71
4. Material Recovery Facilities	12916	6329	5812	25057	1.49	1.94
5. Recyclable Mat'l Wholesalers	74499	27565	44699	146763	1.37	1.97
Total Recycling Processing	90474	34811	51766	177051	1.38	1.96
6. Glass Container Mfg. Plants	10285	6274	5554	22113	1.61	2.15
7. Glass Products (other uses)	430	108	159	697	1.25	1.62
8. Nonferrous Sec. Smelting & Refining	20503	33420	17017	70940	2.63	3.46
9. Nonferrous Product Producers	94728	106095	66310	267133	2.12	2.82
10. Nonferrous Foundries	44465	21788	21343	87596	1.49	1.97
11. Paper & Paperboard Mills	0	0	0	0	1.78	2.35
12. Paper-based Product Mfg	2385	1193	1193	4770	1.50	2.00
13. Pavement Mix Producers	1257	993	716	2967	1.79	2.36
14. Plastics Reclaimers	621	540	354	1515	1.87	2.44
15. Plastics Converters	60450	61055	38688	160193	2.01	2.65
16. Rubber Product Manufacturers	586	398	328	1313	1.68	2.24
17. Steel Mills	190373	178951	118031	487355	1.94	2.56
18. Iron and Steel Foundries	56516	22606	25997	105120	1.40	1.86
19. Other Recycling Proc/Mfging	4308	2068	2542	8918	1.48	2.07
Total Recycling Manufacturing	486907	435488	298233	1220628	1.89	2.51
Total Recycling Industries	589834	472586	353943	1416363	1.80	2.40
20. Computer & Electronic Demfg	5368	4348	3167	12883	1.81	2.40
21. Motor Vehicle parts	10814	7137	5731	23683	1.66	2.19
22. Retail used merchandise	21654	6929	10177	38761	1.32	1.79
23. Tire Retreaders	9050	4616	4344	18010	1.51	1.99
24. Wood reuse	1740	1549	1044	4333	1.89	2.49
25. Materials exchange services	0	0	0	0	1.26	1.60
26. Other Reuse	1450	1131	856	3437	1.78	2.37
Total Remanufacturing & Reuse	50076	25710	25319	101105	1.51	2.02
Total All RRR Industries	639910	498296	379262	1517468	1.78	2.37

Table 4-5C
SLMA Indirect and Induced Industrial Output Values

	Industrial Output (\$000)				Output Multipliers	
	Direct	Indirect	Induced	Total	Indirect	Induced
1. Govt. Staffed Residential Collection	6526	1109	3916	11551	1.17	1.77
2. Private Staffed Collection	19366	4261	9102	32729	1.22	1.69
Total Recycling Collection	25892	5370	13018	44280	1.21	1.71
3. Compost & Organics Prod.	17630	4584	6347	28561	1.26	1.62
4. Material Recovery Facilities	32799	9840	11808	54446	1.30	1.66
5. Recyclable Mat'l Wholesalers	2387555	596889	1002773	3987217	1.25	1.67
Total Recycling Processing	2437984	611312	1020928	4070224	1.25	1.67
6. Glass Container Mfg. Plants	45000	14850	14400	74250	1.33	1.65
7. Glass Products (other uses)	2093	419	942	3453	1.20	1.65
8. Nonferrous Sec. Smelting & Refining	194750	62320	33108	290178	1.32	1.49
9. Nonferrous Product Producers	717517	287007	165029	1169553	1.40	1.63
10. Nonferrous Foundries	151118	60447	57425	268990	1.40	1.78
11. Paper & Paperboard Mills	0	0	0	0	1.34	1.57
12. Paper-based Product Mfg	13081	3401	3924	20406	1.26	1.56
13. Pavement Mix Producers	7695	2847	2539	13082	1.37	1.70
14. Plastics Reclaimers	1513	560	348	2421	1.37	1.60
15. Plastics Converters	269312	102339	67328	438979	1.38	1.63
16. Rubber Product Manufacturers	4387	1667	1579	7633	1.38	1.74
17. Steel Mills	665000	266000	166250	1097250	1.40	1.65
18. Iron and Steel Foundries	165408	56239	66163	287810	1.34	1.74
19. Other Recycling Proc/Mfging	21070	6110	8217	35398	1.29	1.68
Total Recycling Manufacturing	2257944	864205	587253	3709402	1.38	1.64
Total Recycling Industries	4721820	1480887	1621198	7823905	1.31	1.65
20. Computer & Electronic Demfg	25060	10525	7518	43103	1.42	1.72
21. Motor Vehicle parts	51400	21074	14906	87380	1.41	1.70
22. Retail used merchandise	65553	17699	27532	110785	1.27	1.69
23. Tire Retreaders	34181	11280	10596	56057	1.33	1.64
24. Wood reuse	8389	4195	2936	15520	1.50	1.85
25. Materials exchange services	0	0	0	0	1.21	1.52
26. Other Reuse	5055	2426	1870	9352	1.48	1.85
Total Remanufacturing & Reuse	189638	67199	65359	322196	1.35	1.70
Total All RRR Industries	4911458	1548087	1686557	8146101	1.32	1.66

In addition to the direct employment of 15,776, this study estimates that the RRR industries generate additional indirect employment of 11,975 and induced employment of 12,212, for a total employment in the SLMA of 39,963. Similarly, the direct, indirect, and induced annual personal income in the SLMA attributed to RRR is estimated to be \$1,517,468,000, and the total monetary value of the direct, indirect, and induced output is \$8,146,101,000.

Earlier it was noted that businesses in the recycling manufacturing sector accounted for almost two-thirds of direct RRR employment and over three-fourths the direct payroll. Furthermore, a majority of these jobs and payroll are due to just a handful of establishments. This clearly shows the importance of large industrial establishments. Yet these direct economic values understate the importance of these large manufacturers on the economic well being of the RRR industry and the SLMA as a whole. These companies are very large buyers of local goods and services, and their employees are relatively well paid, so the local multipliers for indirect and induced economic effects for these industries are very large relative to other industries. Of the 26 business categories, the induced employment multipliers for only three business categories are above 3.00: Nonferrous Secondary Smelting and Refining, Nonferrous Product Producers, and Steel Mills. Several other of the manufacturing categories have induced employment multipliers above 2.00. The result is that the recycling manufacturing sector accounts for over 75% of the total employment (direct, indirect, and induced) attributable to RRR industries, and over 80% of the total annual payroll. Clearly, it is very important to the SLMA to retain, and hopefully attract, establishments in recycling-based manufacturing industries.

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

The purpose of this study was simply to estimate the values of important economic measures related to recycling, remanufacturing, and reuse business activities in the SLMA. There was no attempt to investigate the dynamics of the industries, temporal patterns, geographical patterns, or any underlying causes for the magnitudes or distributions of the values. However, in the process of collecting and analyzing the data, some general observations and conclusions, or at least conjectures, are possible. In addition, there were a number of things that the researchers learned while performing this study, which could be of value in selecting and executing future studies related to RRR activities. These conclusions, conjectures, and suggestions for future study are presented below.

5.1 CONCLUSIONS

Although these issues were not specifically researched for this study, the following are some observations and conclusions.

1. There is a very wide variety of materials and products recycled, remanufactured, and reused in the SLMA. Most people are familiar with the more common materials: steel, copper, aluminum, glass, plastic, paper, clothes, books, vehicle parts, and furniture. But we also identified establishments that recycled, remanufactured or reused oil, solvents, lead, salts, metal drums, computers, telecommunications equipment, sports equipment, wood, and tires. In addition, there are opportunities for many other materials and products to be recycled or reused, such as medical supplies and devices.
2. RRR businesses are quite diverse and span the manufacturing, service, and construction sectors of the economy. Some are very labor intensive with relatively low capital requirements, such as recycling collection, materials recovery, retail used merchandise sales, and many types of remanufacturing. Others are very capital intensive and require high-skilled workers; these are mainly in the recycling manufacturing sector.
3. RRR businesses employ a very wide range of workers. There are many opportunities for very low-skill workers in the collection, material recovery, pallet remanufacturing, and used merchandise sales businesses. Medium to high skill jobs, with commensurately higher pay, are available in the manufacturing and remanufacturing industries as well as in the wholesale brokering business. It would appear that there are some good opportunities in the scientific and engineering research fields to investigate new materials that can be recovered and reused, and devising methods to recover and reuse materials and products. In fact, we encountered a number of consulting companies that specialize in advising companies (including companies that are not part of the RRR industry) on how to reduce, reuse, and recycle materials as part of their business operations.

4. A substantial portion of RRR employment and payroll in the SLMA are currently attributable to a few large establishments. Because of the interrelationships among companies in the RRR value chain, closure of one or a few of these large employers could have a substantial negative impact on other establishments earlier in the value chain. For example, the closing of the only local paperboard mill eliminated a major source of demand for locally collected paper scrap, and closure of one of the two local steel mills substantially reduced the local demand for and consumption of scrap steel. Closure of additional large recycling manufacturers could dry up most or all local demand for scrap steel, brass, and copper. Therefore, local and state governments should undertake whatever actions they can to retain these businesses in the SLMA.

5. Currently the SLMA is very strong in the areas of steel manufacturing and nonferrous products manufacturing, but it is well below the national average in paper and paperboard production and plastics reclaiming manufacturing. It would seem that with the excellent local collection rates for recyclables, including paper and plastic, there would be some opportunities for attracting manufacturers that use paper and plastic scrap. Although we are not familiar with the current status of the Smurfit-Stone paperboard mill in Alton, it would seem that efforts to reopen that mill, possibly under different ownership, might be pursued by government officials. Similarly, the SLMA currently appears to have a good source of recycled plastic scrap, and a large number of companies that produce plastic end products, but there appears to be an absence of companies that reclaim and transform the scrap into plastic pellets and granulated plastic for use by product producers. It would seem that the plentiful raw material supplies and the large number of potential customers for primary plastic products would make the SLMA attractive as a location for potential plastics reclaimers.

6. Although there are a few dominant RRR establishments in the SLMA, over 90% of the RRR businesses are small to medium in size (typically fewer than 50 workers). Most of these companies are in industries with relatively low barriers to entry, not requiring high levels of technology or large amounts of capital. In fact, RRR industries are very attractive to entrepreneurs. There are over 900 nonemployers (mainly sole proprietors, but also several husband/wife or family partnerships) just in the recyclable materials wholesalers and retail used merchandise categories. But we also found many very small companies (often with less than five or ten workers) in most other categories, including many manufacturing categories. So RRR businesses appear to offer excellent entrepreneurial opportunities, which may not be evident to government officials or the general public. Greater publicity of this fact could be beneficial.

7. Although recyclables collection and first stage processing do not employ a large number of people or generate large amounts of receipts directly, these businesses form an important part of the RRR value chain. Having plentiful, low-cost supplies of recyclable materials in usable form (cleaned, densified, and baled) available locally promotes downstream business activities that are much more value-adding and which create more jobs with higher payroll. So efforts to increase recyclables collection should be maintained.

8. The Remanufacturing and Reuse sector offers substantial economic benefits to the SLMA, which are probably not obvious, and are probably under measured and unappreciated. Used items tend to lose all or almost all of their economic value quickly. Yet remanufacturing that item can often return its value close to its original value. If the original item was made outside the SLMA, then the value added to the remanufactured item, and the labor to remanufacture it, is retained in the SLMA. In fact, this is a good way to attract/import manufacturing to the SLMA that is currently not here. For example, most or all telephone and telecommunications equipment is not manufactured locally. But there are several new, local companies that remanufacture and resell that equipment. So a used telecommunications “box”, which may have sold for \$1000 new, and which normally would have been discarded after a few years when a system was upgraded, is now purchased for a few dollars (or taken as trade-in), remanufactured and then sold for maybe \$800. This remanufactured box is then replacing a new box that would have been imported from outside the SLMA. The local company in effect is able to capture most of the manufacturing value and employment locally.

