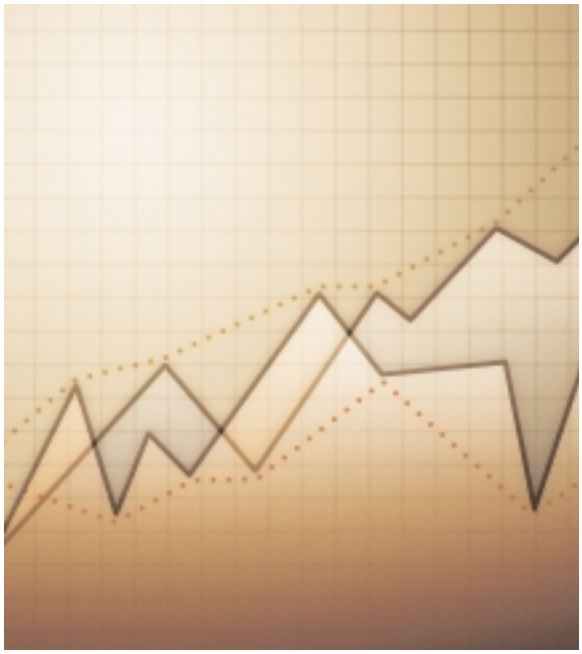
Final Report

Ohio Recycling Economic Information Study

Prepared for the Ohio Department of Natural Resources
by The National Recycling Coalition
in association with R. W. Beck, Inc.



Ohio DNR

January 2001

R·W·BECK

NATIONAL RECYCLING COALITION INC.

Acknowledgements

R. W. Beck, Inc. and the National Recycling Coalition would like to acknowledge the contributions of the following individuals and industry groups for their participation in reviewing the methodologies and draft materials developed for this report.

Greg Crawford, Steel Recycling Institute
Pete Dinger, American Plastics Council
Will Ferretti, Executive Director, National Recycling Coalition
John Papp, U. S. Geological Survey
Pat Plunkert, U. S. Geological Survey
Donna Stusek, Ohio Department of Natural Resources
Tom Tyler, Associate Counsel/Director of State & Local Programs, Institute of Scrap Recycling Industries

Economic Modeling provided by:

David Swenson, Iowa State University

TABLE OF CONTENTS

EXECUTIVE SUMMARY ES-1

OVERVIEW ES-1
SUMMARY OF DIRECT RESULTS ES-1
SUMMARY OF INDIRECT AND INDUCED ECONOMIC ACTIVITY ES-6
CONCLUSIONS ES-7

1 INTRODUCTION 1-1

1.1 OVERVIEW 1-1
1.2 COMPARISON TO SIMILAR STUDIES 1-1
1.3 INTENDED USES FOR THE STUDY 1-2
1.4 REPORT ORGANIZATION 1-3

2 DATA CHARACTERIZATION 2-1

2.1 STUDY BOUNDARIES 2-1
2.2 BUSINESS CATEGORIES 2-2
2.3 TYPES OF INFORMATION DEVELOPED 2-4

3 STUDY METHODOLOGY 3-1

3.1 OVERVIEW 3-1
3.2 APPROACHES TO DIRECT DATA DEVELOPMENT 3-1
3.2.1 Existing Data 3-3
3.2.1.1 Relation of SIC and NAICS to Business Categories 3-3
3.2.1.2 Use of U.S. Department of Commerce, Bureau of Census Statistics 3-4
3.2.1.3 Additional Sources of Existing Data 3-4
3.2.2 Survey Data 3-5
3.2.2.1 Recycling Economic Information Study Database 3-5
3.2.2.2 Survey Design 3-5
3.2.2.3 Survey Approach 3-6
3.2.2.4 Survey Calculations 3-6
3.2.3 Derivation Data 3-6
3.3 INTERMEDIATE INPUT DATA FOR ECONOMIC MODELING 3-7
3.4 ECONOMIC MODELING 3-7
3.5 VALIDATION OF STUDY RESULTS 3-9

4 STUDY RESULTS 4-1

4.1 GENERAL NOTES ON DATA TABLES 4-1
4.1.1 Three-tiered Approach to Data Presentation 4-1
4.1.1.1 Tier One - Statistics on All Industry Establishments 4-2
4.1.1.2 Tier Two - Statistics on Establishments Involved in Recycling 4-2
4.1.1.3 Tier Three - Statistics on Covered Recycling Activities 4-2
4.1.2 Definitions of Column Headings in the Data Tables 4-2
4.1.3 Abbreviations Used in Data Tables 4-4
4.2 DATA TABLES 4-5
4.3 SPECIFIC NOTES ON DATA TABLES 4-9
4.4 ANALYSIS OF RESULTS 4-10
4.5 ACCURACY AND COMPLETENESS OF RESULTS 4-18

5 INDIRECT AND INDUCED ECONOMIC INFORMATION 5-1

5.1 OVERVIEW 5-1
5.1.1 Input-Output Modeling Process and Limitations 5-1
5.1.2 Kinds of Economic Information Produced by I-O Models 5-4
5.2 RESULTS 5-5
5.3 INTERPRETATION OF RESULTS 5-10

6 RECOMMENDATIONS FOR FUTURE STUDIES 6-1

APPENDICES

A. DESCRIPTION OF RECYCLING AND REUSE BUSINESS CATEGORIES
B. DATA SOURCES
C. SAMPLE OF DATA FROM U.S. CENSUS BUREAU'S *STANDARD STATISTICAL ESTABLISHMENTS LIST (SSEL)*
D. SURVEY MATERIALS
E. STATISTICAL ANALYSIS OF SURVEY RESULTS
F. GLOSSARY OF TERMS

EXECUTIVE SUMMARY

OVERVIEW

This report presents the results of the Ohio Recycling Economic Information (REI) Study commissioned by the Ohio Department of Natural Resources (DNR). This study was conducted by R. W. Beck, Inc. as part of the National Recycling Coalition's U. S. Recycling Economic Information (US REI) Study, and data from the Ohio REI study was incorporated into the US REI Study results. The Ohio REI study conforms to the methodology developed by the Northeast Recycling Council for gathering economic data on the recycling and reuse industries.[1] This Executive Summary contains the results of the study. The remainder of the report is dedicated to a complete and thorough documentation of the results and the methodology used in producing them.

This study had two primary goals:

1. Document the size of the recycling and reuse industries in Ohio; and
2. Contribute REI data to the US REI Study.

To achieve the two goals, the project approach included the following steps:

- A review of existing sources of recycling and reuse data;
- Creation of a database of recycling and reuse businesses and surveying them to gather primary data for categories where little or no existing information was otherwise found;
- Deriving estimates using limited existing information for categories with insufficient existing data or incomplete/unavailable lists of establishments;
- Conducting limited surveys to gather supplemental intermediate input data for economic modeling; and
- Conducting economic modeling to estimate the total economic values.

SUMMARY OF DIRECT RESULTS

Twenty-six recycling and reuse industry categories are used in this study and can be grouped into the following two sectors based on the general types of activities undertaken:

- Recycling; and
- Reuse and Remanufacturing.

[1] Northeast Recycling Council, *Recycling Economic Information Study*, June 2000.

Direct industry size data was determined for each category by one of three methods:

- Utilizing existing data from a variety of sources including the U.S. Census Bureau, publications of trade associations, and periodicals;
- Surveying establishments and performing a statistical analysis of results; or
- Deriving estimates using limited existing information.

Table ES-1 presents the estimates of direct economic activity, by category and sector, for Ohio. As shown in the table, Ohio hosts approximately 3,200 recycling and reuse establishments employing nearly 100,000 people generating an annual payroll of $3.6 billion and $22.5 billion in annual revenues.

A majority of the economic activity for the recycling and reuse industries is accounted for by the following four categories:

- Recyclable material wholesalers;
- Plastics converters;
- Steel mills; and
- Iron and steel foundries.

These four categories alone account for 61 percent of all employees, 70 percent of wages, and 74 percent of total receipts.

A noticeable distinction exists between the recycling and reuse sectors regarding the size of establishments and average annual payroll. The recycling establishments have an average of 46 employees each, with an average annual payroll per employee of $39,000. Comparatively, the reuse sector is made up of smaller establishments (an average of 7 employees per establishment) with an average annual payroll of $17,000 per employee. Although the reuse and remanufacturing sector comprises 38 percent of total establishments, it makes up only 9 percent of total employees, 4 percent of payroll, and 4 percent of receipts.

These figures are thought to represent the minimum amount of reuse and remanufacturing captured by the methodology, however, because remanufacturing activities are often included with traditional manufacturing industries that were not included in this study. Several years ago Professor Robert T. Lund of Boston University estimated remanufacturing activities on a national level,[2] although state or regional estimates were not attempted. Extrapolating figures from his study down to Ohio indicated that reuse and remanufacturing categories might be as much as three times that characterized by this study's methodology.

[2] Professor Robert T. Lund, *The Remanufacturing Industry: Hidden Giant*, 1996.

Table ES-1
Summary of Estimates of Direct Economic Activity

Annual Payroll and Estimated Receipts are in $1,000. Throughput is in thousands of tons. Throughput estimates are not summed due to the potential for triple counting at the collecting, processing, and manufacturing stages.
(D) - Data not disclosed due to a limited number of establishments in this business category and the need to avoid revealing data that could identify a single business. Data is not included in totals.

Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
Recycling Industry Economic Activity		
1. Government Staffed Collection	Establishments	149
	Employment	700
	Annual Payroll	18,753
	Estimated Receipts	30,579
	Estimated Throughput	263
2. Private Staffed Collection	Establishments	223
	Employment	1,060
	Annual Payroll	28,397
	Estimated Receipts	45,869
	Estimated Throughput	2,164
3. Compost and Miscellaneous Organics Producers	Establishments	241
	Employment	1,248
	Annual Payroll	23,509
	Estimated Receipts	78,404
	Estimated Throughput	495
4. Materials Recovery Facilities (MRF's)	Establishments	40
	Employment	1,281
	Annual Payroll	20,043
	Estimated Receipts	147,939
	Estimated Throughput	187
5. Recyclable Material Wholesalers	Establishments	577
	Employment	7,593
	Annual Payroll	219,846
	Estimated Receipts	2,392,720
	Estimated Throughput	1,745
6. Glass Container Manufacturing Plants	Establishments	1
	Employment	(D)
	Annual Payroll	(D)
	Estimated Receipts	(D)
	Estimated Throughput	(D)
7. Glass Product Producers (other recycled uses)	Establishments	10
	Employment	791
	Annual Payroll	18,194
	Estimated Receipts	120,729
	Estimated Throughput	60
8. Nonferrous secondary smelting and refining mills	Establishments	22
	Employment	997
	Annual Payroll	34,364
	Estimated Receipts	489,913
	Estimated Throughput	176
9. Nonferrous product producers	Establishments	23
	Employment	2,849
	Annual Payroll	106,810
	Estimated Receipts	840,889
	Estimated Throughput	207
10. Nonferrous foundries	Establishments	161
	Employment	9,557
	Annual Payroll	305,169
	Estimated Receipts	1,078,559
	Estimated Throughput	68

(continued)

Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
11. Paper and Paperboard Mills/Deinked Market Pulp Producers	Establishments	31
	Employment	5,772
	Annual Payroll	243,247
	Estimated Receipts	1,568,169
	Estimated Throughput	1,525
12. Paper-based Product Manufacturers	Establishments	9
	Employment	1,807
	Annual Payroll	35,959
	Estimated Receipts	84,236
	Estimated Throughput	470
13. Pavement Mix Producers (asphalt and aggregate)	Establishments	20
	Employment	1,446
	Annual Payroll	67,260
	Estimated Receipts	280,820
	Estimated Throughput	12,196
14. Plastics Reclaimers	Establishments	48
	Employment	561
	Annual Payroll	16,336
	Estimated Receipts	47,259
	Estimated Throughput	88
15. Plastics Converters	Establishments	215
	Employment	13,003
	Annual Payroll	357,035
	Estimated Receipts	2,361,038
	Estimated Throughput	193
16. Rubber Product Manufacturers	Establishments	6
	Employment	186
	Annual Payroll	3,806
	Estimated Receipts	9,113
	Estimated Throughput	51
17. Steel mills	Establishments	16
	Employment	20,699
	Annual Payroll	1,097,738
	Estimated Receipts	9,215,229
	Estimated Throughput	8,405
18. Iron and Steel foundries	Establishments	130
	Employment	18,963
	Annual Payroll	831,590
	Estimated Receipts	2,752,823
	Estimated Throughput	1,726
19. Other Recycling Processors/Manufacturers	Establishments	33
	Employment	1,028
	Annual Payroll	24,533
	Estimated Receipts	169,688
	Estimated Throughput	224
Recycling Industry Subtotals	**Establishments**	1,955
	Employment	89,541
	Annual Payroll ($1,000)	3,452,590
	Estimated Receipts ($1,000)	21,713,974

(continued)

Business Category	Data Type	Estimates of Total Recycling and Reuse-Related Economic Activity
Reuse and Remanufacturing Industry Economic Activity		
20. Computer and Electronic Appliance Demanufacturers	Establishments	6
	Employment	17
	Annual Payroll	200
	Estimated Receipts	1,550
	Estimated Throughput	N/A
21. Motor Vehicle Parts (used)	Establishments	351
	Employment	2,358
	Annual Payroll	51,698
	Estimated Receipts	253,146
	Estimated Throughput	N/A
22. Retail Used Merchandise Sales	Establishments	704
	Employment	4,200
	Annual Payroll	52,027
	Estimated Receipts	237,940
	Estimated Throughput	N/A
23. Tire Retreaders	Establishments	79
	Employment	576
	Annual Payroll	12,344
	Estimated Receipts	63,581
	Estimated Throughput	N/A
24. Wood Reuse	Establishments	69
	Employment	1,232
	Annual Payroll	26,338
	Estimated Receipts	177,604
	Estimated Throughput	N/A
25. Materials Exchange Services	Establishments	5
	Employment	10
	Annual Payroll	552
	Estimated Receipts	2,865
	Estimated Throughput	N/A
26. Other Reuse	Establishments	8
	Employment	368
	Annual Payroll	6,994
	Estimated Receipts	64,118
	Estimated Throughput	N/A
Reuse Industry Subtotals	**Establishments**	1,222
	Employment	8,761
	Annual Payroll ($1,000)	150,153
	Estimated Receipts ($1,000)	800,804

GRAND TOTALS	**Establishments**	3,177
Recycling and Reuse/Remanufacturing	**Employment**	98,302
	Annual Payroll ($1,000)	3,602,743
	Estimated Receipts ($1,000)	22,514,778

Another important observation can be made by comparing recycling categories that are primarily local establishments performing collection, sorting, and densification activities to those that source material from large distances for downstream processing, conversion, or manufacturing operations. Local collection and processing (baling, grading, densifying, etc.) includes:

- Government staffed residential curbside collection;
- Privately-staffed residential curbside collection;
- Compost and miscellaneous organics products producers;
- Materials recovery facilities; and
- Recyclable material wholesalers.