5.2 SUGGESTIONS FOR FUTURE STUDIES

There are two sets of suggestions. The first set addresses changes and improvements that we would make in performing any similar recycling economic information (REI) study in the future. The second set addresses other types of studies that might be pursued related to RRR industries in the SLMA or the States of Missouri and Illinois.

Recommendations for Future Recycling Economic Information Studies

1. Data are currently being collected by the U.S. Census Bureau for the 2002 economic census. Any REI study done in 2004 or later should make use of this more current data.
2. The survey can be shortened and simplified in a number of ways. First, the question dealing with the amount and disposition of inputs in the manufacturing process can probably be eliminated. Very few companies completed this part, and many indicated that they either did not keep such data, or it was not readily available. With so few companies in any industry and so few likely respondents, any data received for this question would probably not be representative, and it was not used in this study. Similarly, the last two questions dealing with the amount of inputs purchased from the SLMA and outputs sold to buyers within the SLMA could be deleted. The goal of this was to get alternative information to measure indirect economic values, but so few establishments keep these data, the answers to these questions were ultimately not used.
3. The changes in (2) would make the survey shorter and even less imposing, which should increase response rate. We experimented by sending both general surveys and slightly shorter industry specific surveys to establishments in the remanufacturing/reuse sector. We only had

enough responses in the retail used merchandise category to have a meaningful comparison, but we found that the response rate with the shorter survey was higher.

4. The current response ranges (number of employees, percent of labor devoted to covered activities, etc.) should be modified slightly to identify extreme cases. Specifically, for number of employees and payroll a "0" category should be added to identify whether the establishment has no employees (and then the next category would begin at 1 rather than 0). Similarly, for the percentages of covered labor and receipts, 0% and 100% boxes should be added to differentiate between the cases of no covered activities and small amounts and totally covered activities and large amounts.

5. Telephone follow-ups should be used more extensively, but the procedure should be modified. Our callers attempted to get the contact people to complete the survey verbally over the phone. The result was that few people were able or willing to provide the required information in real-time, so except for identifying the business category and possibly the number of employees, few phone respondents were willing or able to provide the other information. Future studies should use the phone follow-ups to identify a good contact person, and to get the commitment of that person to complete the paper survey. New surveys should then be mailed or faxed to that person, and a follow-up call made a week or two later as a reminder, if the survey is not returned. This gives the contact person time to gather the needed information and to complete the survey when it is more convenient.

6. For the SLMA future studies should make more extensive use of the *Sorkins Directory*. Although we did make some use of *Sorkins* in developing the original database, and in verifying or completing the information for some companies that gave seemingly inconsistent responses, we did not attempt to consult *Sorkins* for every company surveyed or to obtain data for those that did not respond. In addition, while consulting *Sorkins* for other reasons we found several RRR companies that were not in our original database. If the resources are available, future studies should consider doing a complete review of *Sorkins* to both identify RRR establishments and to obtain data for a more extensive set of establishments.

7. There are a variety of RRR activities that the USREIS and this study did not attempt to measure. For example, we identified several recycling collectors that did not perform residential collection, so we did not include them in our estimates, but these jobs are clearly involved with and dependent on RRR activities. There is also some collection done by not-for-profit groups, such as the Boy Scouts or school clubs, that generate revenue by collecting aluminum cans. These activities have economic benefit to society above and beyond those attributable to the ultimate purchaser of the cans, and it may be worth measuring the extent of these activities. There are also extensive recycling and reuse activities internal to companies; i.e., companies capture and reuse materials within their own production process. Some measure of this may be of value.

Recommendations for Other RRR-Related Studies

1. The USREIS and this study are snapshots of the RRR industry at a point in time. Especially with the forthcoming 2002 economic census, it might be of value to perform temporal studies that could measure whether RRR activities are increasing or decreasing, in which categories, and to what extent.
2. For the SLMA and for the States of Missouri and Illinois there may be some value in developing and maintaining a current database of RRR economic information. Specifically, using sources, such as *Sorkins Directory*, industry and business publications, web-sites, industry reports, and some regular targeted surveying a database could be developed that would provide data for most of the companies involved in RRR activities. This would allow constant monitoring of the health and growth of the RRR industries, and it would provide early warning of trends in the industry. It would also be an excellent source for governments, public agencies, and other companies to identify potential sources of recycled materials or remanufactured or reused products, and possible partners for entrepreneurial activities.
3. The remanufacturing and reuse sector appears to be especially promising as a way to indirectly attract manufacturing activity for Missouri, Illinois, and the SLMA. A study which attempts to better measure and understand this sector might be helpful in devising ways to assist this sector in growing and retaining dollars in the area that are currently flowing out of the area to non-SLMA manufacturers.

APPENDIX A DESCRIPTIONS OF RECYCLING, REMANUFACTURING, AND REUSE CATEGORIES

Table A-1 provides descriptions of the 26 recycling, remanufacturing, and reuse (RRR) business categories that were measured directly. The categories are intended to duplicate those used by the USREIS. The descriptions have been abbreviated in some cases; complete descriptions for all categories can be found in Table A-1 of the USREIS report. For each category the Standard Industrial Classification (SIC) codes and the North American Industry Classification System (NAICS) codes that were used to define the categories are listed.

**TABLE A-1
DESCRIPTIONS OF INDUSTRY SECTORS AND RRR BUSINESS CATEGORIES**

Industry Sector	Business Categories in Sectors	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Collection	<p>1. Government Staffed Residential Curbside Collection</p> <p>Programs staffed by municipal, state, or other government agencies that provide curbside, drop-off, or other recycling collection services. Does not include programs focused on education, market development or other activities not directly supporting collection programs. Does not include municipal programs staffed by private contractors.</p>	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)
	<p>2. Private Staffed Residential Curbside Collection</p> <p>Private sector establishments that provide recycling collection services to residential waste generators, sometimes under contract to municipal or other government agencies.</p>	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)
Recycling Processing	<p>3. Compost and Miscellaneous Organics Producers</p> <p>Establishments that produce compost, mulch, bark and other soil amendment or landscaping products from source separated yard trimmings, discarded wood and food, biosolids, and other organic feedstocks; includes vermiculture.</p>	2875 Fertilizers (mixing only)	325314 Fertilizers (mixing only)
	<p>4. Materials Recovery Facilities</p> <p>Establishments that accept mixed and/or source separated recyclables, typically from municipal and drop-off collection programs. Activities include sorting, bailing, grinding, densifying and/or brokering recyclables for wholesale distribution.</p>	4953 Refuse Systems	56292 Materials Recovery Facilities

Industry Sector	Business Categories in Sectors	Typical SIC Code Assignments	Typical NAICS Code Assignments
	<p>5. Recyclable Material Wholesalers</p> <p>Establishments that process recycled materials by sorting, grading, densifying, removing contaminants, and otherwise preparing the materials for shipment to manufacturing facilities for use in industrial production, and/or establishments that provide recovered materials brokering services, such as paper stock dealers and scrap processors.</p>	5093 Scrap & Waste material Wholesalers	42193 Recyclable Material Wholesalers
Recycling Manufacturing	<p>6. Glass Container Manufacturing Plants</p> <p>Establishments that produce finished glass containers for shipment to bottlers, using recycled glass cullet as a feedstock.</p>	3221 Glass Containers	327213 Glass Containers
	<p>7. Glass Product Producers (other recycled uses)</p> <p>Establishments that produce products other than containers, using recycled glass as a feedstock. Examples include fiberglass, decorative tiles, glassware, and construction blocks.</p>	3229 Pressed and Blown Glass and Glassware	327212 Pressed and Blown Glass and Glassware
	<p>8. Nonferrous Secondary Smelting and Refining Mills</p> <p>Establishments involved in the recovery and alloying of nonferrous metals. Activities include grading, sorting, detinning, refining, and other processes. Produce intermediate products, such as ingot. May also include fabrication of basic products.</p>	3341 Secondary smelting and refining (S&R) of NF metals. 3339 Primary S&R of NF metals, except copper and aluminum	331314, 331423, 331492 Miscellaneous Secondary Nonferrous Smelting, Refining, and Alloying
	<p>9. Nonferrous Product Producers</p> <p>Establishments that produce a wide range of intermediate products through extrusion processes, primarily from billets manufactured in smelting operations. Many of these plants also operate in-house casting operations that process unrefined nonferrous scrap.</p>	3351-3356 Miscellaneous Nonferrous Products	331315, 331316, 331319, 331421 Miscellaneous Nonferrous Products
	<p>10. Nonferrous Foundries</p> <p>Establishments that produce castings and die-castings of various nonferrous metals and alloys. Many manufacturers of end products (e.g. automobiles) may operate foundries and purchase scrap.</p>	3363-3369 Nonferrous Foundries	331521-331528 Nonferrous Foundries
	<p>11. Paper and Paperboard Mills/Deinked Market Pulp Producers</p> <p>Establishments that produce first stage intermediate paper and paperboard products (e.g. paper rolls) using recovered paper or deinked market pulp as a feedstock. Also includes establishments that deink recovered paper and produce market pulp for sale to paper and paperboard mills.</p>	2621 Paper Mills 2631 Paperboard Mills	322121 Paper Mills (except newsprint) 322122 Newsprint Mills 32213 Paperboard Mills

Industry Sector	Business Categories in Sectors	Typical SIC Code Assignments	Typical NAICS Code Assignments
	<p>12. Paper-based Product Manufacturers</p> <p>Establishments that produce paper products other than traditional paper and paperboard products, using discarded paper as feedstock. Examples include cellulose insulation, molded fiber products, construction board, or animal bedding.</p>	2679 Miscellaneous Converted Paper and Paperboard Products	322299 Other Converted Paper Product Manufacturing (egg cartons, molded pulp)
	<p>13. Pavement Mix Producers (asphalt and aggregate)</p> <p>Establishments that produce asphalt paving mix and aggregate for use in road construction using recycled pavement, asphalt, rubber modifies asphalt, and/or glass, in addition to virgin materials.</p>	2951 Asphalt Paving Mixtures and Blocks	324121 Asphalt Paving Mixtures and Blocks
	<p>14. Plastics Reclaimers</p> <p>Establishments that produce plastic pellets or granulated plastic suitable for use by plastics product manufacturers. Activities include separating, washing, grinding, flaking and/or pelletizing. Includes establishments that manufacture intermediate products directly from unprocessed recycled plastic, such as plastic lumber products.</p>	3087 Custom Compounding of Purchased Plastics Resins	325991 Custom Compounding of Purchased Plastics Resins
	<p>15. Plastic Converters</p> <p>Establishments that produce intermediate plastic products (e.g., molded products and components, sheet, and fiber) using recycled pellets or granulated plastic as feedstock.</p>	3081-3089 Miscellaneous Plastics products	3261 Plastic Product Manufacturing
	<p>16. Rubber Product Manufacturers</p> <p>Establishments that produce first-stage intermediate products or end products using crumb rubber as feedstock.</p>	3011, 3021, 3052, 3053, 3069 Variety of rubber products, such as tires, inner tubes, footwear, hoses, belts gaskets	3262 Rubber Products Manufacturing (but excluding 326212 tire retreading)
	<p>17. Steel Mills</p> <p>Basic oxygen furnaces (BOF) producing raw steel in various forms using a mix of scrap and molten iron , and also electric arc furnaces using scrap. Primary products are slabs, billets, rebar, or flat or rolled products. Additional fabrication and assembly of final stage products may occur at these facilities.</p>	3312 Steel Works, Blast Furnaces and Rolling Mills	331111 Iron and Steel Mills
	<p>18. Iron and Steel Foundries</p> <p>Establishments that produce a wide range of cast steel products using unrefined scrap and steel ingot produced in steel mills. Activities may include grading scrap, refining, and casting.</p>	3321-3325 Iron and Steel Foundries	331511-331513 Iron and Steel Foundries

Industry Sector	Business Categories in Sectors	Typical SIC Code Assignments	Typical NAICS Code Assignments
	<p>19. Other Collectors and Recycling Processors and Manufacturers</p> <p>Other collectors, recycling processors and manufacturers, not elsewhere classified. May include nongovernmental operators of collection sites, used oil refiners, household hazardous waste processors, engineering application of tires, and other users of materials not elsewhere classified.</p>	Various	Various
Remanufacturing and Reuse	<p>20. Computer and Electronic Appliance Demanufacturers</p> <p>Establishments that sort, classify, grade and remanufacture used electronic equipment, especially computers. Remanufacture may encompass entire appliances or components. They may also recycle materials not suitable for remanufacture.</p>	5065 Electronic Parts 7378 Computer Maintenance and Repair	421690 Other Electr. Parts and Equipment Wholesalers 811212 Computer & Office Machine Repair and Maintenance
	<p>21. Motor Vehicle Parts (used)</p> <p>Establishments that clean, sort, inspect, and remanufacture used motor vehicle parts</p>	5015 Wholesale Used Motor Vehicle Parts	42114 Motor Vehicle Parts (used) Wholesale
	<p>22. Retail Used Merchandise Sales</p> <p>Establishments that operate retail facilities dedicated to reused products. Activities may include drop-off or pick-up collection services for used products; cleaning, repairing, and otherwise preparing for resale. Includes thrift stores, reusable product depots, reuse centers, and product-specific stores such as used clothing and sporting goods. Note: neither pawn shops nor used vehicle sales are included.</p>	5932 Used Merchandise Stores (retail)	45331 Used Merchandise Stores (excluding pawn shops)
	<p>23. Tire Retreaders</p> <p>Establishments that sort, clean, buff, and remanufacture used tires by adding new tread. They also produce crumb rubber as a by-product.</p>	7534 Tire Retreading and Repair Shops	326212 Tire Retreading
	<p>24. Wood Reuse</p> <p>Establishments that produce lumber and/or finished goods by cleaning, grading, and otherwise processing used wood; includes remanufacture of wood pallets. Does not include establishments whose primary use is fuel.</p>	2448 Wood Pallets and Skids 2499 Wood Products, NEC	32192 Wood Container and Pallet Manufacturing 321999 Wood Products, NEC
	<p>25. Materials Exchange Services</p> <p>Establishments that provide listings and otherwise facilitate the reuse of products and materials, primarily by commercial and industrial establishments.</p>	7389 Business services, NEC	54199 All Other Professional, Scientific, and Technical Services

Industry Sector	Business Categories in Sectors	Typical SIC Code Assignments	Typical NAICS Code Assignments
	<p>26. Other Reuse</p> <p>Establishments not elsewhere classified that purchase used equipment or merchandise and remanufacture, clean, or otherwise prepare the used product for distribution.</p>	<p>5082-5084 Wholesale Machinery, Equipment, and Supplies</p>	<p>42181-42183 Wholesale Machinery, Equipment, and Supplies</p>

APPENDIX B

DETAILED DESCRIPTIONS OF THE METHODOLOGIES AND RESULTING ESTIMATES FOR EACH BUSINESS CATEGORY

Due to the unavailability of good data for many RRR business categories, customized estimation methods had to be devised for many of the categories. As described in Section 3, typically at least three estimation methods were used for each business category, and then the method that was believed to be most accurate for that category was selected to be the final estimate. This appendix gives a very detailed description of each method used for each category and gives the resulting estimates along with the rationale of why the “final” method was selected. Although as much information as possible is provided about the aggregate survey responses for each business category, individual establishment information is not reported, nor is aggregate data reported when it might reveal the identity of or proprietary data about a company. When only public information was used, such as from *Sorkins* or company web pages, company identities may be revealed to explain the estimates.

In the following discussions the *Baseline* estimates are always obtained by taking the USREIS estimates for the economic values and multiplying them by 0.00925 (the proportion: SLMA population divided by the U.S. population, based on the 2000 census). The payroll and receipts values for the 1997 economic census data are all adjusted for inflation using an inflation factor based on the change in wages and prices from September 1997 through September 2002: 1.203 for payroll (based on the U.S. compensation index), 1.054 for receipts (based on the producer price index for finished goods), except retail used merchandise was adjusted by 1.123 (based on the consumer price index).

1. Government Staffed Collection

[a] *Baseline* (Based on USREIS derivation formulas)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	3,052	10,560	379,751	651,590
x 0.00925	28	98	3,513	6,027

(Payroll was based on 1997 economic census values, so it has been adjusted for inflation.)

[b] Application of USREIS methodology, with SLMA population and household data.

The USREIS computed the economic values using a set of formulas. We will discuss each USREIS formula and our corresponding application of it in order.

(i) Number of establishments = (Number of curbside programs) x (Percent of homes collected by government staffed collection)

The USREIS identified the number of curbside recycling collection programs nationally as 9247, and it estimated that 33% of the curbside programs were government staffed.

The SLMAREIS had access to a previous (and ongoing) survey by University of Missouri Outreach and Extension of local governments which included information about number of households, who collected their solid waste (government-staffed or if collected by a private company, which company), frequency of collection, whether recyclables were collected (and by whom), whether yard wastes were collected, whether the recycling and yard waste collection programs were universal or discretionary (especially if a separate fee was charged to users), estimated participation rates, and monthly costs per user/household. The information was relatively complete for incorporated municipalities on the Missouri side of the SLMA, and for many of the incorporated municipalities on the Illinois side. For the remaining households in Missouri we assumed that 50% of the households had curbside recycling (this is the national average assumed by the USREIS), and for the remaining households in Illinois we assumed 33% had curbside recycling. (We assumed this below average recycling access because the data for incorporated areas indicated a lower recycling rate in Illinois, and many of the areas are more rural and undeveloped than those on the Missouri side of the SLMA.)

From the UM Outreach and Extension survey we identified 11 government-staffed curbside recycling collection programs. Because of the completeness of the survey, we assumed that any households for which we did not have information, were probably being collected by private companies. So 11 was our final estimate of the number of establishments. (This is not a crucial assumption for the overall study. The important values for collection are the total employment, payroll, and receipts for government-staffed and privately-staff collection combined, so if any collection is mis-assigned to one category or the other, there is no effect on the total collection values.)

(ii) Employment

The USREIS computed the number of workers collecting recyclables and yard waste separately and then added them together as follows (the assumed values for the variables used by the USREIS are given with the variable definitions).

$$\text{Number of Recycling Collection Employees} = [(A/(B*C*F))*D*E]*[(1+G)*(1+H)],$$

and

$$\text{Number of Yard Waste Collection Employees} = [(A/(B*L*F))*D*M*N*O]*[(1+G)*(1+H)],$$

where

A = U.S. population with curbside recycling collection = 133,165,000

B = Persons per household = 2.61 nationally

C = Homes collected per truck per day for recycling = 900

D = Percent of homes collected by government staffed collection = 33%

E = Average crew size per truck for recycling = 1.5

F = Collection days per cycle = 5

G = Additional percent supervisory = 10%

H = Additional percent absenteeism, etc. = 5%

J = Recycling collection cost per household per month = \$2.00

L = Homes collected per truck per day for yard waste = 1000

M = Average crew per truck for yard waste = 2

N = Percent of households (that have curbside collection) with yard waste collection = 70%

O = Percent of year yard waste collection takes place = 75%

P = Yard waste collection cost per household per month = \$1.75

These formulas were implemented for the SLMAREIS in the following way. From the UM Outreach and Extension survey and our assumptions about remaining households, we estimated the number of households receiving curbside recycling to be 571,087. (The UM Outreach and Extension survey identified 465,087 households receiving curbside recycling, and an additional 106,000 households were estimated to be receiving recycling collection based on our assumptions. This is 52.2% of the all households in the SLMA, which is somewhat above the national average assumed by the USREIS to be 50%.)

Based on actual survey data, there were eleven government-staffed curbside recycling programs identified collecting from 69,318 households. (This is 12.1% of all households receiving recycling collection, well below the national average assumed by the USREIS of 33%. All other curbside recycling, not counting yard waste, was believed to be privately staffed. This low percentage of government-staffed collection was not surprising; waste collection in the SLMA is extensively outsourced by municipalities and private collection dominates the SLMA compared to municipalities nationally.)

From the UM Outreach and Extension survey we determined almost all houses in St. Louis County and other Missouri incorporated areas have access (either automatic or voluntary) to yard waste collection; data on Illinois was very limited. For Illinois and for areas of Missouri for which we did not have survey data we assumed 35% of households have access to curbside yard waste collection (the national average). This gave a total of 775,727 households having access to yard waste collection. In many cases the yard waste collection is split between city and private collection, and in other cases there is private collection of recyclables and city collection of yard waste. So the percentage of homes where yard waste is collected by the government is probably greater than the 12% for recyclables. (In fact, it is probably much greater because St. Louis City has very little recyclables collection, but the city collects yard waste; just adding St. Louis City collection to the government recyclable collection number gives us 212,694 households with government yard waste collection, which is 27.4% of all houses with yard waste collection. The actual number is probably above 33%, so we assumed one-third of the yard waste collection was government staffed. (The effect of this assumption is minimal on overall collection employment and economic activity because it simply affects the split between public and private collection.) So one-third of the households with yard waste collection is 258,576.

Note that the number of households receiving government staffed recycling collection is equivalent to $(A \cdot D / B)$ in the USREIS formula, and the number of households receiving government staffed yard waste collection is equivalent to $(A \cdot D \cdot N / B)$. So replacing these quantities with our direct estimates of the numbers of households receiving recycling and yard waste collection, and assuming the USREIS values for the other variables in the formulas, we get

$$\begin{aligned} \text{No. of Govt. Staffed Recycling Collection Employees} &= [(69,318 / (C \cdot F)) \cdot E] \cdot [(1+G) \cdot (1+H)] \\ &= [((69,318) / (900 \cdot 5)) \cdot 1.5] \cdot [(1.10) \cdot (1.05)] = 26.69 \end{aligned}$$

$$\begin{aligned} \text{No. of Govt. Staffed Yard Waste Collection Employees} &= [258,576 / (L \cdot F)] \cdot [M \cdot O] \cdot [(1+G) \cdot (1+H)] \\ &= [(258,576) / (1000 \cdot 5)] \cdot [2 \cdot 75] \cdot [(1.10) \cdot (1.05)] = 89.60 \end{aligned}$$

$$\text{Total Government Staffed Collection Employment} = 26.69 + 89.60 = 116.29 = 116$$

(iii) Annual Payroll

The USREIS computed the annual payroll by multiplying the total employment by \$29,893, which was the average pay for collection employees from the 1997 economic census.

From the 1997 economic census, the average pay per worker for solid waste collection (NAICS category 562111) in the SLMA was \$29,242. Adjusting the average pay per employee for inflation gives \$35,178. Then the

$$\text{Annual Payroll} = 116 \text{ employees} \times \$35,178 = \$4,080,648.$$

(iv) Annual Receipts

The USREIS computed annual receipts as

$$\text{Annual receipts} = (A/B) * D * (J + N * P) * 12 \text{ months/year.}$$

This is the number of households receiving recycling and yard waste collection multiplied by the cost per month for each (\$2.00 for recycling and \$1.75 for yard waste), times the number of months each year the service is received. (In computing receipts the USREIS appears to assume 12 months collection of yard waste; we assume 9 months throughout.)

Based on the UM Outreach and Extension survey of municipalities, the median cost for recycling collection was \$2.59 per month, with a simple average of \$2.84 per month, but there was a clear pattern that the charge was lower in larger cities, so the \$2.84 is skewed upward. (Only two cities in Illinois reported costs, so only the Missouri values were used.) Taking a conservative approach, we used \$2.25 per month for government staffed recycling collection, which is in line with the USREIS, which assumed \$2.00 a month. Yard waste costs for government collection were estimated to be \$2.00 per month (this was the cost for the *least* expensive private collections). This gives

$$\begin{aligned} \text{Annual Receipts} &= [69,318 \text{ households with recycling} \times \$2.25 \text{ per month} \times 12 \text{ months}] + \\ &\quad [258,576 \text{ households with government collected yard waste} \times \$2.00 \text{ per month} \times 9 \\ &\quad \text{months} = \$1,871,586 + \$4,654,368 = \$6,525,954. \end{aligned}$$

Final Estimates

Establishments	11
Employment	116
Annual Payroll	\$4,081,000
Annual Receipts	\$6,526,000

2. Private Staffed Collections

[a] *Baseline (Based on USREIS derivation formulas)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	6,195	21,450	771,370	1,322,925
x 0.00925	57	198	7,135	12,237

(Payroll was based on 1997 economic census values, so it has been adjusted for inflation.)