Establishments in the remaining recycling categories are considered to be downstream processors of recycled materials and tend to utilize recycled materials in manufacturing. When the two groups are compared, "local" collection and processing make up about 13 percent of total recycling employment and 12 percent of receipts whereas non-local downstream processing makes up the remaining 87 percent of employment and 88 percent of receipts. This suggests that public and private investment in local recyclables collection and processing infrastructure pays great dividends in downstream private recycling economic activity. Public policy in the form of state or local laws and regulations that require collection of recyclables or that discourage disposal (e.g., disposal taxes, material specific bans, etc.) directly affects these local public and private sector establishments, and indirectly affects the larger recycling and reuse industry as a whole.

SUMMARY OF INDIRECT AND INDUCED ECONOMIC ACTIVITY

In addition to the twenty-six categories of direct recycling and reuse establishments, the study estimated data for four specific categories of support businesses that provide goods or services to recycling and reuse industry establishments as shown in Table ES-2. The general category Other Indirect Establishments shown in the table includes all other indirect establishments that provide goods or services (such as office supply companies, accounting firms, legal firms, building and landscape maintenance firms, etc.).

Table ES-2
Estimates of Indirect Economic Activity of Select Support Business Categories
(Annual Payroll and Estimated Receipts are in $1,000)

Business Category	Data Type	Value
Recycling and Reuse Equipment Manufacturers [1]	Employment	3,843
	Annual Payroll	61,897
	Estimated Receipts	630,090
Consulting/Engineering [2]	Employment	1,074
	Annual Payroll	39,001
	Estimated Receipts	82,967
Brokers [2]	Employment	503
	Annual Payroll	35,999
	Estimated Receipts	57,407
Transporters [2]	Employment	4,686
	Annual Payroll	155,403
	Estimated Receipts	502,241
Other Indirect Establishments [2]	Employment	60,323
	Annual Payroll	1,966,493
	Estimated Receipts	6,094,819
Support Businesses Totals	**Employment**	70,430
	Annual Payroll ($1,000)	2,258,793
	Estimated Receipts ($1,000)	7,367,524

Notes:
[1] Data for Recycling and Reuse Equipment Manufacturers are based on a statistical analysis of survey results.
[2] Data come from modeling output and reflect the indirect activity stimulated by the 26 direct categories of recycling and reuse establishments targeted by this study for direct data.

The study also estimated other economic activity produced in Ohio's economy attributable to the recycling and reuse industry using economic modeling. Furthermore, state government tax revenues arising from the recycling and reuse industry were also estimated. Table ES-3 shows summarized state government tax revenues for the direct economic activity of the 26 business categories.

Table ES-3
Summary of Recycling & Reuse Industry
Direct Effects on State Government Revenues
(in $ Millions)

Recycling Collection	3.89
Recycling Processing	24.75
Recycling Manufacturing	287.37
Reuse/Remanufacturing	14.74
Total	330.76

CONCLUSIONS

The recycling and reuse industry significantly contributes to the economy of Ohio, providing large numbers of good jobs that pay well. Here are some statistics:

- The average wage paid by Ohio's recycling and reuse industry is $36,600 – approximately $8,000 per year more than the State's average wage.
- The recycling and reuse industry supports 4.3 percent of the jobs in Ohio – 1.7 percent through direct employment, and 2.6 percent by industry and employee spending in the economy.

- Some 3.7 percent of Ohio's gross state product is attributable to the recycling and reuse industry, with 1.8 percent provided directly by the industry.

Figures ES-1 and ES-2 show how Ohio's recycling and reuse industry compares to a few other select industries.

Figure ES-1
Comparison of Annual Wages per Job

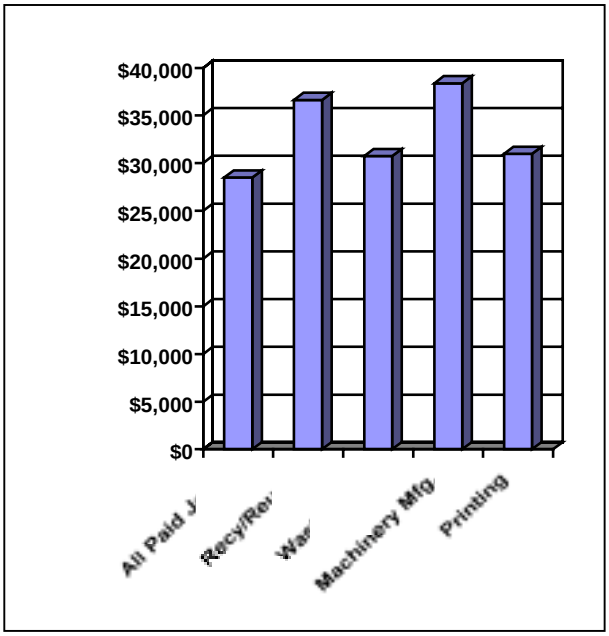
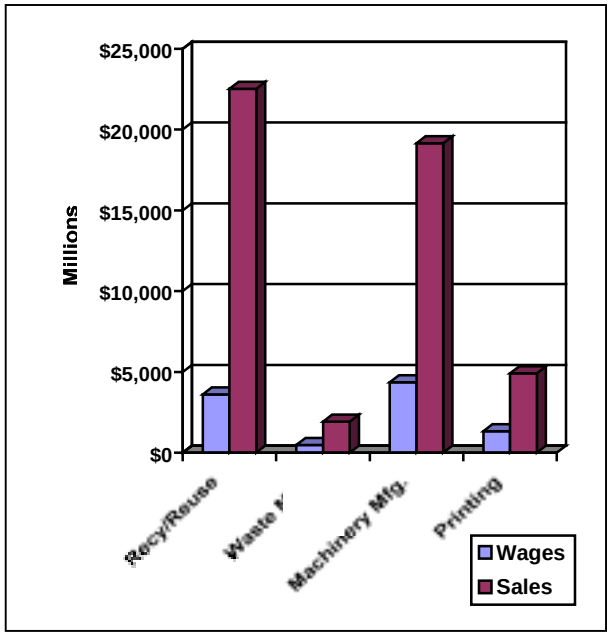


Figure ES-2
Comparison of Total Wages and Sales



As noted previously, investments at the local level in collection and processing of recyclables and public policies that favor recycling and reuse certainly support large private sector investments in downstream processing and manufacturing. However, further study is necessary to rigorously assess the impact of public policy on recycling economic activity and to document recycling and reuse industry growth over the baseline established in this report.[3]

[3] The results of the National REI Study includes information on the size of the recycling and reuse industry in many states, and can be reviewed to gain insight on the influence that various states' public policies may have had in their states.

1 INTRODUCTION

1.1 OVERVIEW

This report presents the results of the Ohio Recycling Economic Information (REI) Study commissioned by the Ohio Department of Natural Resources (DNR). This study was conducted by R. W. Beck, Inc. as part of the National Recycling Coalition's U. S. Recycling Economic Information (US REI) Study. Data from this study has been incorporated into the US REI Study, along with data from other states cooperating in that study.

The goal of the study was to document the size of the recycling and reuse industry by first determining direct economic information for each of twenty-six categories of recycling and reuse establishments. The direct economic values that were measured included:

- Number of establishments;
- Employment;
- Annual payroll;
- Annual receipts; and
- Annual throughput (for applicable categories).

Next, similar information was estimated for four categories of supporting establishments intimately involved in the recycling and reuse industry. Finally, the broader effect of recycling and reuse businesses and their employees on the economy was derived through economic modeling using direct data as inputs. This information included:

- Indirect economic values (inter-industry linkages as measured by purchase of intermediate commodities);
- Induced economic values (personal spending by employees of direct and indirect establishments);
- Multipliers to calculate total economic values (the sum of direct, indirect, and induced) from direct economic values; and
- Tax revenues attributable to the recycling and reuse industry.

1.2 COMPARISON TO SIMILAR STUDIES

The Ohio REI study conforms to the methodology for gathering economic data on the recycling and reuse industries developed by the Northeast Recycling Council (NERC) on behalf of the U.S. Environmental Protection Agency (EPA). As a result, the information contained in this report is directly comparable to that of REI studies conducted for:

- The Northeast Recycling Council,[4] including the states of Delaware, Massachusetts, New Jersey, New York, Pennsylvania, and Vermont;
- The National Recycling Coalition,[5] for the nation as a whole and the states of California, Florida, Indiana, Illinois, and Nebraska; and
- Other states that conform to the specified REI methodology.[6]

At least seven other recycling economic information studies had been performed before NERC developed a standard REI study methodology. Although those existing studies quantified employment and most included other industry size estimates (such as annual sales or value-added), they used varying (and sometimes inconsistent) data collection methodologies and industry definitions. Therefore, care should be taken if attempting to compare the results of this study to previous studies. Table 1-1 lists the types of data collected in this study compared to three previous economic information studies.

Table 1-1

Comparison of Data Presented in Other Recycling Economic Information Studies

Name of Study	Types of Data Presented						
	Recycling Collection	Recycling Processing	Recycling End Use	Reuse	Support Businesses	Multipliers	Tax Revenues
Ohio REI Study (2000)	●	●	●	●	●	●	●
Selected Previous Studies							
Assessment of Economic Impacts of Recycling in Iowa		●	●				●
Arizona Recycling Market Development Study		●	●			●	
Value Added to Recyclable Materials in the Northeast - NERC (1994)	●	●	●				

1.3 INTENDED USES FOR THE STUDY

Recycling and reuse businesses, like other businesses, provide a number of economic benefits, including: creating jobs, making investments, and paying taxes. This study and the economic benefit information it contains may be used as a:

- Reference for economic development agencies, entrepreneurs, and financiers to understand and evaluate recycling and reuse businesses;
- Reference for lawmakers to assist them in evaluating legislation that would affect recycling and reuse;
- Tool for recycling advocates to increase understanding of the industry, promote awareness of recycling and reuse, and target resources for growth; and

[4] "Recycling Economic Information Study", Northeast Recycling Council, June 2000.

[5] Scheduled for completion by March 2001.

[6] Iowa, Minnesota, Missouri, and Wisconsin all conducted studies in 2000 that made use of at least some of the tools and methodology found in "Recycling Economic Information Study", Northeast Recycling Council, June 2000.

- Baseline of economic information to document future growth and development of the industry.

1.4 REPORT ORGANIZATION

This report is organized into the following sections:

1. **Introduction**, which provides a brief overview of the development of the REI study, comparison to similar studies, and intended uses of the study;
2. **Data Characterization**, which briefly describes the development of the business categories, types of data, approaches to data development, and the included activities and boundaries of the study;
3. **Study Methodology**, which explains the methodology used in developing estimates for each category and data type;
4. **Study Results**, which presents detailed data tables and related notes for each sponsoring state and the region as a whole;
5. **Indirect and Induced Economic Information**, which presents the multipliers and related results of economic modeling; and
6. **Recommendations for Future Studies**, which provides suggestions for replication of the study.

The following appendices contain additional detail to support and further explain the methodology and results:

A. Description of Recycling and Reuse Business Categories
B. Evaluation of Data Sources
C. Sample of Raw Data from U.S. Census Bureau's *Standard Statistical Establishments List (SSEL)*
D. Survey Materials
E. Statistical Analysis of Survey Results
F. Glossary of Terms

2 DATA CHARACTERIZATION

2.1 STUDY BOUNDARIES

Defining the recycling and reuse industry is complex. For example, one establishment may perform a variety of processing and/or manufacturing activities, only some of which are related to recycling or reuse. So the question arises whether the establishment should be included, and if so, what portion of that establishment's activities should be attributed to recycling/reuse. In the case of product manufacturing, both recycled and non-recycled materials may be used, again raising the question whether the total activity should be included or only a partial amount.

The most challenging issue that recycling economic information studies face is defining the extent of economic information to include when an industry is able to utilize recovered as well as virgin feedstock or makes an intermediate product as well as converts those intermediate products to end-products within the same facility.

Consistent with the methodology developed by NERC on behalf of the EPA, this study includes those activities that are most essential to the continued recycling of materials and reuse of used products. 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 of advocacy, education and 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.

"Recycling and Reuse" as defined in this study includes the following "covered activities":

- 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 "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 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. This study attempted to exclude economic activity associated with further conversion within the same facility as these are essentially manufacturing rather than recycling activities.

2.2 BUSINESS CATEGORIES

This report presents recycling and reuse industry data for twenty-six separate business categories. Data is also presented for four categories of support businesses because of their intimate involvement in the industry. The business categories are grouped into three major sectors:

- **Recycling Industry:** includes all collection and processing of recovered materials and manufacturing using recycled materials;
- **Reuse and Remanufacturing Industry**: includes preparation of materials for reuse and remanufacturing of used or broken equipment; and
- **Support Businesses:** businesses that do not directly recycle materials or reuse products, but provide specialized equipment and services necessary to the recycling and reuse industry.

Table 2-1 briefly defines each of the 30 business categories as used in this study.

Table 2-1
Business Category Definitions

Business Category	Definition
Recycling Industry	
1. Government Staffed Residential Curbside Collection	Recyclables collection using government employees
2. Private Staffed Residential Curbside Collection	Private sector collection of recyclables, including contract collection on behalf of municipalities
3. Compost and Miscellaneous Organics Producers	Produce compost, mulch, bark, or bedding from yard and wood waste, biosolids, or other organics, also 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
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 and Paperboard Mills/Deinked Market Pulp Producers	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, or 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 an 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 or 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

Business Category	Definition
Reuse and Remanufacturing Industry	
20. Computer and Electronic Appliance Demanufacturers	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
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
Support Businesses	
27. Recycling and Reuse Equipment Manufacturers	Produce new primary equipment designed for use by recycling businesses – conveyers, balers, wash systems, sorting systems
28. Consulting/Engineering	Provide technical research, development, and engineering services to recycling and reuse establishments
29. Brokers	Buy and sell recovered materials or reusable products without processing or otherwise adding value
30. Transporters	Transport recovered materials or reusable goods by air, rail, water, or truck

For more detailed definitions, please see Appendix A.

2.3 TYPES OF INFORMATION DEVELOPED

The two types of economic information developed in the study were:

1. **Direct Economic Information:** Information directly derived from the establishments in each business category and necessary to document industry size; and
2. **Total Economic Information**: Information on the economic values that recycling and reuse establishments induce in the greater economy at the state level, including state tax revenue impacts.

In deriving the direct information, five primary data types were developed:

1. **Number of Establishments:** An establishment is a single physical location where business is conducted or where services or industrial operations are performed;
2. **Employment**: Consists of full and part-time employees, including salaried officers and executives of corporations;
3. **Total 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 (e.g., free meals and lodgings) paid during the year to all employees;
4. **Total Annual Receipts**: Revenue for 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; and
5. **Total Throughput**: Total tons of recovered materials collected or processed. This data type was not gathered for reuse and support business categories because reuse businesses typically do not track throughput data in a manner comparable to recycling businesses (e.g., they may use the number of units remanufactured rather than tons).

The total economic information, developed through economic modeling, generated four secondary data types:

1. **Indirect Economic Values**: Economic activity accrued by other establishments (suppliers and customers) as a result of the activities of the recycling and reuse businesses;
2. **Induced Economic Values:** Economic activity accrued by retail and other establishments because of personal purchases by recycling and reuse industry and indirect establishment employees;
3. **Multipliers**: The ratio of total values (direct, indirect, and induced) to direct values; and
4. **Tax Revenues:** State revenues derived from taxes, charges and fees, and miscellaneous revenues.

3 STUDY METHODOLOGY

3.1 OVERVIEW

This chapter provides a detailed description of the methodologies used to develop the economic activity estimates shown in Sections 4 and 5. This section includes general descriptions of strategies for data gathering and analysis employed in the study. Notes on the specific methodology for the direct data for each category are shown in Section 4 along with the results of the study.

3.2 APPROACHES TO DIRECT DATA DEVELOPMENT

In developing the direct economic information reported in Section 4, one of three methods was employed for each business category, depending on the availability and adequacy of existing information and business lists:

- **Existing Data:** Obtained through existing sources of information (e.g., U.S. Census Bureau's Economic Census, U.S. Geological Survey's Mineral Commodity Reports, expert opinions by industry and trade associations);
- **Survey Data:** Gathered by surveying the businesses directly and compiling the data into a database of establishments; or
- **Derivation:** Limited existing data was used to derive estimates of economic activity.

The study focused on using existing data, of sufficient quality, and with categories defined consistently with the study, for as many business categories as possible to avoid duplicating efforts if sources of existing information were available. If little or no existing information was available but listings of businesses in a category were available, the next option was to develop a database of businesses and conduct surveys to obtain the desired economic information. When limited existing information was available, but no specific list of establishments could be found for purposes of surveying, estimates were derived based on limited existing data and estimations by industry experts.

Due to the number of different business categories included in this study, the exact methodology used to calculate economic activity for each category was tailored to fit the material flows and processes found in each. Table 3-1 lists the business categories and the approach used for each category.

Table 3-1
Data Development Approach by Category

	Business Category	Approach
	Recycling Industry	
1.	Government Staffed Residential Curbside Collection	Derivation
2.	Private Staffed Residential Curbside Collection	Derivation
3.	Compost and Miscellaneous Organics Producers	Survey
4.	Materials Recovery Facilities	Survey
5.	Recyclable Material Wholesalers	Existing Data
6.	Glass Container Manufacturing Plants	Survey
7.	Glass Product Producers (other recycled uses)	Survey
8.	Nonferrous Secondary Smelting and Refining Mills	Existing Data
9.	Nonferrous Product Producers	Existing Data
10.	Nonferrous Foundries	Existing Data
11.	Paper and Paperboard Mills/Deinked Market Pulp Producers	Existing Data
12.	Paper-based Product Manufacturers	Survey
13.	Pavement Mix Producers (asphalt and aggregate)	Survey
14.	Plastics Reclaimers	Existing Data
15.	Plastics Converters	Existing Data
16.	Rubber Product Manufacturers	Survey
17.	Steel Mills	Existing Data
18.	Iron and Steel Foundries	Existing Data
19.	Other Recycling Processors/Manufacturers	Survey
	Reuse and Remanufacturing Industry	
20.	Computer and Electronic Appliance Demanufacturers	Survey
21.	Motor Vehicle Parts (used)	Existing Data
22.	Retail Used Merchandise Sales	Existing Data
23.	Tire Retreaders	Existing Data
24.	Wood Reuse	Survey
25.	Materials Exchange Services	Survey
26.	Other Reuse	Survey
	Support Businesses	
27.	Recycling and Reuse Equipment Manufacturers	Survey
28.	Consulting/Engineering	Modeling
29.	Brokers	Modeling
30.	Transporters	Modeling

The breakdown of the number of categories served by each approach is:

- Existing Data – 12;
- Survey Data – 13;
- Derivation Data – 2; and
- Modeling – 3.

Each of the three approaches is described in greater detail in the following subsections. Furthermore, Appendix B summarizes data sources used for compiling the survey database or otherwise used for producing direct data for this study.

After the direct economic values were developed, total economic values were estimated through economic modeling, using the direct data as inputs. In order to apply the economic model accurately, certain categories required additional information, known as intermediate inputs. To derive the total economic values, the following steps were taken:

- Survey for Intermediate Inputs – A detailed survey of a limited number of establishments was conducted to obtain estimates of the amounts of expenditures on inputs such as raw materials, chemicals, electricity, accounting services and other items necessary for production (usually expressed as a dollar amount per $1,000 in output for a particular type of industry); and
- Conduct Economic Modeling – A process based on an input-output approach developed by the U.S. Bureau of Economic Analysis. Several models have been developed, including RIMS II, IMPLAN, and REMI. The model chosen for this study was the IMPLAN.

3.2.1 EXISTING DATA

The first strategy employed was to utilize existing data from public sources or trade associations. The most common example of this strategy was the use of U.S. Census Bureau reports when a category defined in the study was aligned with a distinct SIC code. Reports from the U.S. Census included an extract created from the Standard Statistical Establishments List (SSEL) and the 1997 Economic Census. Other sources of publicly available data included U. S. Geological Survey reports and reports developed by individual state governments.

3.2.1.1 Relation of SIC and NAICS to Business Categories

The U.S. Department of Commerce, Bureau of the Census compiles and reports a wide range of economic data on U.S. industrial activity. Prior to 1997, the Census Bureau classified businesses according to the SIC system developed by the Executive Office of the President, Office of Management and Budget. The system classified establishments by their primary activity. Beginning in 1997, the SIC system is being phased out and will be replaced by the new *North American Industrial Classification System* (NAICS). The new system harmonizes systems used in Mexico and Canada, in accordance with the North American Free Trade Agreement.

Table A-1, in Appendix A, attempts to classify each business category in the study by SIC and NAICS. The codes were assigned by comparing each business category to the definitions listed in the SIC and NAICS manuals. In many cases, the listed SIC also includes businesses not involved in recycling and reuse.

3.2.1.2 Use of U.S. Department of Commerce, Bureau of Census Statistics

The primary source of U.S. Census data used for this study was an extract of the *Standard Statistical Establishments List* (SSEL) for relevant SIC codes. Because the most recent year available was 1996, the data for this study is referenced by SIC code. The SSEL provides number of establishments, number of employees, payroll, and receipts for each SIC code. It should be noted that certain data are not disclosed when an SIC code has a small number of associated businesses and showing exact numbers would reveal sensitive information for a particular company.

In order to use the data when disclosure problems were encountered, a method of estimating based on suppression codes was developed. The U.S. Census Bureau uses lettered suppression codes to represent the range of employees for the category. When required, an estimate of number of employees was calculated by taking the midpoint of each suppression code range and adding all the midpoints for all suppression codes for a particular SIC code. For example, an SIC code with three establishments may have one establishment with code "a" (0-4 employees), one establishment with code "c" (10-19 employees) and the third establishment with code "d" (20-99 employees). In this case, the estimate used for this study was 2 for the first establishment, 14.5 for the second, and 59.5 for the third; for an estimated total of 76 employees. When fractions occurred in the total, the total was rounded down.

In cases of disclosure, the U.S. Census Bureau does not give any information for payroll and estimated receipts. In such cases, payroll and receipts were estimated by using an average payroll per employee and average receipts per employee, based on U.S. totals for employees, payroll, and receipts. See Appendix C for a sample of data provided by U.S. Census SSEL.

3.2.1.3 Additional Sources of Existing Data

Although the most commonly used existing data was the U.S. Census SSEL, other sources provided throughput data or partial data for use in derivations. The most common source of throughput data was the 1997 Economic Census, a series of reports on industrial activity prepared by the U.S. Census Bureau. Other major sources of existing information and their contributions include:

- American Forest & Paper Association – State-wide throughput data for paper, paperboard, and deinked market pulp mills;
- American Plastics Council – Database provided employment and throughput data for plastics reclaimers;
- Ohio Department of Natural Resources – Lists of recycling and reuse establishments in Ohio, including contact information for those establishments.
- Steel Recycling Institute – Expert opinion on the steel recycling process and percentage of activities to include in the study; and

- U.S. Geological Survey – Expert opinions on the recycling of nonferrous metals and the percentage of activities to include in the study for nonferrous product producers and nonferrous foundries.

3.2.2 SURVEY DATA

When little or no existing data was available for a particular business category, R.W. Beck conducted surveys of those businesses and performed a statistical analysis of the results to develop estimates of economic activity.

3.2.2.1 Recycling Economic Information Study Database

The National Recycling Coalition as part of the US REI study developed a national database of establishments as a tool for surveying businesses in categories with little or no sources of existing data. The database was compiled from various electronic databases, state directories, periodicals, and other sources.

During the survey process, about 350 establishments were confirmed to be in survey categories in the state of Ohio. Of the remaining Ohio establishments, as many as 184 are thought to be in survey categories. Although the database contains a number of businesses that are not in survey categories, those listings are incidental incorporations from electronic directories. Please refer to Table 3-1 for a listing of the survey categories for which the database was developed.

3.2.2.2 Survey Design

The survey was designed to obtain economic information from businesses in categories with little or no existing information. Appendix D contains a copy of the survey forms that were used for this study.

The survey cover page confirmed the database records for company name, mailing information, physical location, and contact person. For companies with more than one physical location, one cover page and survey for each physical location were completed.

The survey solicited responses to the following questions:

1. Classify the establishment according to the categories defined for the study (respondents could check more than one category);
2. Identify the single category that is most representative of the recycling or reuse-related operations for the establishment;
3. Give estimations of establishment size including number of employees, total annual payroll, and total annual receipts;
4. Estimate the percentages of labor and receipts based on covered recycling activities; and
5. Estimate the amounts, by type, of recycled materials processed.

Checkboxes with associated ranges (e.g., 0-9 employees, $50,000-$149,999 total payroll) were used for questions regarding number of employees, payroll, receipts, and

percentages. Due to the sensitive nature of the survey questions, it was anticipated that asking for responses in ranges rather than exact numbers would increase the response rate. With enough responses, any variation from exact amounts was likely averaged out.

3.2.2.3 Survey Approach

Prior to beginning the project it was estimated and budgeted that approximately 1,000 establishments would be identified as potentially being in survey categories. Once the survey database was finalized, 1,040 establishments were listed as being in survey categories or as "unknown." All of these establishments were mailed a survey. Then, at least three follow-up telephone attempts were made to establishments that failed to respond to the mailed survey in order to obtain survey information. Furthermore, Ohio DNR staff also contacted unresponsive establishments in an effort to encourage them to complete the survey.