[b] *Application of USREIS methodology with SLMA population and household data.*

The USREIS used the same formulas to compute the private staffed collection of recyclables and yard waste, assuming that 67% of all collection was privately staffed.

(i) Number of Establishments

From the UM Outreach and Extension survey of municipalities survey we identified 16 private establishments with municipal curbside collection contracts. The SLMAREIS surveys identified two other smaller collection companies that collect on a contract basis from individuals (usually in unincorporated areas) and they perform commercial/industrial collection, of which some is recycling activity. This suggests that there are probably several more private collectors (possibly 30-40 in total). However, we took a conservative approach on this and only included the 18 we could identify explicitly. This number is much smaller than the baseline value of 57, probably because a few large collectors dominate the SLMA market.

(ii) Employment

Subtracting the number of households receiving government staffed recycling collection from the total receiving collection, gives 501,769 households receiving private staffed recycling collection. Using the same computations as for government staffed collection:

$$\begin{aligned} \text{No. of Private Staffed Recycling Collection Employees} &= [(501,769/(C*F))*E]*[(1+G)*(1+H)] \\ &= [((501,769)/(900*5))*1.5]*[(1.10)*(1.05)] = 193.18 \end{aligned}$$

Estimating the extent of private staffed yard waste collection is much more complex because some households receive both government collection (such as for leaves and tree limbs), and private staffed collection. Also, unlike government staffed yard waste collection which all households in a municipality would receive, many households with access to private yard waste collection often must contract with the collector and pay for it as an extra charge. Some of these households purchase this service on a monthly or yearly basis, while many more purchase it on a per bag basis. To account for this fact, we assumed that the participation rate for private yard waste collection is 25%. So of the 517,151 households with access to private yard waste collection, we are assuming the equivalent of 25% of them, 129,288 households, receive full-time contract collection. Therefore, the

$$\begin{aligned} \text{No. of Private Staffed Yard Waste Collect. Employees} &= [(129,288)/(L*F)][M*O][(1+G)*(1+H)] \\ &= [(129,288)/(1000*5)]*[2*.75][(1.10)*(1.05)] = 44.80 \end{aligned}$$

$$\text{Total employees} = 193.18 + 44.80 = 237.98 = 238$$

(iii) Annual Payroll

Using the same approach as for government staffed collection:

$$\text{Annual Payroll} = 238 \text{ employees} \times \$35,178 = \$ 8,372,364$$

(iv) Annual Receipts

For private staffed recycling collection a cost of \$2.25 per month was used because much of this collection is done on a contract basis with municipalities, which are able to negotiate favorable rates. (When individuals pay separately for recycling collection on a voluntary basis the cost charged by collectors is usually much higher than this.) For private collection of yard wastes, the costs reported in the UM Outreach and Extension survey were much higher than for recycling; the median for the Missouri cities reporting was \$5.00 and the average was \$4.89. (A check of recent prices from some collectors indicated that the price in some areas is now well above \$5.00 per month.) We assumed that the cost per household for full-time equivalent collection was \$5.00 per month. (Remember, we assumed only a 25% participation rate. Although less than 25% may subscribe on a regular basis, many residents participate on a per bag basis, paying a fee of typically \$1.50 - \$2.00 for each bag of yard waste. In addition, note that some houses receive double yard waste service, possibly private collection as well as leaf and tree trimming collection by the city, and these double costs are not being included in our estimates.)

$$\begin{aligned} \text{Annual Receipts} &= [501,769 \text{ households with recycling} \times \$2.25 \text{ per month} \times 12 \text{ months}] + \\ & [129,288 \text{ households with private collected yard waste} \times \$5.00 \text{ per month} \times 9 \text{ months}] = \\ & \$13,547,763 + \$5,817,960 = \$19,365,723. \end{aligned}$$

[c] Survey Data

There were nearly 900 establishments in the original database with an SIC of 4212 (Local Trucking without Storage), which was used by the USREIS as the census code for this business category. Most of these companies were clearly not involved in waste collection. This list was pruned to 211 establishments, all of which were sent surveys. Twelve establishments returned surveys indicating that they were primarily private-staffed waste collectors; of these only four had a 4212 SIC.

Of the twelve establishments responding, four appeared to do contract curbside recycling collection, but only three provided sufficiently complete data to be useful. For these three establishments (using the midpoint values of their interval responses and weighting labor and payroll by the percentage of labor spent on covered activities), the employment devoted to covered activities was 58.5 and the annual payroll was \$1,436,000. Based on economic census data for the SLMA, it appears that these three establishments make up approximately 1/4 of the private waste collection market in the SLMA. If they are 1/4 of the market then this would project out to 234 workers and \$5,744,000 in annual payroll for the SLMA as a whole. These values are quite consistent with the estimates in [a] and [b]. All three companies did not report the receipts, so no estimate was attempted.

The other eight establishments responding were small collection/recovery operations (in some cases they were operators of recyclables collection sites that then hauled the materials to processors or brokers). Because the USREIS did not include these collection activities, no attempt was made in this study to estimate the extent of this activity in the SLMA. However, these eight alone employed over 40 workers, so future studies might consider measuring this sector of the recycling industry.

[d] SLMA Economic Census Data

The 1997 economic census reported that for NAICS 562111 (Solid Waste Collection without disposal) the SLMA had 73 establishments, employment of 1557, payroll of \$54,773,000 and annual receipts of \$202,572,000. The three establishments mentioned in [c] reported that 10-19% of their labor was used for covered activities. If these companies are representative of other private collectors, then 15% of the census employment of 1557 would be 234 workers which is exactly the value computed in [c] and almost exactly that computed in [b]. Similarly, 15% of the census payroll would be \$8,216,000, almost exactly the same as in [b]. Only two of the three establishments reported the percentage of covered receipts (both said 0-9%), so it would be quite tenuous to estimate their receipts from covered recycling. However, if we assumed covered receipts were on average 5% of all collection establishments' receipts, the resulting estimate would be $\$202,572,000 \times 0.05 = \$10,129,000$. If covered activities were 10% of receipts this would project to \$20,257,000 in receipts. The estimates from [a] and [b] are within this range.

Our final estimates are based on method [b], because we believe we were able to duplicate the USREIS method accurately with data specific to the SLMA. In addition, the other three methods provide similar, confirming estimates.

Final Estimates

Establishments	18
Employment	238
Annual Payroll	\$8,372,000
Annual Receipts	\$19,366,000

3. Compost and Miscellaneous Organics Producers

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	2,295	31,718	330,679	1,905,971
x0.00925	21	293	3,059	17,630

[b] SLMA Economic Census Data

Economic census data for the 325314 NAICS category was not available for the SLMA because there were too few establishments and/or there was a dominant establishment. Deducing the data from the SLMA 1997 economic census (taking data for those classified as NAICS 3253 minus those in subcategories other than 325314) indicates the following:

Number of establishments	4
Employment	161
Payroll	\$9,393,000
Receipts	\$59,905,000

The number of establishments and employees is way below the baseline values of 21 and 293, but the payroll and receipts values are far above the baseline values of \$3,059,000 and \$17,630,000. The resulting wage per worker is also very large, so we are reluctant to use the deduced SLMA census values. But it should be noted that the USREIS, which used survey data, found that the number of establishments doing composting, etc. was about five times the number listed in this NAICS category in the national economic census; the number of employees was about 3.5 times the NAICS national value, 1.4 times the NAICS payroll, but only 57% of the NAICS receipts.

Making comparable adjustments (using the same proportions of the USREIS values to the national census values) indicates that there are 20 establishments, with 578 employees, \$13,134,000 annual payroll, and \$34,316,000 in annual receipts in the SLMA.

[c] Survey Data

We identified 8 private compost/organics producers in the SLMA, sent surveys to them all, and received surveys from three of them. (This does not include primarily landfill operators.) All three were small producers (one of which is probably a sole proprietor) with a total estimated number of employees of between 6 and 17, a payroll of between \$150,000 and \$600,000, and receipts of \$650,000-\$1.300 million. (It should also be noted that in spite of the USREIS using the 2875 SIC code, none of the three survey respondents were classified as 2875 in the data bases that had an SIC listed. Our impression is that most compost/organics producers do not view themselves as fertilizer producers.) Because these three appear to be among the smaller of the eight companies identified, they are not representative, and we really cannot use these data to project recycling employment, etc, other than to use them as a projected lower bound on values, i.e., we can probably say that employment, payroll, and receipts are at least three times the total values reported by them.

Considering that the SLMA appears to have a more extensive yard waste recycling program than the national average, we should expect the composting/mulching rate to be at least that of the national average, so for this reason we used the baseline values for our final estimates. These should be considered very uncertain, but probably on the conservative side considering the estimates in [b].

Final Estimates

Establishments	21
Employment	293
Annual Payroll	\$3,059,000
Annual Receipts	\$17,630,000

It should be noted that these estimates do not include any composting or organics production done by governments. There appear to be some cities that do, in fact, have government staffed mulching and composting operations that are tied to their yard waste collection activities.

4. Materials Recovery Facilities

(a) *Baseline* (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	668	14,155	266,590	1,099,272
x 0.00925	6	131	2,466	10,168

[b] *SLMA Economic Census Data*

Census data for the 56292 NAICS category (Material Recovery facilities) was not available for the SLMA because there were too few establishments and/or there was a dominant establishment. Deducing the data from the SLMA 1997 economic census (taking data for those classified as NAICS 5629 minus those in 56291 produced the following.

Establishments	37
Employment	407
Payroll	\$13,527,000
Receipts	\$35,833,000

These are larger than the baseline values, but part of this may be because they include companies other than those in 56292 (it includes companies listed as “all other waste management services”). So these should be viewed as upper bounds on the actual values.

[c] *Survey Data*

There were 128 company sites listed in our database, excluding duplicates or incorrect addresses, with the 4953 SIC (Refuse Systems); we surveyed them all. We received responses from 10 companies with SIC 4953; seven of these classified themselves as MRFs. A total of 19 companies identified themselves primarily as MRFs, including many that were not listed as being in the 4953 SIC (they were mainly in 5093 - recyclable material wholesalers). In fact, it appears that many of the companies classified as wholesalers do a substantial amount of sorting and processing of materials, and that appears to be where much of their labor is devoted. To maintain comparability with the USREIS, we only considered those companies that were **not** classified in the original database as SIC 5093 (Scrap and Waste Wholesalers). (Those that had a 5093 classification were assigned to the recyclable material wholesalers category.) This left only eight usable surveys, seven of which were from the SIC 4953 list.

For these eight establishments the total estimated number of employees working on covered activities is 99.3 workers; annual covered payroll is \$3,563,000; annual covered receipts are \$9,048,000. These give averages of 12.4 workers per establishment, \$35,881 of payroll per worker, and \$91,118 receipts per worker (also \$445,375 payroll and \$1,131,00 receipts per establishment) devoted to recycling. Determining how many of the SIC 4953 nonrespondents were operating material recovery facilities is very difficult. If we used the USREIS assumption, that nonrespondents from SIC 4953 were the same as the ten respondents, this would imply that 7/10 (those from SIC 4953 responding as MRFs divided by total number of SIC 4953 respondents) of 128 are MRFs. This would lead to grossly inflated estimates (e.g., 90 establishments), exceeding the upper bounds in [b]. On the other hand it is clear that there are many more than the eight establishments that responded as being MRFs. We decided to make the far more conservative assumption that nonrespondents were 1/4 as likely to be MRFs as respondents. Applying this to the 118 nonresponding establishments in SIC 4853 gives 21 additional establishments (118 x 7/10 x 1/4). Adding this to the eight respondents, including the one outside of SIC 4953, gives a total of 29 establishments. Assuming that the average employment, payroll, and sales for these 21 additional establishments is the same as for the eight respondents would result in the following estimates:

Establishments	29
Employment	360
Annual Payroll	\$12,916,000
Annual Receipts	\$32,799,000.