Once surveys were completed, senior staff reviewed all survey data for accuracy and completeness. Responses were then entered into the REI Study database. After checking the database for errors, the raw data was compiled and analyzed using a statistical approach.

3.2.2.4 Survey Calculations

Survey data was analyzed in an attempt to identify the recycling characteristics of establishments in Ohio. Survey data on three variables (number of employees, payroll, and receipts) provided the primary information analyzed.

Survey information obtained from 350 firms was used to estimate the number of employees[7] involved in recycling activities, as well as the dollar value of recycling and reuse payroll and receipts. Based on initial estimates and survey participation responses, R. W. Beck estimated the total number of firms engaged in recycling activities for each of thirteen survey business categories in the state. In Ohio, 581 establishments are believed to be involved in recycling activities in these categories. For a detailed explanation of the statistical analysis of surveys, please refer to Appendix E.

3.2.3 DERIVATION DATA

In the third strategy, derivations were made by using data from a variety of sources, such as trade organizations, industry experts, periodicals and other publications. Data points from various sources were pieced together to develop estimates of economic activity. As an example of this approach, a detailed explanation of the sources and methodology used for both public and private curbside collection of recyclables is given in Section 4.3, note 6. Additionally, direct data for three of the four support business categories was derived as a result of economic modeling.

[7] Employee responses were adjusted to a full-time equivalent basis. Thus, two employees each working 50% on recycling activities would be counted as one recycling employee.

3.3 INTERMEDIATE INPUT DATA FOR ECONOMIC MODELING

Prior to beginning economic modeling, the 26 direct recycling and reuse business categories were evaluated to identify those categories where recycling establishments were thought to significantly differ from similar non-recycling establishments in the way they operate, their process inputs, and their purchases from other establishments in the economy. Next, existing in-house data from previous studies was examined to identify where recycling and reuse industry-specific data was lacking.

For those categories lacking adequate input data, a detailed survey that asked for much greater detail regarding the cost elements of production was sent to select establishments. Those establishments that were cooperative and expressed interest in the study during the gathering of the direct economic information (employment, payroll, and revenues) were targeted for the additional surveys. Only a handful of establishments were targeted for each business category because the major process inputs and cost elements of the businesses were assumed to be very similar to each other (and quite different from the cost elements of virgin business establishments).

3.4 ECONOMIC MODELING

This study modeled indirect, induced, and total economic values of 26 categories of recycling or reuse establishments using the IMPLAN[8] economic model.

Economic modeling started with the purchase of data files that provided a standard inter-industrial accounting of the economy of Ohio. These data files were procured from Minnesota IMPLAN Group, Inc., the data supplier for the IMPLAN model. What followed was an eight-step process to construct a model that would isolate the 26 categories of recycling and reuse establishments from other establishments in the state so that their economic values could be separately analyzed and reported.

The eight-step process is described below:

1. U.S. standard industrial classifications were identified that best corresponded to the kind of recycling product, process, or service that each of the 26 recycling and reuse categories produces. This was necessary because there is no specific set of "recycling and reuse" industries in the 537 industries contained in the data files.
2. These industrial types were controlled for in the initial model while the remaining industries were aggregated to the one-digit SIC level. The initial model that was produced, then, had twenty-six specific recycling industry candidates and twelve broad industrial aggregates (e.g., farming, the remainders of manufacturing, wholesale trade, transportation, etc.).
3. The direct values obtained from the study were substituted for the direct values (also called the "social" accounts) in the model. Estimates of returns to proprietors,

[8] The modeling system used for this study is called IMPLAN Pro, published by the Minnesota IMPLAN Group, Inc. Data are available and may be purchased from this company for all states and all counties in the U.S. Their data standards are rigorous, their data sets are updated annually, and their methods for compiling and processing the main input-output data sets are widely considered to be a significant enhancement of the basic input-output data that are compiled and solicited by the U.S. Bureau of Economic Analysis. This company has the largest user base of any of the commercial input-output models available in the U.S.

property income, and indirect tax payments to state and local governments were derived from the averages of the original industrial group. This assumed that the recycling or reuse firms yield roughly the same return on investment to sole proprietors or investors as the corresponding industry that may contain significant non-recycling establishments.

4. The remaining values in the parent category (the original values minus the recycling industry direct values) were then manually placed back into the one-digit industrial sector so that the only direct data in the sector reflected the recycling and reuse industries. This ensured the model's total amount of industrial activity summed to precisely the same value as it had originally, before isolating recycling and reuse business categories.

5. Recycling and reuse establishments differ from non-recycling and reuse establishments in the way they operate, their process inputs, and their purchases from other establishments in the economy. This step attempted to account for these differences with data from two sources: (1) the additional intermediate input data that was collected as described previously; and (2) "in-house" data from other previous county-level studies that were conducted in Iowa, Illinois, Nebraska, and Wisconsin counties that reflected the kinds of recycling industries measured in this study but did not contain virgin-only establishments. Twelve models were built from in-house data from counties to isolate recycling industries (primarily ferrous and nonferrous metals, plastics manufacturing, and paper industries) and their production characteristics. The production inputs in the model were then re-configured so that the industrial linkages to raw commodities, mining, or refiners were reduced and linkages to recycling-related processors were strengthened. These changes resulted in a recalculation of all of the production input values for each recycling and reuse industry category.

6. There are several other components to input-output modeling that were investigated. One modification involved changing regional purchase coefficients (RPCs) in the model. For some materials, recycled commodities may be shipped on average less or greater distances than the virgin alternative, including across state boundaries. In-house data from a previous Recycle Iowa Study (an early economic impact study of recycling) of the general likelihood of a recycled commodity being purchased locally for industrial usage was examined for its bearing on this study. Absent other information about some commodity types, the RPC adjustment for a recycling commodity that was believed to be much more likely purchased locally was estimated by taking the square root of the existing number for that industry. For example, an RPC of 0.31 in a commodity supply category would be inflated to 0.56 to increase the likelihood that the input commodity was purchased locally. RPCs were only changed for a small subset of industries[9] and were only done so to maximize the expected linkage between recovered materials collection, processing, and conversion into final demand goods.

[9] RPCs were increased for the following categories: compost and miscellaneous organics producers, plastics reclaimers, motor vehicle parts (used),and wood reuse.

There were other account categories that were assessed also in the input-output model. The byproducts category in the model itemizes the commodity production by industry. Each of these categories was scrutinized and assessed as to its reasonableness for each recycling or reuse industry. No other accounts categories were altered in the models (including exports, institutional demands, or household incomes).

7. The resulting model was then re-checked for errors, omissions, and reasonableness and re-estimated in final form. This step included rebalancing the model so that the gross total equaled the original starting values.
8. Once the final state model was constructed, multipliers were generated for each recycling and reuse industry for Total Industrial Output, Personal Income, Value Added, and Jobs. These multipliers were applied to the original direct values to isolate each industry's unique economic contribution.

In order to estimate state revenues associated with the economic data (direct as well as indirect and induced), data on Ohio's government finances were gathered for 1995 through 1997 from the U.S. Census of Governments publications. Data on incomes were obtained from the U.S. Bureau of Economic Analysis Regional Economic Information System. Annual incomes were converted to fiscal values, and the weighted average revenue incidences for state government own-source revenues[10] was compiled for:

- All State Taxes (e.g., personal, corporate, sales, use, excise, etc.)
- Charges and Fees (e.g., direct state charges and fees, including higher education and health)
- Miscellaneous Revenues (e.g., special revenues, gifts, interest earnings, etc.)
- Total Own-Source Revenues (i.e., the sum of the previous three items).

The revenue indices that were developed were then applied to the direct and total values of industrial output and personal income to yield state revenue estimates.

3.5 VALIDATION OF STUDY RESULTS

Upon completion of the REI study, various methods of internal and external review were used to ensure that both direct and indirect study results are valid and meaningful. The methods of internal review included:

- Review of completed surveys by senior staff;
- Comparisons to other industries in the region; and
- Estimations of recycling and reuse as a portion of Ohio's economy.

External review included a review of the direct economic information for the 26 recycling and reuse categories by the DNR. Furthermore, a previous review by state

[10] "Own-source" means collected through the state revenue system and not received, for example, as a state disbursement of funds collected through the federal revenue system.

government staff and industry trade associations of the Northeast data produced by the NERC REI Study validated that the study methodology fairly and conservatively characterized the level of economic activity for their state or industry.[11]

[11] Trade associations that reviewed the NERC study included the American Forest & Paper Association, the American Plastics Council, the Institute of Scrap Recycling Industries, and the Steel Recycling Institute.

4 STUDY RESULTS

This section presents the detailed results and explanations of estimates for individual data points. The section contains:

- A general description of the format for the data tables;
- A detailed table of results, including numbered notes that correspond to specific data points in the data table and explain how the data was derived;
- An analysis of the results; and
- A discussion of the accuracy and completeness of the results.

4.1 GENERAL NOTES ON DATA TABLES

This section provides general information regarding the format of the data tables presented in section 4.2. Detailed descriptions of all table column headings and an explanation of the three tiers of data presented are given here.

4.1.1 THREE-TIERED APPROACH TO DATA PRESENTATION

Three facts about recycling and reuse businesses complicate recycling economic information studies and have led to inconsistency in past efforts:

1. Most establishments involved in recycling and reuse are part of industries in which many establishments do not recycle or reuse recovered materials or products at all;
2. Some establishments involved in recycling or reuse are also involved in non-recycling activities not intended to be covered in this study; and
3. Many recycling manufacturers use less than 100 percent recycled feedstock and/or adjust the percentage of recycled feedstock throughout the year.

Past studies have handled each of these challenges differently. In an effort to exclude non-recycling activities, some studies relied on survey respondents to estimate recycling activities. Other studies have targeted all facilities involved in recycling and did not attempt to adjust the statistics to account for non-recycling activities. Various industry and recycling experts have criticized both approaches.

To overcome these challenges, the Ohio REI Study is reporting three tiers of statistics. The goals of this approach are:

- To report statistics on recycling and reuse-related businesses as they actually exist in the economy (i.e., as part of industries and establishments that do not always involve recycling); and
- To derive conservative estimates for the amount of economic activity that can "reasonably" be attributed exclusively to recycling. The three tiers of statistics are described below.

4.1.1.1 Tier One - Statistics on All Industry Establishments

Tier One statistics are reported only for certain business categories where data was available from a source that included all establishments in the category, even though some of them may not do any recycling. This information typically comes from U.S. Bureau of Census data by SIC code. For example, data for all paper mills will be shown even though some of those establishments do not utilize recovered paper.

4.1.1.2 Tier Two - Statistics on Establishments Involved in Recycling

Like Tier One, Tier Two statistics are only reported for certain business categories where data was available from a source that aggregated data for recycling and non-recycling establishments. The data covers only those establishments that have some involvement in recycling, and attempts to exclude data on establishments with no recycling activities. Although all of these establishments perform some amount of recycling or reuse activity, they may also perform non-recycling activities not covered in this report. For example, information on all paper mills that utilize recovered paper would be included here, even though some of these establishments may also be involved in non-covered activities like production of wood pulp.

4.1.1.3 Tier Three - Statistics on Covered Recycling Activities

Tier Three statistics are the heart of this study and are reported for all business categories. They are conservative estimates of the portion of economic activity in Tier One or Tier Two that can be reasonably attributed to the recycling activities covered in the study. Most Tier Three estimates are derived from survey results in which respondents themselves are asked to identify what percentage of their facility's activities involves “covered activities.”[12] For some important categories, including paper, plastics and metals manufacturers, an algorithm is being used to estimate covered economic activity. The algorithms begin with Tier One and Tier Two data as described above. Then, the percentage of Tier Two activity involving covered recycling activities is being estimated based on available statistics and industry expert opinions. The exact approach used for each category is documented in detail in Section 4.3. Additionally, Tier Three statistics are reported in two columns, depending on whether the establishments in the category are "100 percent dependent on recycling," or simply "undertaking recycling activities." Those establishments that are dependent on recycling have 100 percent of employment and revenues derived from recycling activities, while those that are “undertaking recycling activities” have only a portion of economic activity derived from recycling. This distinction is intended to assist in accurately and conservatively reporting overall results and to further illuminate the actual structure of the recycling industry.

4.1.2 DEFINITIONS OF COLUMN HEADINGS IN THE DATA TABLES

For Table 4-2, the lettered column headings are defined as follows:

[12] For a complete definition of covered activities, refer to Section 2.1 and note 2 on page 4-9.

A. Business Category – for a detailed list of business category definitions, refer to Appendix A.

B. Data Type – the data types presented in Table 4-2 are:

- Establishments – an establishment is a single physical location of a company or government. A single company or government may have multiple establishments (physical locations).
- Employment – total number of employees for all establishments in a category.
- Annual Payroll – total annual payroll for all employees in a category; reported in thousands of dollars.
- Estimated Receipts – total annual estimated receipts for all establishments in a category; reported in thousands of dollars.
- Estimated Throughput – if possible, total tons of materials processed is estimated; reported in thousands of tons.[13]

C. Total Statistics on all Industry Establishments – the combined statistics for all establishments in categories without regard to recycling activity.[14]

D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities – a subset of Column C and reports statistics on only those establishments with some portion of operations in covered recycling activities.[15] Establishments in this column may have all of their operations or only a portion of their operations involved in covered recycling activities. This column excludes any virgin-only establishments that may be shown in Column C.