These values are slightly below the upper limits from [b], but they are based on far more conservative assumptions than the USREIS, so we have selected these as the final estimates.

Final Estimates

Establishments	29
Employment	360
Annual Payroll	\$12,916,000
Annual Receipts	\$32,799,000

5. Recyclable Material Wholesalers

[a] Baseline (Based on national economic census data)

The USREIS did not include the economic activity of nonemployer establishments (mainly sole proprietorships). However, sole proprietorships make up an important, though small, segment of this industry. Because the USREIS based its estimates on available economic census data, we have adjusted the reported USREIS values to incorporate nonemployer establishments. (For

nonemployer wholesalers, the census defines receipts as being comparable to payroll for employers, and receipts/sales are not reported, so it was assumed that receipts per worker are the same for nonemployers as for employers. It was also assumed that all nonemployer establishments were single-person sole proprietorships.)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
Reported USREIS Values	9088	114,992	3,884,598	40,841,087
Including Nonemployers	15,063	120,967	4,354,990	42,963,245
x 0.00925	139	1119	40,284	397,410

[b] SLMA Economic Census Data

There were enough companies in the 42193 NAICS category in the SLMA to be reported by the 1997 economic census. The census values for employer establishments are

Establishments	111
Employment	1592
Annual Payroll	\$71,370,000
Annual Receipts	\$2,300,840,000.

In addition there were 60 nonemployer establishments (mainly sole proprietors) with the following (assuming these establishments have the same receipts per worker as employers):

Establishments	60
Employment	60
Annual Payroll	\$3,129,000
Annual Receipts	\$86,715,000.

Combining these give the following totals:

Establishments	171
Employment	1652
Annual Payroll	\$74,499,000
Annual Receipts	\$2,387,555,000

These values may seem extremely large compared to the baseline values (especially the receipts), but in fact, they seem reasonable because the SLMA is a major trading center for recycled materials, and has several very large material wholesaling firms. For example, from *Sorkins Directory* we identified two recyclables wholesalers that alone have nearly \$600,000,000 in annual sales combined.

[c] Survey Data

After eliminating duplicates or companies that had moved or gone out of business, there were 119 companies in the database that had SIC 5093; all were surveyed. Eighteen establishments returned surveys and were classified as materials wholesalers (all but one were listed as SIC 5093); of these, eleven (all with SIC 5093) provided sufficient information to be useful.

Although most reported that 100% of their labor and receipts were for covered activities, three reported somewhat lower percentages, and these percentages were used in the following computations. For these 11 establishments there were 227 employees doing covered recycling activities; of those reporting payroll the average payroll per worker was \$31,597, so we can project this to be a payroll for the 11 companies of \$7,173,000.

The total covered receipts of the seven companies reporting receipts were \$205,250,000; average receipts per employee of those reporting were \$1,609,000. This projects to \$365,139,700 in annual receipts for the 11 companies. For industries, such as this one, where all or almost all the economic activity is based on recycling, it is reasonable that nonresponding establishments are just as likely to be involved in covered recycling activities, and involved to the same extent, as those that did respond (it is inherent to being in the industry). However, the seven to eleven companies that reported employment, payroll, and receipts may not be representative of the size of the average nonresponding establishment. If we were to assume that they are representative, then projecting these averages to all 119 companies would give:

Establishments	119
Employment	2456
Annual Payroll	\$77,602,000
Annual Receipts	\$3,951,704,000

The payroll estimate is very close to the census value in [b], but the employment and annual receipts are much higher. The high estimate for receipts is probably due to one company in the sample that had very large receipts relative to employment. The high employment and relatively lower payroll is probably due to the fact that the sample contained almost no nonemployers.

We selected the estimates from [b] to be the final estimates because these are based on the same methodology as used in the USREIS, but using data specific to SLMA, and it represents a conservative estimate that lies between the other two estimates, which give confirming evidence.

Final Estimates

Establishments	171
Employment	1652
Annual Payroll	\$74,499,000
Annual Receipts	\$2,387,555,000

6. Glass Container Manufacturing Plant

[a] *Baseline* (Based on national economic census data and adjusted for covered activities).

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	61	19,066	910,230	982,339
x 0.00925	1	176	8420	36,837

[b] *Survey Data*

There was only one establishment in SIC 3221 (Glass Containers) in the database and it did not return a survey.

[c] *SLMA Economic Census Data*

There was one company listed in the 327213 NAICS category (Glass Containers) in the SLMA in the 1997 economic census, but the employment and other numbers were not listed because there were not enough companies. It appears that this is the St. Gobain Glass Container plant in Pevely, Missouri. Using deduced values, we subtracted the data for the 327215 category from those for 3272, which left 2 establishments (one of which was the one in 327213), and a maximum of 269 employees; no information could be deduced about payroll or receipts. There were no surveys returned that indicated this industry. However, the 2002 *Sorkins Directory* reports that the employment at the St. Gobain plant is 250, and the sales are between \$20 million and \$50 million. If we assume the average pay at this plant is the same as the national average (taken from [a]), the payroll would be \$11,935,000, and if the receipts per employee were the same as the national average the receipts would be \$52,218,000. Because *Sorkins* reports sales as being between 20 and 50 million dollars, we assumed sales are at the upper limit of \$50,000,000, and we scaled down the payroll proportionately to \$11,428,000.

The USREIS estimated the covered activities in these plants as 90%, so adjusting employment, payroll, and receipts by this amount gives the final estimates.

Final Estimates

Establishments	1
Employment	225
Annual Payroll	\$10,285,000
Annual Receipts	\$45,000,000

7. Glass Product Producers

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	89	4,723	92,831	452,425
x 0.00925	1	44	859	4185

[b] SLMA Economic Census Data

There were no companies reported by the 1997 economic census for the SLMA for the NAICS 327212 category (Pressed and Blown Glass and Glassware). (Using category deduction, there may have been one company in this category.)

[c] Survey Data

We identified and surveyed 6 companies with the SIC 3229 (pressed and blown glass and glassware), and one of them returned a survey. This company did report 100% of its labor and receipts were due to “covered” activities. The other five appeared to be small glass blowing or products manufacturers. We can conclude that there is at least one establishment in the SLMA, but for confidentiality we cannot report this company or its reported data. If only one or two of the other establishments have covered activities, and if they are as small as they appear, the total payroll and receipts would probably be about half the baseline values, so we assumed there are two establishments with half the employment, payroll, and receipts of the baseline values. In any case the reported values are quite small compared to the other industries and not large enough to affect to overall totals significantly.

Final Estimates

Establishments	2
Employment	22
Annual Payroll	\$430,000
Annual Receipts	\$2,093,000

8. Nonferrous Secondary Smelting and Refining Mills

[a] *Baseline (Based on national economic census data and adjusted for covered activities)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	253	12,790	534,069	6,967,719
x 0.00925	2	118	4,940	64,446

[b] *SLMA Economic Census Data*

There were no data reported in the NAICS 331314, 331423, or 331492 categories (miscellaneous secondary nonferrous smelting, refining, and alloying) for the SLMA. Relying on deduction of census values (subtracting the values for NAICS categories 33141 and 33142 from 3314) indicates that there are no more than 4 establishments, employment is between 111 and 620, but no payroll or receipt values could be reasonably deduced. If we were to multiply employment by the national average payroll and receipts per employee from [a], we would get a payroll range of \$4,670,000 to \$25,664,000 and a receipts range of \$60,470,000 to \$332,315,000. These should then be multiplied by 95% to get values comparable to the USREIS.

[c] *Survey Data*

There were 4 companies in the database that had SIC codes of 3339 and 12 with SIC 3341; all of these were surveyed. Two of these returned surveys, but one listed itself as primarily a material recovery facility. The one remaining company had a 3341 SIC. However, Cerro Copper Products, which is the largest copper recycler in the country, is reported by *Sorkins* to have its main smelting/refining facility in East St. Louis. Based on reported employment for Cerro and the other responding company alone gives an employment of 517 and receipts of \$205 million. If we assume 95% covered activities (the USREIS estimate), and that the payroll per employee is the same as the national average from [a], and the receipts per employee are the same at the responding company as at Cerro, we get the following:

Establishments	2
Employment	491
Annual Payroll	\$20,503,000
Annual Receipts	\$194,750,000.

(Note that Olin Brass Co. was listed in the database with a 3341 SIC, so according to the USREIS definitions it should be part of this category. *Sorkins* reports that it has 2000 employees in the Brass plant alone with divisional sales of \$761 million. However, the SLMA economic census data suggests that it is probably reported in the next category, so it was placed there.)

Because the survey estimates are within the economic census bounds from [b], and are based solely on identified establishments (which are clearly much greater than the baseline values), the survey estimates were used as the final estimates.

Final Estimates

Establishments	2
Employment	491
Annual Payroll	\$20,503,000
Annual Receipts	\$194,750,000

9. Nonferrous Product Producers

[a] *Baseline (Based on national economic census data and expert estimate of 50% recycling)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	61	19,066	910,230	3,982,339
x 0.00925	1	176	8,420	36,837

[b] *SLMA Economic Census Data*

The economic census reported 1 firm in the 331315 NAICS category (aluminum sheet, plate, foil) with an employment of 250-499; 1 firm in the 331316 category (aluminum extruded products) with an employment of 250-499; and 2 firms in the 331421 category (copper rolling, drawing, extruding) with a total employment of 2500-4999. For confidentiality reasons, no payroll or receipts data were reported. Relying purely on these data we would have to conclude that there are at least 4 establishments with a total employment of 3000-6000. We are assuming that one of the

two latter sites reported is the Olin plant in East Alton. The Olin Brass plant in East Alton alone is reported by *Sorkins* to have 2000 employees with divisional receipts of \$761 million, and the Olin Brass and Winchester Divisions combined have employment of 4000 at East Alton with total receipts of \$1.041 billion; the *St. Louis Business Journal* reports employment of 4000 and receipts of \$1.3 billion at Olin. Data for the 33142 NAICS (copper rolling, drawing, extruding, and alloying) are provided for the SLMA: three establishments, employment of 3014, payroll of \$158,935,000 and receipts of \$1,163,811,000. (Two of these three are in NAICS 33142.) It appears that almost all of this is Olin facilities. The receipts are consistent with the *Sorkins* and *St. Louis Business Journal* values, and the employment difference could be due either to including only the Brass plant, to a change in employment since 1997, or to the removal of sales or other nonmanufacturing personnel in Alton from the 4000 total for census reporting. We will assume that the third company in 33142 (but not in 331421) is relatively small, 100 employees, with the same average payroll and receipts per employee as 33142 as a whole. If the two additional firms (from 331315 and 331316) that exist (these are in aluminum products industries, so they are not Olin) have an employment of 750 combined, and we assume they have the same average pay per worker and average receipts per worker as in [a] we get a total employment of 3664 (3014 from NAICS 33142 minus 100 for the company in 33142 but not in 331421, plus the 750), annual payroll of \$187,957,000, and annual receipts of \$1,406,626,000. However, based on the USREIS, half of the economic activity in this category is covered recycling activities, so multiplying these by 50% gives

Establishments	4
Employment	1832
Annual Payroll	\$93,978,000
Annual Receipts	\$703,313,000.

[c] *Survey Data*

There were 11 companies in the database with SICs of 3351-3356 (miscellaneous nonferrous products), all of which were surveyed. Three of these returned a survey, and two other companies listed themselves in this category.

None of the responding companies could be the two companies reported by the economic census (they were too small). One of these companies reported 100% of its labor was devoted to covered recycling activities (manufacturing ingots from recycled stock); one reported 55%, while the other three reported less than 10% covered activities. The one reporting 55% covered activity was small and did not report payroll or sales. Based on the economic census data and the five responses it appears that there are at least six to nine establishments in this industry, but we only added the firm reporting 100% covered activities to the SLMA census estimates. (We assumed the receipts per employee for this company were the same as the estimates in [b].) This gave the final estimates.