E. Statistics on Establishments Undertaking Recycling or Reuse Activities – a subset of Column D and focuses on the employment, payroll, and receipts figures in establishments with less than 100 percent of operations involved in recycling or reuse-related activities. The same establishments are considered in columns D and E. The employment, payroll, and receipts figures are adjusted to eliminate employees who are focused on virgin material preparation, and further discounted for other non-covered activities.

F. Statistics on Establishments 100% Recycling or Reuse-Dependent – estimates for establishments with 100 percent of operations dependent on recycling or reuse, which in most cases establishments consume no virgin material.[16] This column presents data that is discounted for non-covered activities.

---

[13] Note that subtotals and grand totals for throughput are not shown due to the potential for triple-counting material by adding tons of the same material at three different stages — collection, local processing, and reclamation/manufacturing.

[14] A category may not show data for Column C because: (1) it does not have virgin-only establishments; or (2) virgin-only establishments were excluded from the data collection process.

[15] For a complete definition of covered recycling activities, refer to page 2-1 and note 2 on page 4-9.

[16] All domestic steel mills depend on a minimum level of scrap in their processes. Therefore, all steel mill economic activity is included in this column even though some mills use virgin feedstock.

G. Estimates of Total Recycling-Related Economic Activity – conservative estimates of total recycling or reuse-related economic activity. These estimates were developed by adding Columns E and F.

4.1.3 ABBREVIATIONS USED IN DATA TABLES

Table 4-1 presents a list of abbreviations used in the data tables.

Table 4-1
Abbreviations Used in Tables of Results

Abbreviation	Definition
AF&PA	American Forest & Paper Association
AISE	American Iron and Steel Engineers
APC	American Plastics Council
GPI	Glass Packaging Institute
REI	Recycling Economic Information Study
SPI	Society of the Plastics Industry
SRI	Steel Recycling Institute
U.S. Census SSEL	U.S. Census *Standard Statistical Establishments List*
U.S.G.S.	U.S. Geological Survey

4.2 DATA TABLES

Table 4-2
State of Ohio
Summary of Recycling and Reuse Industry Economic Information

Annual Payroll and Estimated Receipts are in $1,000. Throughput is in thousands of tons.
All numbered notes are fully explained in Section 4.3 - Specific Notes on Data Tables
(D) - Data not disclosed due to a limited number of establishments in this business category and the need to avoid revealing data that could identify a single business. Data for multiple disclosure categories are included in totals.

		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		**D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities** (includes recycling and non-recycling activities) [2],[3]		**E. Statistics on Establishments Undertaking Recycling or Reuse Activities** (excluding virgin material preparation and downstream conversion activities) [2],[4]		**F. Statistics on Establishments 100% Recycling or Reuse-Dependent** (No virgin material) [2],[5]		**G. Estimates of Total Recycling-Related Economic Activity** (Sum of columns E and F)
A. Business Category	**B. Data Type**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	
Recycling Industry Economic Activity										
1. Government Staffed Collection	Establishments							149	Derivation; multiple sources [6]	149
	Employment							700	Derivation; multiple sources [6]	700
	Annual Payroll							18,753	Derivation; multiple sources [6]	18,753
	Estimated Receipts							30,579	Derivation; multiple sources [6]	30,579
	Estimated Throughput							263	OH EPA 1996 data [7]	263
2. Private Staffed Collection	Establishments							223	Derivation; multiple sources [8]	223
	Employment							1,060	Derivation; multiple sources [8]	1,060
	Annual Payroll							28,397	Derivation; multiple sources [8]	28,397
	Estimated Receipts							45,869	Derivation; multiple sources [8]	45,869
	Estimated Throughput							2,164	OH EPA 1996 data [9]	2,164
3. Compost and Miscellaneous Organics Producers	Establishments							241	REI Study Database [10]	241
	Employment							1,248	Survey results extrapolated	1,248
	Annual Payroll							23,509	based on OH responses.	23,509
	Estimated Receipts							78,404	(n=131). [11], [12]	78,404
	Estimated Throughput							495	OH EPA 1996 data [13]	495
4. Materials Recovery Facilities (MRFs)	Establishments							40	REI Study Database [10]	40
	Employment							1,281	Survey results extrapolated	1,281
	Annual Payroll							20,043	based on OH responses.	20,043
	Estimated Receipts							147,939	(n=22). [11], [14].	147,939
	Estimated Throughput							187	OH EPA 1996 data [15]	187
5. Recyclable Material Wholesalers	Establishments							577	U.S. Census SSEL, 1996; SIC	577
	Employment							7,593	code 5093. [16], [17]	7,593
	Annual Payroll							219,846		219,846
	Estimated Receipts							2,392,720		2,392,720
	Estimated Throughput							1,745	Derivation [18]	1,745
6. Glass Container Manufacturing Plants	Establishments					1	REI Study Database [10]			1
	Employment					(D)	[19]			(D)
	Annual Payroll					(D)	[19]			(D)
	Estimated Receipts					(D)	[19]			(D)
	Estimated Throughput					(D)	[19]			(D)
7. Glass Product Producers (other recycled uses)	Establishments					10	REI Study Database [10]			10
	Employment					791	Survey results extrapolated			791
	Annual Payroll					18,194	based on OH responses.			18,194
	Estimated Receipts					120,729	(n=4). [11],[20]			120,729
	Estimated Throughput					60	R. W. Beck estimate [21]			60

continued

		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		**D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities** (includes recycling and non-recycling activities) [2],[3]		**E. Statistics on Establishments Undertaking Recycling or Reuse Activities** (excluding virgin material preparation and downstream conversion activities) [2],[4]		**F. Statistics on Establishments 100% Recycling or Reuse-Dependent** (No virgin material) [2],[5]		**G. Estimates of Total Recycling-Related Economic Activity** (Sum of columns E and F)
A. Business Category	**B. Data Type**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	
8. Nonferrous secondary smelting and refining mills	Establishments			22	U.S. Census SSEL, 1996; SIC			22	From Column D [24]	22
	Employment			1,049	code 3341. [16], [22]			997	Column D adjusted for	997
	Annual Payroll			36,173				34,364	non-covered activities [24]	34,364
	Estimated Receipts			515,698				489,913		489,913
	Estimated Throughput			176	1992 Economic Census [23]			176	From Column D [24]	176
9. Nonferrous product producers	Establishments	45	U.S. Census SSEL, 1996; SIC	23	Column C adjusted for	23	From column D [28]			23
	Employment	6,332	codes 3351-3356. [16], [25]	3,166	non-recycling establishments [26]	2,849	Column D adjusted for			2,849
	Annual Payroll	237,356		118,678		106,810	non-covered activities [28]			106,810
	Estimated Receipts	1,868,642		934,321		840,889				840,889
	Estimated Throughput			207	1997 Economic Census [27]	207	From column D [28]			207
10. Nonferrous foundries	Establishments			161	U.S. Census SSEL, 1996; SIC	161	From column D [28]			161
	Employment			10,619	codes 3363-3369. [16], [29]	9,557	Column D adjusted for			9,557
	Annual Payroll			339,077		305,169	non-covered activities [28]			305,169
	Estimated Receipts			1,198,399		1,078,559				1,078,559
	Estimated Throughput			68	1997 Economic Census [30]	68	From column D [28]			68
11. Paper and Paperboard Mills/Deinked Market Pulp Producers	Establishments	34	U.S. Census SSEL, 1996; SIC	31	Derived from column C with	17	From Column D [34]	14	Derived from Column D with	31
	Employment	7,792	codes 2611, 2621, and 2631.	7,104	data from AF&PA Paper	2,735	Derived from Column D with	3,037	data from AF&PA [35]	5,772
	Annual Payroll	328,353	[16], [31]	299,381	Matcher. [32]	115,262	data from AF&PA and adjustment	127,985		243,247
	Estimated Receipts	2,116,833		1,930,054		743,071	for non-covered activities [34]	825,098		1,568,169
	Estimated Throughput			1,525	AF&PA [33]	587	Derived from Column D [34]	938	Column D - Column E [35]	1,525
12. Paper-based Product Manufacturers	Establishments							9	REI Study Database [10]	9
	Employment							1,807	Survey results extrapolated	1,807
	Annual Payroll							35,959	based on OH responses.	35,959
	Estimated Receipts							84,236	(n = 3). [11],[36]	84,236
	Estimated Throughput							470	R. W. Beck estimate [37]	470
13. Pavement Mix Producers (asphalt and aggregate)	Establishments					20	REI Study Database [10]			20
	Employment					1,446	Survey results extrapolated			1,446
	Annual Payroll					67,260	based on OH responses.			67,260
	Estimated Receipts					280,820	(n = 7). [11],[38]			280,820
	Estimated Throughput					12,196	R. W. Beck estimate [39]			12,196
14. Plastics Reclaimers	Establishments							48	APC Database [40]	48
	Employment							561		561
	Annual Payroll							16,336	U.S. Census 1997 [40]	16,336
	Estimated Receipts							47,259	Plastics News [40]	47,259
	Estimated Throughput							88	APC Database [40]	88
15. Plastics Converters	Establishments	1,322	Probe Economics [41]	215	Derivation; from SPI data [42]	215	From Column D [44]			215
	Employment	99,804	Probe Economics [41]	16,254	Derivation; from SPI data [42]	13,003	Column D adjusted for			13,003
	Annual Payroll	2,740,400	Probe Economics [41]	446,294	Derivation; from SPI data [42]	357,035	non-covered activities [44]			357,035
	Estimated Receipts	18,122,000	Probe Economics [41]	2,951,297	Derivation; from SPI data [42]	2,361,038				2,361,038
	Estimated Throughput			193	APC Database [43]	193	From Column D [44]			193
16. Rubber Product Manufacturers	Establishments					6	REI Study Database [10]			6
	Employment					186	Survey results extrapolated			186
	Annual Payroll					3,806	based on OH responses.			3,806
	Estimated Receipts					9,113	(n = 4). [11],[45]			9,113
	Estimated Throughput					51	R. W. Beck estimate [46]			51

continued

		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		**D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities** (includes recycling and non-recycling activities) [2],[3]		**E. Statistics on Establishments Undertaking Recycling or Reuse Activities** (excluding virgin material preparation and downstream conversion activities) [2],[4]		**F. Statistics on Establishments 100% Recycling or Reuse-Dependent** (No virgin material) [2],[5]		**G. Estimates of Total Recycling-Related Economic Activity** (Sum of columns E and F)
A. Business Category	**B. Data Type**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	
17. Steel mills	Establishments	24	U.S. Census, 1997 Econ. Census	16	Column C minus non-integrated			16	From Column D [50]	16
	Employment	22,764	NAICS code 331111. [47]	21,788	mills (NAICS code 3311114). [48]			20,699	Column D adjusted for	20,699
	Annual Payroll	1,199,146		1,155,514				1,097,738	non-covered activities [50]	1,097,738
	Estimated Receipts	10,088,697		9,700,241				9,215,229		9,215,229
	Estimated Throughput			8,405	1997 Economic Census [49]			8,405	From Column D [50]	8,405
18. Iron and Steel foundries	Establishments			130	U.S. Census SSEL, 1996; SIC	130	From Column D [53]			130
	Employment			19,961	codes 3321-3325. [16], [51]	18,963	(Column D-Column F) adjusted for			18,963
	Annual Payroll			875,358		831,590	non-covered activities [53]			831,590
	Estimated Receipts			2,897,708		2,752,823				2,752,823
	Estimated Throughput			1,726	1997 Economic Census [52]	1,726	From Column D [53]			1,726
19. Other Recycling Processors/Manufacturers	Establishments					33	REI Study Database [10]			33
	Employment					1,028	Survey results extrapolated			1,028
	Annual Payroll					24,533	based on OH responses.			24,533
	Estimated Receipts					169,688	(n = 16). [11],[54]			169,688
	Estimated Throughput					224	R. W. Beck estimate [55]			224
Recycling Industry Subtotals	**Establishments**					616		1,339		1,955
	Employment					50,559		38,982		89,541
	Annual Payroll					1,829,658		1,622,931		3,452,590
	Estimated Receipts					8,356,728		13,357,245		21,713,974

continued

		Tier 1		Tier 2		Tier 3				
		C. Total Statistics on All Industry Establishments (not all perform recycling or reuse-related activities) [1]		**D. Total Statistics on Establishments Undertaking Some Recycling or Reuse Activities** (includes recycling and non-recycling activities) [2],[3]		**E. Statistics on Establishments Undertaking Recycling or Reuse Activities** (excluding virgin material preparation and downstream conversion activities) [2],[4]		**F. Statistics on Establishments 100% Recycling or Reuse-Dependent** (No virgin material) [2],[5]		**G. Estimates of Total Recycling-Related Economic Activity** (Sum of columns E and F)
A. Business Category	**B. Data Type**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	**Estimates**	**Sources**	
Reuse and Remanufacturing Industry Economic Activity										
20. Computer and Electronic Appliance Demanufacturers	Establishments					6	REI Study Database [10]			6
	Employment					17	Survey results extrapolated			17
	Annual Payroll					200	based on OH responses.			200
	Estimated Receipts					1,550	(n=3). [11],[56]			1,550
	Estimated Throughput					N/A				N/A
21. Motor Vehicle Parts (used)	Establishments							351	U.S. Census SSEL, 1996	351
	Employment							2,358	SIC code 5015; [16],[57]	2,358
	Annual Payroll							51,698		51,698
	Estimated Receipts							253,146		253,146
	Estimated Throughput							N/A		N/A
22. Retail Used Merchandise Sales	Establishments							704	U.S. Census SSEL, 1996	704
	Employment							4,200	SIC code 5932; [16],[58]	4,200
	Annual Payroll							52,027		52,027
	Estimated Receipts							237,940		237,940
	Estimated Throughput							N/A		N/A
23. Tire Retreaders	Establishments							79	U.S. Census SSEL, 1996	79
	Employment							576	SIC code 7534; [16],[59]	576
	Annual Payroll							12,344		12,344
	Estimated Receipts							63,581		63,581
	Estimated Throughput							N/A		N/A
24. Wood Reuse	Establishments					69	REI Study Database [10]			69
	Employment					1,232	Survey results extrapolated			1,232
	Annual Payroll					26,338	based on OH responses.			26,338
	Estimated Receipts					177,604	(n=32). [11],[60]			177,604
	Estimated Throughput					N/A				N/A
25. Materials Exchange Services	Establishments							5	REI Study Database [10]	5
	Employment							10	Survey results extrapolated	10
	Annual Payroll							552	based on OH responses.	552
	Estimated Receipts							2,865	(n=3). [11],[61]	2,865
	Estimated Throughput							N/A		N/A
26. Other Reuse	Establishments					8	REI Study Database [10]			8
	Employment					368	Survey results extrapolated			368
	Annual Payroll					6,994	based on OH responses.			6,994
	Estimated Receipts					64,118	(n=2). [11],[62]			64,118
	Estimated Throughput					N/A				N/A
Reuse Industry Subtotals	**Establishments**					83		1,139		1,222
	Employment					1,617		7,144		8,761
	Annual Payroll					33,532		116,621		150,153
	Estimated Receipts					243,272		557,532		800,804

GRAND TOTALS	**Establishments**					699		2,478		3,177
Recycling and Reuse/Remanufacturing	**Employment**					52,176		46,126		98,302
	Annual Payroll					1,863,191		1,739,552		3,602,743
	Estimated Receipts					8,600,001		13,914,777		22,514,778

4.3 SPECIFIC NOTES ON DATA TABLES

The purpose of this section is to provide detailed descriptions of the numbered notes presented in Table 4-2.

[1] Statistics for Column C include data for all establishments in industries with recycling or reuse-related activities. Although the industry overall performs recycling or reuse-related activities, it may include some establishments with no recycling or reuse-related activities.

[2] Covered activities is defined as all activities that support:
- Transforming pre-consumer materials or post-consumer products into a recycled material;
- Transforming recycled materials into a first intermediate product (e.g., sheet, fiber, roll);
- Transforming recycled materials directly into a finished product;
- Preparing used products for reuse; and
- Manufacturing equipment for the recycling or reuse industries.

Covered activities *do not* include converting a first intermediate product to finished or semi-finished products or preparing materials for fuel use.

[3] Statistics are for establishments with some amount of covered recycling activities. Establishments may perform both non-recycling and recycling activities.

[4] These estimates include activities where virgin and recycled feedstock materials are co-processed. The estimates do not include virgin-only feedstock material preparation activities and further conversion of intermediate products to finished or semi-finished goods.

[5] Statistics on establishments where 100 percent of labor and receipts are dependent on recycling or reuse-related activities. The estimates do not include virgin-only feedstock material preparation activities and further conversion of intermediate products to finished or semi-finished goods.

[6] The data for Category 1, Government Staffed Residential Curbside Collection, was derived through an algorithm based on data points from a variety of sources. The following tables summarize calculations and data sources used in making estimates of economic activity for this category.

Summary of Calculations

Data Type	Calculation[17]
Establishments	1) K*D
Recycling Collection Employees	2) ((A/(B*C*F))*D*E)*(1 + G)*(1 + H)
Yard Waste Collection Employees	3) ((A/(B*L*F))*D*M*N*O)*(1 + G)*(1 + H)
Total Curbside Recycling and Yard Waste Collection Employees	4) Calculation 2 + Calculation 3
Annual Payroll	5) Calculation 4*I
Receipts	6) (A/B)*D*J*12 months/year

[17] Variables are defined in the following table.

Summary of Data Sources Used for
Government Staffed Residential Curbside Collection

Data Label	Data Type	Value	Reference
A	Population with curbside collection	6,600,000	BioCycle (4/99)
B	Persons per household	2.59	U. S. Census Bureau
C	Homes collected per truck per day	900	R. W. Beck Estimate
D	Percent of homes collected by government staffed collection	40%	R. W. Beck Privatization Study
E	Average crew per truck	1.5	R. W. Beck Estimate
F	Collection days per cycle	5	Assumes once per week collection
G	Additional percent supervisory	10%	R. W. Beck Estimate
H	Additional percent absenteeism, etc.	5%	R. W. Beck Estimate
I	Average payroll per employee	$26,790	1997 U. S. Economic Census
J	Recycling collection cost per household per month	$2.50	R. W. Beck Estimate
K	Number of curbside programs	372	BioCycle (4/99)
Additional Data for Yard Waste Collection			
L	Homes collected per truck per day	1,000	R. W. Beck Estimate
M	Average crew per truck	2	R. W. Beck Estimate
N	Percent of households with yard waste collection	100%	Estimated from BioCycle (5/98)
O	Percent of year collection takes place	100%	R. W. Beck Estimate

[7] Estimated throughput is equal to total tons of residential recyclables plus yard waste as provided by Ohio EPA's *1997 Summary of Solid Waste Management in Ohio* report times the percentage of homes collected by government staffed collection.

[8] Calculations and values for Private Staffed Residential Curbside Collection are the same as those presented in Note 6, with the exception of Data Label D. For Category 2, Data Label D is "Percent of Homes Collected by Private Sector."

[9] Throughput is equal to total state recycling collection of all recyclables minus throughput by government staffed curbside collection.

[10] Number of establishments for all survey categories is based on the REI study database.

[11] In general, data for all survey categories is based on a statistical analysis of survey results. See Section 3.2.2 for a detailed description of survey design and calculations. The number of completed surveys on which results are based is given as "n."

[12] Number of employees, payroll, and receipts for Compost and Organics Producers are based on a statistical analysis of survey results. Surveys focused on active processing of organic materials for beneficial use. As a result, number of establishments and potential economic activity associated with inactive composting techniques (i.e., allowing materials to slowly and independently decompose over time) may not be fully reflected in totals.

[13] Throughput is equal to tons of yard waste recycled as reported by Ohio EPA's *1997 Summary of Solid Waste Management in Ohio* report.

[14] Number of employees, payroll, and receipts for Materials Recovery Facilities (MRF's) are based on a statistical analysis of survey results.

[15] Throughput is derived by multiplying the curbside tons from state reports by percent of material collected that is estimated to go to MRF's.

[16] Data derived from the 1996 U.S. Census Bureau's Standard Statistical Establishments List. See Section 3.2.1.2 for a detailed description of the use of census bureau statistics.

[17] Data are taken directly from U.S. Census SSEL for SIC code 5093 – Recyclable Material Wholesalers. This category includes a number of different types of businesses including scrap metal and plastics dealers, C&D processors, beneficiation facilities, crumb rubber producers and textile processors. No adjustments were made to Census data since the category is defined as 100 percent recycling-related.

[18] Throughput for Recyclable Material Wholesalers is derived as follows: Government Staffed Throughput + Private Staffed Throughput – Compost/Organics Throughput – Materials Recovery Facilities Throughput.

[19] (D) indicates that figures cannot be reported in order to avoid disclosure of individual company information.

[20] Number of employees, annual payroll, and receipts for Glass Product Producers are based on a statistical analysis of survey results.

[21] Throughput is estimated as 76 tons per employee based on a nationwide average of survey responses and Glass Packaging Institute secondary glass use data of 614,000 tons per year nationally.

[22] Data for Nonferrous Smelting and Refining Mills is taken from SIC code 3341, Secondary Smelting and Refining. Estimates assume that a sizeable percentage of nonferrous scrap is recovered in secondary nonferrous mills.

[23] Throughput for nonferrous smelting and refining is estimated based on national scrap consumption for smelting and refining mills from the 1992 Economic Census, adjusted upward based on employment increases for this category. Data from the 1997 Economic Census were not used because they conform to the new NAICS system, which includes data for making nonferrous metal powder, paste, and flake from purchased nonferrous metals. Allocations to the state-level are on a state-employment basis.

[24] Employment, payroll, and receipts are derived from Column D with an adjustment for the percent of covered activities (95 percent). Number of establishments and throughput are from Column D with no adjustment.

[25] Data for Nonferrous Product Producers is taken from U.S. Census SSEL for SIC codes 3351-3355 with no adjustments.

[26] Data are derived by multiplying Column C figures by 50 percent, the percentage of establishments assumed to be utilizing scrap or recycled materials, based on comments from U.S.G.S. nonferrous metals specialists.

[27] Throughput for Nonferrous Product Producers is estimated based on scrap purchases reported in the 1997 Economic Census. Total tons of scrap for the U.S. is

calculated as:
Total Scrap Cost (by SIC) / ($0.45/lb) / (2,000 lbs./ton).
Tons of scrap on a state-level is estimated as:
Total tons of scrap x State Employees/U.S. Employees.

[28] Estimates of employees, payroll, and receipts are derived from Column D with an adjustment for the percent of covered activities (90 percent). Number of establishments and throughput are from Column D with no adjustments.

[29] Data for Nonferrous Foundries is taken from U.S. Census SSEL for SIC codes 3363, 3365, 3366, and 3369, with no adjustments.

[30] Throughput for Nonferrous Foundries is estimated based on scrap purchases reported in the 1997 Economic Census. Total tons of scrap for the U.S. is calculated as:
Total Scrap Cost (by SIC) / ($0.45/lb) / (2,000 lbs./ton).
Tons of scrap on a state-level is estimated as:
Total tons x State Employees/U.S. Employees.

[31] Data for Paper, Paperboard, and Deinked Market Pulp Producers is taken directly from the U.S. Census SSEL for SIC codes 2611, 2621, and 2631, with no adjustments.

[32] Establishments, employees, payroll, and revenue figures are derived from Column C by multiplying each data point by the percentage of total pulp, paper, and paperboard mills in the state utilizing recovered paper (as found in *Paper Matcher*).

[33] Throughput is taken from the AF&PA *Annual Statistical Summary Recovered Paper Utilization* (April, 1999). Throughput numbers used are for 1996 to coincide with the data from U.S. Census SSEL.

[34] Data in Column E is derived from Column D based on data from AF&PA *Paper Matcher*. Number of establishments from Column D is multiplied by 55 percent (national percentage of mills utilizing recovered paper but which do not entirely depend on recovered paper). Employees, payroll, receipts, and throughput from Column D are multiplied by 55 percent and again by 70 percent (average percent of employees involved in covered recycling–related activities in mills that are not entirely dependent on recycling).

[35] Data in column F is derived from Column D based on data from AF&PA *Paper Matcher*. Number of establishments, employees, payroll, and receipts from Column D are multiplied by 45 percent (national percentage of mills utilizing recovered paper which are entirely dependent on recovered paper) and again by 95 percent (adjustment for non-covered activities). Throughput is equal to Column D – Column E.

[36] Number of employees, payroll, receipts, and throughput for Paper-Based Product Manufacturers are based on a statistical analysis of survey results.

[37] Throughput is estimated by multiplying employees times a tons per employee figure (260) derived from a nationwide average of survey responses.

[38] Number of employees, payroll, and receipts for Pavement Mix Producers are based on a statistical analysis of survey results.

[39] Throughput is estimated by multiplying employees times a tons per employee figure derived from a nationwide average of survey responses.

[40] For Plastics Reclaimers, establishments, employees, and throughput are based on the American Plastics Council Handler & Reclaimer database developed by R.W. Beck. Payroll is calculated by multiplying employment figures by Census Bureau's 1997 average wage for plastics industry employees ($29,120). Estimated receipts is calculated by multiplying throughput of recycled resins produced times an average of recycled resin prices from Plastics News.

[41] Establishments, employees, payroll, and receipts in column C for Plastics Converters are obtained from *Contribution of Plastics to the U.S. Economy*, prepared for the Society of the Plastics Industry by Probe Economics, and multiplied by 84 percent (national employment percentage of the "industry" that converts products instead of selling resins, making molds, selling machinery, and wholesaling products).

[42] Number of establishments, employees, payroll, and estimated receipts in Column D are derived by multiplying column C figures by the industry-wide recycled-content percentage (5.7 percent) divided by the average recycled content of products that contain recycled materials (35 percent).

[43] Throughput is calculated from the state's percentage of national plastics converter employees multiplied by the total tons of plastics recycled nationally (APC Plastics Recycling Rate Study as compiled by R. W. Beck, with additions for pre-consumer plastics recycled).

[44] Number of establishments and throughput are directly from Column D. Employees, payroll, and receipts are derived from Column D by multiplying by the estimated percent of employees at recycling-related establishments that are involved in covered recycling-related activities (80 percent).

[45] Number of employees, payroll, and receipts for Rubber Product Manufacturers are based on a statistical analysis of survey results.

[46] Throughput is estimated by multiplying employees times a tons per employee figure (272) derived from a nationwide average of survey responses.

[47] Steel Mill data comes from the U.S. Census Bureau's 1997 Economic Census, Geographic Area Series.

[48] Establishments, employees, payroll, and revenue figures are derived from Column C by excluding non-integrated mills, which do not make steel.

[49] Throughput is calculated as state's percentage of national steel mill employees multiplied by the total tons of steel scrap consumed (1997 Economic Census) by steel mills nationally.