Final Estimates

Establishments	5
Employment	1869
Annual Payroll	\$94,728,000
Annual Receipts	\$717,517,000.

10. Nonferrous Foundries

[a] *Baseline (Based on national economic census data and adjusted for covered activities)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	196	36,363	1,662,743	13,644,767
x 0.00925	2	336	15,380	126,214

[b] *SLMA Economic Census Data*

For the 33152 NAICS category (nonferrous foundries) the SLMA census data were

Establishments	19
Employment	1772
Payroll	\$64,409,000
Receipts	\$224,818,000

These are upper bounds on the estimates because they include NAICS 331522, which USREIS deleted.

For the 331521 and 331524 categories we have:

	331521	331524	Combined
Establishments	5	7	12
Employment	617	500-999	1117-1616
Payroll	\$17,209,000	D (unreported)	\$17,209,000 + D
Receipts	\$55,530,000	D (unreported)	\$55,530,000 + D

The combined values are a lower bound because they include only two of the four NAICS categories included in the USREIS. Based on the employment values, the combined payroll and receipts values should probably be at least twice those for category 331521; i.e., payroll of approximately \$34.4 million and receipts of \$111 million. The USREIS multiplied its census values for employment, payroll, and receipts by 90% based on its estimate of covered activities, so the same adjustment should be made for these upper and lower bounds.

[c] Survey Data

There were 28 companies in our database with SIC codes of 3363-3369 (various nonferrous foundries), all of which were surveyed. Five surveys were returned that identified themselves as nonferrous foundries; four of these had a 3365 or 3369 SIC; the other was 5093 (material wholesaler). The first four surveys provided some information, while the last one did not. Considering the relatively large response rate (4 out of 28), it is likely that there are, in fact, close to 19 establishments in this industry (the upper bound). Just for the four responding establishments, employment is approximately 800, annual payroll approximately \$25 million, and receipts approximately \$165 million. It appears that two of the four establishments are relatively large, so projecting these values to all 12 to 19 establishments would produce inflated estimates. One concern we had, however, was that the responding establishments reported their covered activities to be far less than the 90% used by the USREIS (some of this appears to be misunderstanding of the definitions; it appears that some seemed to think they had to process the recycled scrap themselves rather than using primary products made from recycled materials). In order to be consistent with our desire to use the USREIS methodology as much as possible, yet to take into account our concerns about the covered activity rate, we decided to use as our final estimates the midpoints between our lower and upper bounds from [b], and to use the 90% covered activity adjustment. (For employment we used the lower value of the lower bound range, and for the payroll and receipts we used \$34.4 million and \$111 million as the lower bounds.) The midpoint estimates are

Establishments	16
Employment	1,445
Annual Payroll	\$49,406,000
Annual Receipts	\$167,909,000

Multiplying these by 90% gives our final estimates.

Final Estimates

Establishments	16
Employment	1,300
Annual Payroll	\$44,465,000
Annual Receipts	\$151,118,000

11. Paper, Paperboard, and De-inked Market Pulp Mills

[a] *Baseline (Based on national economic census data and adjusted by various estimates of recycling usage within operations)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	474	139,375	8,289,658	51,459,559
x 0.00925	4	1,289	76,679	476,001

[b] *SLMA Economic Census Data*

There was only one entry for the 3221 NAICS category (pulp, paper, and paperboard mills) in the SLMA. This was also listed in 32213 (paperboard mill), which suggests that this was the Smurfit-Stone paperboard mill in Alton. The employment was listed as 250-499 (which matches information we had from other sources for the Smurfit-Stone plant), but payroll and receipts were not reported. The Smurfit-Stone plant was a paperboard mill that used 100% recycled fiber as feedstock. Unfortunately it stopped operation a year or two ago. So it appears that there is no major employment in this industry in the SLMA.

[c] *Survey Data*

There were five companies in the database other than Smurfit-Stone that were listed as 2621 or 2631 SICs, all of which were surveyed. One of these returned a survey but classified itself as a paper-based product manufacturer (which looked correct). Two other companies responded as being paper or paperboard mills, but they had SIC codes of 2679, and they do, in fact, appear to be producers of paper products from reused materials, so they were assigned to category 12 below.

Therefore our conclusion is that there are no establishments in this industry in the SLMA.

Final Estimates

Establishments	0
Employment	0
Annual Payroll	0
Annual Receipts	0

12. Paper-based Product Manufacturers

[a] *Baseline (Based on USREIS survey data)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	215	12,867	312,714	1,715,935
x 0.00925	2	119	2,893	15,872

[b] *SLMA Economic Census Data*

There were no companies reported in the 322299 NAICS category (other converted paper products manufacturing). Using deduced values (subtracting those of 32221, 32222, and 32223 from 3222) gives an upper bound on establishments of 6 with employment of no more than 448. Payroll and receipts could not be deduced due to missing values.

[c] *Survey Data*

There were 9 companies in the database with SIC 2679 (miscellaneous converted paper or paperboard products), and all were surveyed. We received 5 completed surveys that were assigned to this industry, three of which had a 2679 SIC. Four of the surveys gave sufficient information to be useful.

The high return rate relative to the number of companies in the database again suggests that the number of companies is, in fact, probably close to nine, if not more (one of the respondents stated that it had two other facilities in the SLMA, which were not in the database). Based on the midpoints of the item ranges, the four responding companies have 43.6 workers in covered activities. The average pay per worker for those reporting was \$44,118 (much higher than the USREIS value of \$24,304), and receipts per worker were \$230,392 (versus USREIS value of \$133,359). These high values are probably due to the actual employment being higher than the interval midpoints and the actual payroll and receipts being below the interval midpoints. Therefore, using the USREIS averages instead, these 4 companies would have projected payroll for covered activities of \$1,060,000 and receipts of \$5,814,000. Although the economic census upper bound was six establishments, we are estimating that there are nine. Five establishments responded to the survey, and there were six others in the SIC 2679 category in the database that did not respond, plus there were two other establishments reported by one respondent that were not in the database. If we project employment, payroll, and receipts to all 9 establishments (multiplying by 9/4), we get our final estimates:

Final Estimates

Establishments	9
Employment	98
Annual Payroll	\$2,385,000
Annual Receipts	\$13,081,000

These are consistent with the baseline estimates, yet quite conservative. They are especially conservative because based on information from *Sorkins*, the fifth company that returned a survey, but did not give complete information so it was not used in the estimates, was by far the largest and it reported moderate covered activities (although the covered activities appear to be overstated based on other information available). In fact, its employment and sales were reported by *Sorkins* to be larger than those of the other four companies combined. Including this company would have increased all the estimates substantially.

13. Pavement Mix Producers

[a] *Baseline (Based on USREIS survey database)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	120	3,460	135,936	831,912
x 0.00925	1	32	1,257	7,695

[b] *SLMA Economic Census Data*

There were no reported data for the 324121 NAICS category (asphalt paving mixtures and blocks). By deduction (subtracting values for 32411 and 32419 from those for 324) gives an upper limit of 17 establishments, but no employment or other data could be deduced due to missing values.

[c] *Survey Data*

The database had 35 companies (eliminating those found to be out of business or moved) with SICs of 2951, all of which were surveyed. Only three surveys were returned in this category; all had a 2951 SIC.

One indicated no covered activities, while the other two reported (and identified in some detail) 0-9%-covered activities for labor and/or receipts. Most of the 35 companies in the database appeared to be primarily appliers of asphalt or concrete, rather than manufacturers. There does appear to be some covered activities in this industry (from the three respondents alone there appear to be two establishments with covered activities and covered employment of 12), but they appear to be relatively small. It is likely that the number of establishments with covered activities is two or three times the number actually responding, and based on this the survey results would project employment, payroll, and receipts consistent with the small baseline values. Therefore, we estimated that there were four establishments with covered activities, and we used the baseline estimates for employment, payroll, and receipts.

Final Estimates

Establishments	4
Employment	32
Annual Payroll	\$1,257,000
Annual Receipts	\$7,695,000

14. Plastics Reclaimers

[a] Baseline (Based on American Plastics Council Handler and Reclaimer Database, with payroll estimated using average pay from economic census, and receipts from throughput times average prices)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	780	19,411	671,261	1,635,183
x 0.00925	7	180	6,209	15,125

[b] SLMA Economic Census Data

Data for the 325991 NAICS category (custom compounding of purchased resins) were not reported. Using deduced values (subtracting values for the 325992 and 325998 categories from those for 32599) gives an upper bound of 6 establishments, and the other values cannot be deduced because of missing values.

[c] USREIS Methodology

The USREIS based much of its estimate on the American Plastics Council Database, developed by R.W. Beck. That information is proprietary and was not available to us. However, the number of

covered establishments derived from the APC database was less than the number of establishments listed for NAICS category 325991, so we would expect a maximum of five or six establishments in the SLMA.

[d] Survey Data

There were no companies listed in the database with a 3087 SIC (custom compounding of purchased resins), but two companies that returned surveys identified themselves as being both converters and reclaimers, without identifying their primary category (one was in SIC 3083 and the other was 3089). One company provided almost no information, but the other indicated that 90-100% of its labor was involved in covered activities. (The establishment reported very large employment, but Sorkins suggests that this value was probably for the company as a whole, and the SLMA operations are much smaller.)

Because there were no companies in the database listed as reclaimers (and the SLMA economic census suggests a maximum of 6 companies) the baseline values from [a] probably overestimate the actual plastics reclaiming activity in the SLMA. The data from the one responding company alone suggests that covered employment, payroll, and receipts, are at least 10% of the estimates in [a]. So taking a very conservative approach we used 10% of the baseline values as our final estimates.

Final Estimates

Establishments	1
Employment	18
Annual Payroll	\$621,000
Annual Receipts	\$1,513,000

15. Plastics Converters

[a] Baseline (Based on information from the Society of the Plastics Industry's Economic Report 2000 plus additional estimates of plastics conversion by nonplastics industries.)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	2,510	178,700	5,354,547	27,951,145
x 0.00925	23	1,653	49,530	258,548

[b] USREIS Methodology

We did not have the SPI Economic Report 2000 available, but it appears that the data are reasonably correlated with economic census data for NAICS category 3261, so we made similar adjustments to economic census data below.

[c] SLMA Economic Survey Data, adjusted to match USREIS methodology

The USREIS classified establishments in this industry as those in NAICS categories 3261 (plastic product manufacturing) and 325991. The 3261 category accounted for over 94% of the establishments and receipts and over 96% of the employment and payroll. The economic census for NAICS category 3261 listed 141 establishments for the SLMA, with employment of 7540, payroll of \$262,284,000 and receipts of \$1,209,530,000 (inflation adjusted). However, there were no census data available for the 325991 category. So we'd prefer using only category 3261 for the projections, and this seems appropriate because nationally 325991 adds about 5% to the totals pretty consistently, so not including them would not create a significant distortion and would create a slight underestimation. The ratios of the USREIS unadjusted values to the census values for NAICS 3261 values are 1.097 for establishments, 1.659 for employment, 1.769 for payroll, and 1.709 for receipts. So multiplying the SLMA census values for NAICS 3261 by these adjustments gives

Establishments	155
Employment	12,509
Payroll	\$463,980,000
Receipts	\$2,067,087,000

We now multiply by the same adjustment factors used by USREIS to represent the fraction of covered recycling activity to get.

Establishments	25
Employment	1630
Payroll	\$60,450,000
Receipts	\$269,312,000

[d] Survey Data

There were 111 establishments in the database with SICs of 3081-3089 (eliminating duplicates or companies that had moved or gone out of business), and all were surveyed. We received 11 surveys, all from the 3089 category.

Ten of the 11 companies were willing to report employment, only three reported payroll and receipts, and five reported some covered activities percentages. This made it impractical to devise a better estimate of the recycling activities than in [c] because it is very possible that these are not representative of the population (those responding were all small companies). At best these could be used to compute lower bounds on the estimates, but they are quite low: for the five companies reporting covered activities, we have covered employment of 10; projecting this to the 111 companies in the database gives employment of 222; projecting it to the 141 companies in the SLMA census gives employment of 281.