[50] Employment, payroll, and receipts are equal to estimates from Column D multiplied by 95 percent (5 percent deduction to account for downstream conversion). Based on comments from SRI, 100 percent of steel mills are dependent on recovered steel to make new steel, utilizing anywhere from 15 percent-100 percent recovered steel. Therefore, the only deduction taken is to account for non-covered activities. Establishments and throughput are from Column D with no adjustment.

[51] For Iron and Steel Foundries, estimates for Column D are taken directly from U.S. Census SSEL with no adjustments. SRI states that all foundries as a matter of practice utilize a significant percentage of scrap in the making of new iron products.

[52] Throughput for Iron and Steel Foundries is estimated as the state's percentage of total national foundry employees multiplied by national scrap consumption by foundries (1997 Economic Census).

[53] In Column E, establishments and throughput are taken directly from Column D. Employees, payroll, and receipts from Column D are multiplied by 95 percent, the estimated percent of foundry employees involved in covered recycling-related activities.

[54] Number of employees, payroll, and receipts for Other Recycling Processors/Manufacturers are based on a statistical analysis of survey results.

[55] Throughput is estimated by multiplying employees times a tons per employee figure (218) derived from a nationwide average of survey responses.

[56] Number of employees, payroll, and receipts for Computer and Electronic Appliance Demanufacturers are based on a statistical analysis of survey results.

[57] Estimates for Motor Vehicle Parts are taken directly from U.S. Census SSEL for SIC code 5015 with no adjustments.

[58] Estimates for Retail Used Merchandise Sales are taken directly from U.S. Census SSEL for SIC code 5932 with no adjustments.

[59] Estimates for Tire Retreaders are taken directly from U.S. Census SSEL for SIC code 7534 with no adjustments.

[60] Number of employees, payroll, and receipts for Wood Reuse are based on a statistical analysis of survey results.

[61] Number of employees, payroll, and receipts for Materials Exchange Services are based on a statistical analysis of survey results.

[62] Number of employees, payroll, and receipts for Other Reuse are based on a statistical analysis of survey results.

4.4 ANALYSIS OF RESULTS

Table 4-5 presents an analysis of three data types related to the results presented in Table 4-2. The three analyses performed for each category and sector (recycling, reuse, or support businesses) were:

- The number of establishments, employees, payroll, and receipts as a percentage of the total for all categories;
- Number of employees per establishment; and
- Average annual payroll per employee.

Table 4-3

Analysis of Economic Activity for the Recycling and Reuse Industry

Annual Payroll and Estimated Receipts are in $1,000. Throughput is in thousands of tons.
(D) - Data not disclosed due to a limited number of establishments in this business category and the need to avoid revealing data that could identify a single business. Data for multiple disclosure categories are included in totals.

Business Category	Data Type	Estimates of Recycling and Reuse-Related Economic Activity	Percent of Total for All Categories	Employees per Establishment	Annual Payroll per Employee	Estimated Receipts per Employee
Recycling Industry Economic Activity						
1. Government Staffed Residential Curbside Collection	Establishments	149	4.7%			
	Employment	700	0.7%	5		
	Annual Payroll	18,753	0.5%		27	
	Estimated Receipts	30,579	0.1%			44
2. Private Staffed Residential Curbside Collection	Establishments	223	7.0%			
	Employment	1,060	1.1%	5		
	Annual Payroll	28,397	0.8%		27	
	Estimated Receipts	45,869	0.2%			43
3. Compost and Miscellaneous Organics Producers	Establishments	241	7.6%			
	Employment	1,248	1.3%	5		
	Annual Payroll	23,509	0.7%		19	
	Estimated Receipts	78,404	0.3%			63
4. Materials Recovery Facilities (MRFs)	Establishments	40	1.3%			
	Employment	1,281	1.3%	32		
	Annual Payroll	20,043	0.6%		16	
	Estimated Receipts	147,939	0.7%			116
5. Recyclable Material Wholesalers	Establishments	577	18.2%			
	Employment	7,593	7.7%	13		
	Annual Payroll	219,846	6.1%		29	
	Estimated Receipts	2,392,720	10.6%			315
6. Glass Container Manufacturing Plants	Establishments	1	< 0.1%			
	Employment	(D)	(D)	(D)		
	Annual Payroll	(D)	(D)		(D)	
	Estimated Receipts	(D)	(D)			(D)
7. Glass Product Producers (other recycled uses)	Establishments	10	0.3%			
	Employment	791	0.8%	79		
	Annual Payroll	18,194	0.5%		23	
	Estimated Receipts	120,729	0.5%			153
8. Nonferrous Secondary Smelting and Refining Mills	Establishments	22	0.7%			
	Employment	997	1.0%	45		
	Annual Payroll	34,364	1.0%		34	
	Estimated Receipts	489,913	2.2%			492
9. Nonferrous Product Producers	Establishments	23	0.7%			
	Employment	2,849	2.9%	127		
	Annual Payroll	106,810	3.0%		37	
	Estimated Receipts	840,889	3.7%			295
10. Nonferrous Foundries	Establishments	161	5.1%			
	Employment	9,557	9.7%	59		
	Annual Payroll	305,169	8.5%		32	
	Estimated Receipts	1,078,559	4.8%			113
11. Paper and Paperboard Mills/Deinked Market Pulp	Establishments	31	1.0%			
	Employment	5,772	5.9%	186		
	Annual Payroll	243,247	6.8%		42	
	Estimated Receipts	1,568,169	7.0%			272
12. Paper-based Product Manufacturers	Establishments	9	0.3%			
	Employment	1,807	1.8%	201		
	Annual Payroll	35,959	1.0%		20	
	Estimated Receipts	84,236	0.4%			47
13. Pavement Mix Producers (asphalt and aggregate)	Establishments	20	0.6%			
	Employment	1,446	1.5%	72		
	Annual Payroll	67,260	1.9%		47	
	Estimated Receipts	280,820	1.2%			194
14. Plastics Reclaimers	Establishments	48	1.5%			
	Employment	561	0.6%	12		
	Annual Payroll	16,336	0.5%		29	
	Estimated Receipts	47,259	0.2%			84
15. Plastics Converters	Establishments	215	6.8%			
	Employment	13,003	13.2%	60		
	Annual Payroll	357,035	9.9%		27	
	Estimated Receipts	2,361,038	10.5%			182
16. Rubber Product Manufacturers	Establishments	6	0.2%			
	Employment	186	0.2%	31		
	Annual Payroll	3,806	0.1%		20	
	Estimated Receipts	9,113	0.0%			49

Business Category	Data Type	Estimates of Recycling and Reuse-Related Economic Activity	Percent of Total for All Categories	Employees per Establishment	Annual Payroll per Employee	Estimated Receipts per Employee
17. Steel Mills	Establishments	16	0.5%			
	Employment	20,699	21.1%	1294		
	Annual Payroll	1,097,738	30.5%		53	
	Estimated Receipts	9,215,229	40.9%			445
18. Iron and Steel Foundries	Establishments	130	4.1%			
	Employment	18,963	19.3%	146		
	Annual Payroll	831,590	23.1%		44	
	Estimated Receipts	2,752,823	12.2%			145
19. Other Recycling Processors/Manufacturers	Establishments	33	1.0%			
	Employment	1,028	1.0%	31		
	Annual Payroll	24,533	0.7%		24	
	Estimated Receipts	169,688	0.8%			165
Recycling Subtotals	**Establishments**	1,955	61.5%			
	Employment	89,541	91.1%	46		
	Annual Payroll ($1,000)	3,452,590	95.8%		39	
	Estimated Receipts ($1,000)	21,713,974	96.4%			243

Reuse and Remanufacturing Industry Economic Activity						
20. Computer and Electronic Appliance Demanufacturers	Establishments	6	0.2%			
	Employment	17	0.0%	3		
	Annual Payroll	200	0.0%		12	
	Estimated Receipts	1,550	0.0%			91
21. Motor Vehicle Parts (used)	Establishments	351	11.0%			
	Employment	2,358	2.4%	7		
	Annual Payroll	51,698	1.4%		22	
	Estimated Receipts	253,146	1.1%			107
22. Retail Used Merchandise Sales	Establishments	704	22.2%			
	Employment	4,200	4.3%	6		
	Annual Payroll	52,027	1.4%		12	
	Estimated Receipts	237,940	1.1%			57
23. Tire Retreaders	Establishments	79	2.5%			
	Employment	576	0.6%	7		
	Annual Payroll	12,344	0.3%		21	
	Estimated Receipts	63,581	0.3%			110
24. Wood Reuse	Establishments	69	2.2%			
	Employment	1,232	1.3%	18		
	Annual Payroll	26,338	0.7%		21	
	Estimated Receipts	177,604	0.8%			144
25. Materials Exchange Services	Establishments	5	0.2%			
	Employment	10	0.0%	2		
	Annual Payroll	552	0.0%		55	
	Estimated Receipts	2,865	0.0%			287
26. Other Reuse	Establishments	8	0.3%			
	Employment	368	0.4%	46		
	Annual Payroll	6,994	0.2%		19	
	Estimated Receipts	64,118	0.3%			174
Reuse and Remanufacturing Subtotals	**Establishments**	1,222	38.5%			
	Employment	8,761	8.9%	7		
	Annual Payroll ($1,000)	150,103	4.2%		17	
	Estimated Receipts ($1,000)	800,804	3.6%			91

GRAND TOTALS	**Establishments**	3,177	100.0%			
Recycling, Reuse and Remanufacturing	**Employment**	98,302	100.0%	31		
	Annual Payroll ($1,000)	3,602,693	100.0%		37	
	Estimated Receipts ($1,000)	22,514,778	100.0%			229

A majority of the economic activity for the recycling and reuse industry is accounted for by the following four categories:

- Recyclable material wholesalers;
- Plastics converters;
- Steel mills; and
- Iron and steel foundries.

These four categories alone account for 61 percent of all employees, 70 percent of wages, and 74 percent of total receipts.

A noticeable distinction exists between the recycling and reuse sectors regarding the size of establishments and average annual payroll. The recycling establishments have an average of 46 employees each, with an average annual payroll per employee of $39,000. Comparatively, the reuse sector is made up of smaller establishments (an average of 7 employees per establishment) with an average annual payroll of $17,000 per employee. Although the reuse and remanufacturing sector comprises 38 percent of total establishments, it makes up only 9 percent of total employees, 4 percent of payroll, and 4 percent of receipts.

The methodology used to capture reuse and remanufacturing activity for this report provides a conservative estimate for these sectors. This is because remanufacturing activities are often included with traditional manufacturing industries that were not included in this study. A report entitled *The Remanufacturing Industry: Hidden Giant* by Professor Robert T. Lund of Boston University estimated remanufacturing activities on a national level, although state or regional-level estimates were not attempted. Extrapolating the figures from that report down to Ohio indicated that reuse and remanufacturing categories may be as much as three times that characterized by this study's methodology.

Another important observation can be made by comparing recycling categories that are primarily “local” establishments performing collection, sorting, and densification activities to those that source material from large distances for downstream processing, conversion, or manufacturing operations. Local collection and processing (baling, grading, densifying, etc.) includes:

- Government staffed residential curbside collection;
- Privately-staffed residential curbside collection;
- Compost and miscellaneous organics products producers;
- Materials recovery facilities; and
- Recyclable material wholesalers.

Establishments in the remaining recycling categories are considered to be downstream processors of recycled materials and tend to utilize recycled materials in manufacturing. When the two groups are compared, “local” collection and processing make up 13 percent of total recycling employment and 12 percent of receipts whereas non-local downstream processing makes up the remaining 87 percent of employment and 88 percent of receipts. This indicates that public and private investment in local recyclables collection and processing infrastructure pays great dividends in downstream private recycling economic activity. Public policy in the form of state or local laws and regulations that require collection of recyclables or that discourage disposal (e.g., disposal taxes, material specific bans, etc.) directly affects these local public and private sector establishments, and indirectly affects the larger recycling and reuse industry as a whole.

The data found in Table 4-3 can be compared to other Ohio industries and statewide averages to put it into perspective. For example, the average wage of the recycling and reuse industry is $36,600 – approximately $8,000 per year more than the State's average wage. The industry also composes 1.7 percent of all jobs in the state, and directly contributes to 1.8 percent of Ohio's gross state product.

Figures 4-1 and 4-2 show how Ohio's recycling and reuse industry compares to a few other select industries.