The estimates from [c] are very close to the baseline values and based specifically on SLMA data using the same adjustments as the USREIS, so these are the final estimates that were used.

Final Estimates

Establishments	25
Employment	1630
Annual Payroll	\$60,450,000
Annual Receipts	\$269,312,000

16. Rubber Product Manufacturers

[a] *Baseline (Based on USREIS survey database)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	158	3,917	91,456	337,434
x 0.00925	1	36	846	3,491

[b] *SLMA Economic Census Data*

The USREIS report listed as its population, those companies with NAICS 3262 (rubber product manufacturing). However, tire retreading is treated as a separate industry in the USREIS, so we removed the 326212 category (tire retreading) from our data (we actually subtracted 326211 from 32621 to deduce 326212; and then subtracted these values from 3262). The SLMA data are then

Establishments	27
Employment	1,603-1,854
Payroll	at least \$42,472,000
Receipts	at least \$171,367,000

The payroll and receipts are lower bounds because there was one “new tire” manufacturer reported with only an employment range, but no payroll or receipts.

Using the ratios of the USREIS survey data base data to the corresponding national economic census data, we get that the number of establishments was 7.64% of the national census values, employment was 2.00%, payroll was 1.38 %, and receipts were 2.56% of the census values. Applying these factors to the SLMA census data gives

Establishments	2
Employment	32-37
Payroll	\$586,000+
Receipts	\$4,387,000+

(If we simply assume that the average payroll and receipts per person are the same as the national averages, the payroll would be \$747,000-\$864,000 and the receipts would be \$2,894,000-\$3,346,000.)

[c] Survey Data

There were 42 companies in our database that had SICs of 3011, 3021, 3052, 3053, 3069, and 3061 (The last one was added because it appeared to fit this category, and our only respondent was from this category). All 42 were surveyed, but only one responded. The responding company was small and reported a small level of covered activities. This provides little information other than there is at least one company in the SLMA that is in this category and it has some covered activities.

Because of the consistency between the baseline values and the SLMA census values, and given our desire to be conservative in our estimates we used the midpoint of the SLMA census for the employment and the lower bounds for annual payroll and annual receipts.

Final Estimates

Establishments	2
Employment	35
Annual Payroll	\$586,000
Annual Receipts	\$4,387,000

17. Steel Mills

[a] Baseline (Based on national economic census data and adjusted for covered activities)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	101	118,544	7,426,700	48,488,625
x 0.00925	1	1,097	68,697	448,520

[b] SLMA Economic Census and Survey Data

There were two companies listed in the SLMA with NAICS 331111 (iron and steel mills). The total employment was listed as 2500-4999, but no payroll or receipts information was provided for privacy. We assume that these two companies were Granite City Steel (a division of National Steel) and Laclede Steel, both integrated steel mills. However, the Laclede Steel Mill has closed. The *St. Louis Business Journal* reports that National Steel has 3100 employees in the SLMA (out of a company total of 9400), and company receipts of \$2.85 billion (so 3100/9400 of this is \$940 million). *Sorkins* reports that the Granite City division in the SLMA has 3200 employees and sales of \$700 million, and it has a sales office with 5-9 employees and sales of \$20-50 million. Three companies returned surveys indicating themselves as steel mills, but it appears that they are primarily steel processors or distributors. None had the 3312 SIC (steel works, blast furnaces and rolling mills). All three reported some covered recycling, but it was not clear how much recycled material was used in their processes. We have placed these in the “other recycling” category.

Taking a very conservative approach, we are assuming that Granite City Steel is the only steel producer, and we are only considering its primary steel making operations, not its downstream operations. Then using the Sorkins estimates and making adjustments similar to those in the USREIS, and assuming the same pay per employee as the national average, we get

Final Estimates

Establishments	1
Employment	3040
Annual Payroll	\$190,373,000
Annual Receipts	\$665,000,000

18. Iron and Steel Foundries

[a] *Baseline (Based on national economic census data and adjusted by factors in USREIS)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	1,143	126,313	5,329,561	17,588,185
x 0.00925	11	1,168	49,298	162,691

[b] *SLMA Economic Census Data*

For NAICS category 33151 (iron and steel foundries) complete data were reported for the SLMA. (Data specifically for categories 331511 and 331513 (iron and steel foundries) were given, but not for 331512, but 33151 is made up only of these three subcategories.)

Establishments	15
Employment	1568
Payroll	\$59,491,000
Receipts	\$174,114,000

Adjusting the employment, annual payroll and receipts using the same adjustments as the USREIS gives:

Establishments	15
Employment	1490
Payroll	\$56,516,000
Receipts	\$165,408,000

[c] *Survey Data*

There were 11 companies in SICs 3321-3325 in the database, and all were surveyed. One returned a survey, as did three other companies with other SICs. Three provided employment data, but none provided meaningful payroll or receipts data. Therefore, no estimates were attempted using these responses.

Given that [b] used exactly the same methodology as the USREIS except with data specific to the SLMA, [b] was used for the final estimates.

Final Estimates

Establishments	15
Employment	1490
Annual Payroll	\$56,516,000
Annual Receipts	\$165,408,000

19. Other Recycling Collectors/Processors/Manufacturers

[a] *Baseline (based on USREIS survey data)*

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	552	14,901	411,483	2,012,571
x 0.00925	5	138	3,806	18,616

[b] *SLMA Economic Census Data*

There were no specific SIC or NAICS categories identified by the USREIS for this industrial category. So no estimates can be made using census data.

[c] *Survey Data and Sorkins Data*

There were nine companies that returned surveys and indicated some degree of recycling processing or manufacturing covered activities that either did not have an SIC that corresponded to the earlier categories, or that from their information made it appear that they did not quite fit even if the SIC matched. (An additional 18 companies returned surveys that did not fit into the other categories that indicated they did not have covered recycling activities. So 1/3 of them did have covered activities.) Simply in the process of verifying information in Sorkins, we found three other companies that were exclusively involved in recycling activities. The covered activities of these 12 companies alone are

Establishments	12
Employment	78
Payroll	\$2,154,000 (Using \$27,614 national average)
Receipts	\$10,535,000 (using \$135,063 national average); \$8,044,000 (just from the eight reporting receipts)

These 12 companies are probably just a small subset of companies that fall into this category. The USREIS study assumed that the employment, etc., for nonresponding companies was the same as responding and unsampled companies. We think this is intuitively unlikely (a company that recycles is probably going to be more likely to take the effort to respond, although 18 companies in these categories responded and said they did no recycling activities). Empirically we found that companies in those industries that are clearly recycling industries (MRFs, brokers, retail used items) had twice the response rate as other industries, which would suggest that responders are probably twice as likely to recycle as nonresponders (except for industries that are inherently recycling oriented, such as MRFs, brokers, recycled paper makers, etc.; in those industries all companies probably recycle the same, and we found smaller companies more likely to respond than big companies). There were over 1000 companies in the database from unassigned SICs, and of these almost 400 were sampled, of which 27 returned surveys and 9 did some covered recycling. Assuming unsampled and nonresponders are the same as responders would mean that 1/3 or over 330 companies in this category recycle, and if they recycle at the same rate as responders the above values for employment, etc., should be multiplied by 27-28. This is clearly way overly aggressive. If we assumed nonresponders were half as likely to recycle as responders, we would still multiply the above values by 13-14. However, we are taking an extremely conservative approach, and are assuming that we found half of the establishments in the SLMA that are in this category, so for our final estimates we multiplied the sample values by two. (In effect, we are assuming that companies that did not respond to the survey do not perform covered RRR activities.) This also gives estimates that are quite close to the baseline values, which provides some supporting credence. Given how many companies we found accidentally in *Sorkins* that were totally involved in recycling activities but were not in our sample, or did not return a survey, this estimate is probably very conservative.

Final Estimates

Establishments	24
Employment	156
Payroll	\$4,308,000
Receipts	\$21,070,000

20. Computer and Electronic Appliance De-Manufacturers

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	187	3,837	93,312	435,509
x 0.00925	2	35	863	4,028

Although SLMA economic census data exist for the NAICS 421690 and 811212 categories, the number of establishments reported by the USREIS is a tiny fraction of those in these industry categories (and in fact, it appears that other companies should be included, such as those in 811211 and 811213 because from our surveys we actually found many telecommunications equipment remanufacturers). So no use was made of census data for this category.

[c] Survey Data

There were 109 companies in the database with SICs of 5065 (5 of them) or 7378 (104), not counting duplicates or companies out of business. Seven companies returned surveys indicating they were in this industry (one had 5065 and one had 7378 SIC). Two other companies with 7378 SIC returned surveys but did not indicate that they were in this industry, and they had no recycling. Six of the seven respondents provided some useful information on covered activities.

For the six respondents providing information, the covered employment was 55.2. For the four companies providing payroll and receipts information the covered payroll was \$1,764,000, and receipts were \$4,896,000. These four companies had covered employment of 40.2. This indicates that the payroll per employee is nearly twice what the USREIS found, but the receipts per employee are about the same. (If we used the payroll and receipts per employee from [a] and assigned it to the 40.2 workers, we would get an annual payroll of \$977,000 and receipts of \$4,563,000; assigning these averages per worker to the 55.2 workers would give payroll and receipts of \$1,342,000 and \$6,265,000.)

Just from the survey responses, there are at least seven establishments with covered activities, with employment, payroll, and receipts well above the baseline estimates. We also found data from Sorkins identifying an eighth company totally involved in remanufacturing and reselling computers. (We also found a large number of companies that seem to be doing remanufacturing of various types that are “hidden” by the SIC codes and did not show up in our database. In fact, as part of a conversation with the contact person at one of the responding companies in this category, she identified four local competitors that she was sure were electronics equipment remanufacturers, but they did not show up in our database. We also identified some not-for-profit organizations that were doing electronics remanufacturing, but those were also not included here.) If we used the USREIS methodology and assumed that responders were representative of the total pool of 114 companies (109 in the SIC categories plus the other five respondents), we would conclude that the actual number of establishments, payroll, and receipts are $114/9 = 12.67$ times the previous values. Given the rate of survey returns relative to the total sample, along with the apparent number of companies in this industry that were not in the database, a reasonable, yet conservative estimate is that the actual number of establishments, employment, etc. is probably at least three to five times the number from the respondents alone. The USREIS report mentioned that other research has indicated that this was an industry that was probably grossly underestimated in size, and that is what we found as well. We have taken a conservative approach and used an estimate of four times the numbers from actual survey respondents. Because our

payroll per employee seems quite high relative to the USREIS value, but the receipts per employee are almost the same, we have decided to use the number of covered employment (55.2) times the USREIS averages per employee (notice that we are being further conservative by not including the unknown employment from the seventh company, because it did not report the percentage of covered activity). This gives the final estimates

Final Estimates

Establishments	28
Employment	221
Annual Payroll	\$5,368,000
Annual Receipts	\$25,060,000

21. Motor Vehicle Parts (USED)

[a] Baseline (Based on national economic census data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	7,105	45,807	1,169,047	5,556,801
x 0.00925	66	424	10,814	51,400

[b] SLMA Economic Census Data

For the 42114 NAICS (motor vehicle parts used wholesale) the SLMA economic census reported 74 establishments with employment of 250-499, but no payroll or receipts are listed.

[c] Survey Data

There were 105 companies in the 5015 SIC (wholesale used motor vehicle parts) in our database. Due to an error, only 7 were surveyed; one returned a survey but classified itself in a different category, so no useful estimates could be made from the survey, although checking the list of companies in the database, almost all of them make it clear in their company names that they are salvage/used vehicle parts demanufacturers and dealers. So the baseline values are probably an underestimate of the actual values in the SLMA, but we used the baseline as our estimates.

Final Estimates

Establishments	66
Employment	424
Annual Payroll	\$10,814,000
Annual Receipts	\$51,400,000

22. Retail Used Merchandise Sales

[a] Baseline (Based on national economic census data)

The USREIS did not include the economic activity of nonemployer establishments. However, nonemployer establishments make up an important part of this industry. Because the USREIS based its estimates on economic census data, we adjusted the reported USREIS values to incorporate nonemployer establishments assuming all establishments were single-person sole proprietorships. (For nonemployer retailers, the census does not include a value comparable to payroll, so we are making the conservative assumption that earnings per sole proprietor are the same as payroll per worker for employers.)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
Reported USREIS Values	17,990	97,965	1,447,920	6,787,010
Including Nonemployees	105,034	185,009	2,734,428	9,335,131
x 0.00925	972	1,711	25,293	86,350

[b] SLMA Economic Census Data

For the 45331 NAICS category (used merchandise excluding pawn shops) we found there to be 146 establishments with employees and another 844 without employees. Unlike the recyclable material wholesalers category, the sole proprietors in this category make up a substantial part of the industry: the number of sole proprietors exceeds the number of employees. Receipts from sole proprietors also make up a substantial amount of total receipts.

For only establishments with employees we have

Establishments	146
Employment	767
Payroll	\$10,310,000
Receipts	\$46,580,000

Including the nonemployer establishments and making the same payroll assumptions as in [a], gives the following totals for all establishments.

Establishments	990
Employment	1611
Payroll	\$21,654,000
Receipts	\$65,553,000

[c] Survey Data

There were 705 establishments in the database with an SIC of 5932. (It was not surprising that the number in our database was well below the census number because so many of the establishments were one-person operations, and they are often not in credit rating databases, which is where we got many of the establishments for our database.) Of these we sampled 372; eliminating those found to be out of business, moved, or duplicates we had an actual sample of 334. Of these 35 returned surveys.

Although the response rate was good (above 10%) respondents in this category (especially sole proprietors or small businesses) were very reluctant to give any payroll or sales data. Of the 35 responses, 33 gave meaningful employment data, but only 23 gave payroll data (often because it was 0), and 20 gave receipts. Especially confusing were the responses to percentage of covered activities. Some businesses listed their covered activities as less than 90%, which was not surprising because several of the stores sold new as well as used items. But a few listed their covered activities as low as 0-9%, even though they then explained how their entire business was selling used merchandise. The USREIS assumed all companies in this category had 100% covered activities because the establishments are essentially in business to sell used merchandise, even if they also happen to sell some new merchandise. If we were to make the same assumption, then the covered employment (including sole proprietors) for the 33 respondents would be 181. For the 23 providing payroll information and the 20 reporting receipts, the payroll and receipts per person are close to the baseline values in [a]. In industries where recycling/reuse are a dominant or total part of the business, there is no reason to believe that those responding to the survey are recycling any more than the nonrespondents (in each case it's near 100%). Therefore projecting the employment, payroll, and receipts per establishment, from the survey to just the 705 establishments in the database (assuming companies going out of business or moving are replaced

at the same rate by new companies) would give employment of 3867; payroll of \$48,277,000 and receipts of \$196,520,000. Assuming that the number of establishments is actually closer to the SLMA census figure of 990, would give even larger values. These estimates are much larger than the estimates in [a] and [b]. Upon closer inspection of the data, it appears that this is because establishments over weight the response pool with employees. We would expect (146/990 = 15%) of the respondents to be employers and the rest to be sole proprietors, but it appears that least 11 of the 33 have employees, and one of them is disproportionately large. If we were to treat the employers and nonemployers separately, this would substantially reduce the employment estimate. However, we felt that trying to get accurate estimates, based on these responses would not improve accuracy above those in [a] or [b].

Therefore, because the estimates in [b] use the same methodology as the USREIS, but with data specific to the SLMA, we used the estimates in [b] as the final estimates.

Final Estimates

Establishments	990
Employment	1611
Annual Payroll	\$21,654,000
Annual Receipts	\$65,553,000

23. Tire Retreaders

[a] Baseline (Based on national economic census data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	754	7,939	231,442	1,035,668
x 0.00925	7	73	2,141	9,580

[b] SLMA Economic Census Data

Data for 326212 NAICS (tire retreading) was not reported for the SLMA, but for 32621 (tire manufacturing) the following were reported:

Establishments	11
Employment	608
Payroll	\$18,100,000
Receipts	\$68,363,000.

There are only two subcategories for 32621, and 326211 (new tire manufacturing) was reported to have one establishment with 250-499 employees (values for 326212 could not be reported because it would reveal the values for the one company in 326211). So we can conclude that there are 10 retreading establishments, but we could not identify the new tire manufacturer or discover information about it. Using national data, the average new tire manufacturing site has 397 employees while retreaders have 10.5. However, the average payroll per employee and receipts per employee for NAICS 32621 for the SLMA are very close to (or even smaller than) the national averages for retreaders rather than for new tire manufacturers (which are 75-90% larger), so it would be reasonable to assume that most of the 608 employees are involved in retreading, even allowing for lower wages in the SLMA. We have taken what we believe is a conservative approach and assumed that half of the employment, payroll, and receipts are involved in retreading. Using the national payroll and receipts per employee we get

Establishments	10
Employment	304
Payroll	\$9,050,000
Receipts	\$34,181,000

[c] Survey Data

There were 35 companies in the database (not counting one that was out of business) with an SIC of 7534, and we surveyed them all. We received only one response. From inspection of the list it appeared that most of the establishments were auto repair and/or retail tire stores. For confidentiality we cannot reveal the values of the one respondent, but its employment was quite consistent with the average establishment size in [b], but its payroll per worker was much higher; receipts were not reported, but based on data from *Sorkins*, its annual receipts were consistent with those of establishments in [b]. No estimate is possible based on this one response.

Therefore, the final estimate was the one from [b], which uses methodology similar to what was used in the USREIS.

Final Estimates

Establishments	10
Employment	304
Annual Payroll	\$9,050,000
Annual Receipts	\$34,181,000

24. Wood Reuse

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	490	9,109	188,097	906,878
x 0.00925	5	84	1,740	8,389

[b] SLMA Economic Census Data

Economic census data for the SLMA for NAICS categories 32192 (wood container and pallet manufacturing) and 321999 (miscellaneous wood products) were not reported. For 3219 (other wood products) we have

Establishments	58
Employment	481
Payroll	\$11,930,000
Receipts	\$46,169,000

In the 321 category (wood products) there were twice as many nonemployers as employers, but because we don't have data specific to 3219, we are not including nonemployer data, which should underestimate total activity.

At the national level, pallet manufacturing (32192) constitutes 28% of 3291 and 321999 constitutes another 23%. So we estimated the number of establishments as half the 58, or 29 with 16 of these being pallet remanufacturers. The survey data suggests that the only wood remanufacturing in the SLMA may be pallet remanufacturing. If this is the case, and we assume pallet manufacturing has the same payroll and receipts per employee as the 321 category in general, the estimates would be:

Establishments	16
Employment	133
Payroll	\$3,291,000
Receipts	\$12,736,000

[c] Survey Data

There were 42 companies in the database with SICs of 2448 (wood pallets and skids) or 2499 (miscellaneous wood products) (11 were in 2448 and 31 in 2499). All were surveyed, and three returned surveys, all from the 2448 category, pallet manufacturing. Two of these provided usable data. While verifying information in *Sorkins* another company was identified that was primarily a pallet rebuilder.

The survey data provide no evidence that wood remanufacturing other than for pallet rebuilding is occurring in the SLMA (although there might be). The data for the three companies are not sufficient to make firm estimates, but they do indicate that actual wood remanufacturing activity is probably above the baseline estimates. These three establishments alone have employment of 26, payroll of approximately \$480,000, and annual receipts of \$2,300,000. If these were representative of the eleven pallet manufacturing in the database, this projects to an employment of 95, annual payroll of \$1,760,000, and annual receipts of \$8,433,000. These are almost identical to the baseline values. If we scaled down the estimates in [b] to assuming there were only 11 establishments (and multiplied employment, payroll, and receipts by 11/16), we would get estimates very close to these as well. However, to be especially conservative, we used the baseline values as our final estimates.

Final Estimates

Establishments	5
Employment	84
Annual Payroll	\$1,740,000
Annual Receipts	\$8,389,000

25. Materials Exchange Services

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	54	186	4,415	16,976
x 0.00925	0.5	1.7	41	157

[b] SLMA Economic Census Data

The 54199 NAICS category includes a wide range of services, so even though data for the SLMA are available, they are meaningless because of the broad definition.

[c] Survey Data

There were 5 companies in our database with a 7389 SIC (business services). (There were also several companies listed in other SICs that had identified themselves as materials exchange services on recycling organizations' lists, but none responded as being materials exchange services.) All were surveyed, and two returned a survey, but neither listed materials exchange service as their primary business (one was a recycled material processor and the other an electronics demanufacturer). So there is no evidence of a functioning materials exchange service in the SLMA. Due to the small numbers involved in [a] we are simply assuming there are no establishments in the SLMA.

Final Estimates

Establishments	0
Employment	0
Annual Payroll	\$0
Annual receipts	\$0

26. Other Reuse

[a] Baseline (Based on USREIS survey data)

	Establishments	Employment	Payroll (\$000)	Receipts (\$000)
USREIS Values	136	4,340	93,920	524,811
x 0.00925	1	40	869	4,855

[b] SLMA Economic Census Data

The 42181-42183 NAICS categories have 544 establishments in the SLMA, almost none of which are related to reuse or remanufacturing, so we could not use these data.

[c] Survey Data

There were nearly 800 companies in the initial database with an SIC of 5082-5084; almost none looked like they were in appropriate businesses. We did send surveys to a few, but none were returned. However, for one of these companies we found information in *Sorkins* that clearly indicated that it is a remanufacturer and reseller of used 55-gal drums. For another company in the database with a different SIC, we also found by chance in *Sorkins* that it is entirely a purchaser, processor, and reseller of used clothing (wholesale and especially as export). (There was also one company that returned a survey that refinishes and reconditions parts, but because it does not take ownership of the parts, it was treated as performing uncovered repair activities.)

We are sure that there are other similar companies performing remanufacturing and reuse operations, but simply using the data from these two companies our estimates are

Final Estimates

Establishments	2
Employment	67
Annual Payroll	\$1,450,000
Annual Receipts	\$5,055,000.

APPENDIX C SURVEY MATERIALS

August 2, 2002

Subject: Metro St. Louis Recycling Economic Information Study

Dear Colleague:

Would you please take a few minutes to answer the enclosed **confidential**, 7-question survey? This survey has been funded by the St. Louis - Jefferson Solid Waste Management District to gather economic statistics on the recycling, reuse, and remanufacturing industries in the St. Louis Metro area (including Illinois).

The survey requests information about your firm's activities involving the collection, processing, or resale of recyclable or reusable materials/products, manufacturing of new products from recycled materials, remanufacturing of used products, or production of manufacturing equipment used in the recycling, reuse, or remanufacturing industries. We want to emphasize that **the information you provide will be maintained in strict confidence -under no circumstances will company-specific data be released**. Your responses will be aggregated with data provided by other firms, and will only be released as aggregated, Metro-wide or industry-wide totals.

The St. Louis - Jefferson Solid Waste District has contracted with University Outreach and Extension and the University of Missouri - St. Louis to conduct this study. Surveying organizations, such as yours, is a crucial element of the study, so your participation is very important and much appreciated.

A major goal of this study is to measure and document the level of economic activity and employment associated with recycling, reuse, and remanufacturing. It is our hope that the results of this study will be used to attract more capital to assist entrepreneurs in these industries to grow their businesses, to secure state and federal action favorable to recycling, reuse, and remanufacturing businesses, and to educate the general public about the benefits your industry provides to our economy and environment.

If you have any questions regarding the enclosed survey form please contact me by phone at (314) 516-6145 or by email at joseph.martinich@umsl.edu. If you wish, you may fax your completed survey to me at (314) 516-6827. We would very much appreciate your response by August 23, 2002. Thank you for your assistance in this important project.

Sincerely,

Joseph Martinich
Professor of Operations Management