Figure 4-1
Comparison of Annual Wages per Job

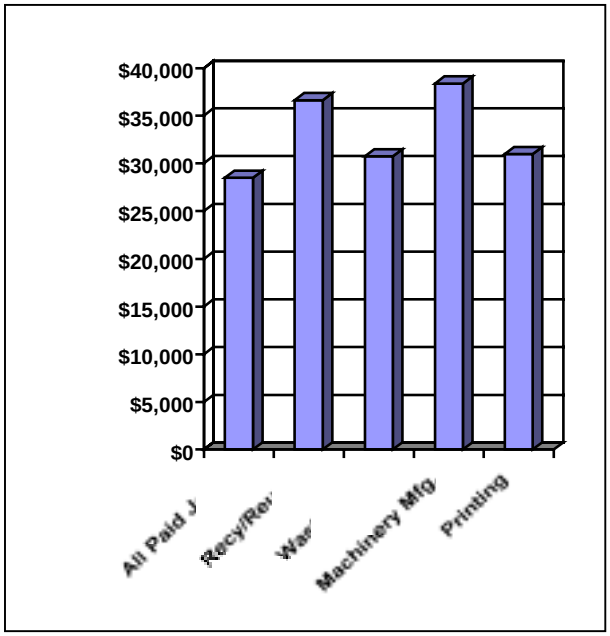
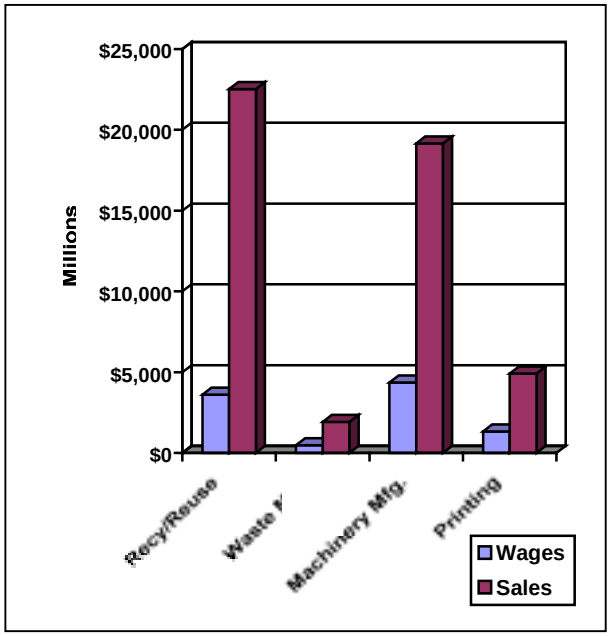


Figure 4-2
Comparison of Total Wages and Sales



4.5 ACCURACY AND COMPLETENESS OF RESULTS

The results of this study for the categories identified are thought to be realistic and generally conservative. The results for categories which used existing U.S. Census data are believed to be the most accurate, followed by data for survey categories, while the derivations are likely to be the least accurate because of the limited amount of available data for estimations. Census data, although updated yearly, lags in publication by three years so that data is not as current as data for survey categories. Survey data is current; however, confidence intervals for total employment, payroll, and receipts for certain categories are quite large because of the small number of establishments in those categories.

The study did encounter a number of limitations that impacted the ability to accurately capture all recycling and reuse activity. The limitations of the study include:

- Survey data asked for intervals rather than discrete numbers;
- Certain business categories that could be considered part of the recycling and reuse industry were excluded for logistical reasons. Examples include

equipment remanufacturers (only national-level data was available) and collectors of commercial and industrial recyclables (very difficult to quantify).

- Many companies in non-traditional recycling categories, such as fluorescent lamps and carpets, were not easily identifiable and may not be included under any of the categories.
- Some derivations, such as that for plastics converters, are based on the best of several less-than-desirable options available; it is very difficult to assess the accuracy of those results.

Although the study was not able to capture every possible type of recycling and reuse activity, it is reasonably accurate for the categories shown and conservatively estimates the total amount of recycling and reuse activity taking place.

5 INDIRECT AND INDUCED ECONOMIC INFORMATION

5.1 OVERVIEW

This study modeled the economic values of twenty-six recycling or reuse categories. Further calculations were made to estimate selected state government revenues that would be associated with the levels of economic activity that were identified through the modeling process. This section provides an overview of the process of input-output modeling, its strengths, its limitations, and its adaptation to this study. This section also defines the terms used and what the model output data represents. The following section provides the results in tabular form.

5.1.1 INPUT-OUTPUT MODELING PROCESS AND LIMITATIONS

Economic values or economic effects studies are usually conducted with input-output (I-O) econometric models of a regional economy. Input-output modeling allows researchers to investigate the interdependencies that industries, institutions, and households have with each other in a region of study. I-O models, therefore, relate the products made within a region and the products consumed by industries and households in that same region.

At a basic level, any industry's or institution's output (usually its gross sales) requires employees, materials, utilities, capital investments, financing, maintenance, equipment, and service inputs. The probability that a firm purchases its inputs locally (meaning within the region being modeled) is estimated in the I-O model. Estimates of an industry's inputs mix and whether those inputs are purchased within the region being modeled are based on national and regional industrial surveys.

Primary survey information to update the national or regional statistics is needed to improve the quality of the model output, particularly where the industry segment under study may differ from national or regional averages. As was discussed previously in the Study Methodology section, this study performed limited surveys to obtain additional intermediate input data. Furthermore, it made use of in-house data from previous county-level and state-level modeling projects to further improve the quality of the model that was produced.

There are important limitations to these models that must be acknowledged. First and foremost, absent highly detailed and costly local industry surveys, which was not done for this study, national and regional averages for major industrial input categories (the production functions) and the likelihood of a local purchase of inputs for the industries that were studied (regional purchasing coefficients) were still heavily relied on. Industries that fall within general industrial categories normally have very similar industrial input characteristics. A plastics firm that produces finished goods from recycled stock will be configured very similarly to a plastics firm that produces goods primarily from virgin inputs. Except for the source of their commodity input into production and the physical configuration of their processing machinery, their overall remaining operational

characteristics – transportation, utilities, services, maintenance, financial inputs, etc. – are likely to be very similar. Consequently, in most instances, production characteristics of existing firms in the state of study provided a very good first pass at identifying intra-regional linkages and supply chains of goods and services required for production. Although the I-O model has information on up to 537 industries, there is no specific set of "recycling and reuse" industries. Consequently, the models that were produced were significantly modified to accept recycling and reuse industries distinctly. Furthermore, the use of in-house data and additional surveys for select recycling and reuse industries enhanced the quality of the model output for this study.

Other limits in these types of models include:

- Difficulties in capturing economies of scale, particularly for industries with relatively small numbers of establishments, where establishment-to-establishment variation may be significant (the current input values or production functions are, therefore, initially constant);
- An inability to identify input substitutes – especially in new technologies or in instances where input modes have changed;
- Dated data on industrial performance and purchases, particularly for industries that are newly-emerging or rapidly changing;
- In-state and out-of-state purchases of commodities within a study area are fixed (regional purchasing coefficients must be adjusted if it is suspected that the regional averages are not right); and
- An implicit assumption that input commodity supply is infinite and perfectly elastic.

I-O models, therefore, are just that – models – that simulate industrial inter-dependencies in the current economy under study. I-O models are not necessarily good models for forecasting because they model the existing economy, and do not forecast the net impact of replacing a virgin-commodity establishment with a recycled-commodity establishment, for example. Furthermore, the results for one region reflect the economy of that particular region and generally are not transferable to other regions. I-O models, therefore, have limits. Nevertheless, I-O models are comparably much less expensive to produce than more involved models, and do an excellent job of estimating the role a particular industry has (such as the recycling industry) on a specific economy.

The generic term “economic impact” is frequently used to describe a set of economic activities in a region. This term often suffers from serious misapplication. There are several kinds of economic activities that may occur within a particular region. For example:

- Firms may produce goods or provide services for export outside the region. They attract outside funds into the region that supports employment, industrial purchases, and household spending.

- Firms may substitute locally produced commodity inputs for those that previously were purchased from outside the region. In this case funds are retained in the region and flow to local suppliers to an industry.
- Firms may produce goods and services for local consumption (either by industries or by households). Although they may help to retain funds in the region, they may not cause significant additional economic activity.

I-O models identify the overall size and contribution of an industry – its *economic effect* or *economic value* – to the area mix of economic activity along with interdependencies that exist between it and other firms or service suppliers. In other words, the strength of linkages that exist among industries and the overall value (output, incomes, and jobs) of their production. The impact of an industry hasn't yet been determined.

In the case of firms that produce finished goods for export outside a region, there is a measurable *economic impact* – were it not for the external demand for the locally-produced product, the economic activity would not be in the local economy.

A much harder measure of potential economic impact falls into the category of import substitution. If a region is able to develop indigenous industries that produce a good that substitutes for a good that is imported, then that industry is *retaining* dollars in the state that used to be exported. An industry that produces a good using recycled feedstock that is supplied locally will create a product that substitutes local inputs for non-local inputs. Recycling industries often fit into the import substitution category, particularly in states without virgin feedstock production infrastructures. By utilizing recycled content, they are purchasing locally and, therefore, stimulating indigenous economic activity.

This study generally reserves the use of the term *economic impact* only for industries that have verifiable levels of exports – where the output that they are producing is a genuine and real increase in industrial output for the region of study – or for true import substitutes. To claim economic impacts over and above those just mentioned would involve much more extensive industrial measures for each category of establishments that was assessed in this study, and over a period of time.

This study does, however, isolate *total economic values* – estimates, by category, of the value of economic interrelationships that exist in Ohio for the industries. These values are the intrinsic worth of a set of industrial activities to Ohio. They represent a slice of the economic pie from a particular point of view.

In summary, economic models are and only can be estimates of inter-industrial linkages and regional values. They are based on an amalgam of federal, county, and state data, academic procedures, along with some survey-derived direct data, all compiled with due diligence for accuracy and reasonableness. Consequently, although an inter-industrial accounting framework is implied, all estimates are simulations of economic values based on the data employed and the assumptions implicit in the modeling.

5.1.2 KINDS OF ECONOMIC INFORMATION PRODUCED BY I-O MODELS

Input-output models produce many kinds of data for analysis and decision making. The more useful results for industrial leaders, planners, and policy makers are estimates of (1) total industrial output, (2) personal income, (3) value added, and (4) jobs. These are the categories of economic activity that are reported in detail in the data tables that follow this section. These terms are defined below:

- *Total industrial output* for most private industries is simply gross sales. For public or quasi-public institutions this normally includes all public outlays, along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.
- *Personal income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).
- *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).
- *Jobs* is the number of full- and part-time positions in the economy, not the number of full time equivalents.[18] This distinction is important because the relationship between job growth and labor force growth is very different in different industries. Some industries rely heavily on semi-skilled part-time labor. Other industries generally only produce full-time skilled jobs. It is always important, when possible, to quantitatively assess whether the jobs that are stimulated are part-time or full-time or higher-paying versus lower-paying.

Economic data is further reported as direct, indirect, induced, and total economic effects.

- *Direct effects* refer to the operational characteristics of the firms or institutions that are studied. This study measured the apparent value of twenty-six categories of recycling and reuse establishments. The direct output of these entities is, therefore, their reported gross sales. The direct jobs are the jobs that are associated with those establishments. The direct personal income contains their reported payments to all employees, plus an additional estimate of benefit values and of returns to sole proprietors. The estimate of benefit values and returns to sole proprietors were based on industrial averages in industries that are similar to the recycling and reuse industries included in this study.
- *Indirect effects* measure the value of additional economic demands that the direct firms or institutions place on supplying industries in the region. When firms produce goods or conduct business or when public entities provide public goods or services, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal

[18] For example, a restaurant may employ 20 people on a half-time basis (20 jobs) to fill its labor requirement of 10 full-time-equivalents.

services, raw and processed commodities, and a variety of professional services are necessary to produce the direct values described above.

- *Induced effects* accrue when workers in the direct and indirect industries spend their earnings on goods and services in the region. Induced effects can also be called household effects, and the terms are often used inter-changeably. When workers in direct and indirect industries purchase goods and services for household consumption, they, in turn, stimulate another layer of the economy. Most induced activity accrues to retail, services, and finance, insurance, and housing spending. Because employment is stimulated in these industries as well, *their* demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity. The I-O models solve for these iterative rounds of transactions until all of the possible inter-industrial transactions have been accumulated.
- *Total economic effects* are the sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this study.

The term *multiplier* or *multiplier effect* is frequently used when referring to economic effects or economic impacts. There are different kinds of multipliers – this study reports two types. The Type I multiplier identifies the value of direct and indirect transactions – e.g., the output of a business category and all other output that it purchases from its suppliers in the region – relative to the value of only the direct transactions. The Type II multiplier identifies the value of <u>all</u> economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry under study, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

5.2 RESULTS

Table 5-1 shows estimates of economic activity accruing to establishments in business categories that provide goods or services to recycling and reuse industry establishments. The category Other Indirect Establishments shown in the table includes all other indirect establishments that provide goods or services (such as office supply companies, accounting firms, legal firms, building and landscape maintenance firms, etc.). It is important to note that the data for Recycling and Reuse Equipment Manufacturers is based on a statistical analysis of survey data and therefore represents complete data for those types of establishments located in a state regardless of where they sell their equipment. Totals for the other categories represent indirect activity relating to only the 26 categories of recycling and reuse industry establishments located in Ohio that were investigated for this study.

Table 5-1
Estimates of Indirect Economic Activity of Select Support Business Categories
(Annual Payroll and Estimated Receipts are in $1,000)

Business Category	Data Type	Value
Recycling and Reuse Equipment Manufacturers [1]	Employment	3,843
	Annual Payroll	61,897
	Estimated Receipts	630,090
Consulting/Engineering [2]	Employment	1,074
	Annual Payroll	39,001
	Estimated Receipts	82,967
Brokers [2]	Employment	503
	Annual Payroll	35,999
	Estimated Receipts	57,407
Transporters [2]	Employment	4,686
	Annual Payroll	155,403
	Estimated Receipts	502,241
Other Indirect Establishments [2]	Employment	60,323
	Annual Payroll	1,966,493
	Estimated Receipts	6,094,819
Support Businesses Totals	**Employment**	70,430
	Annual Payroll ($1,000)	2,258,793
	Estimated Receipts ($1,000)	7,367,524

Notes:

[1] Data for Recycling and Reuse Equipment Manufacturers are based on a statistical analysis of survey results and reflect economic activity associated with in-state and out-of-state equipment sales.

[2] Data come from modeling output and reflect the in-state indirect activity stimulated by the 26 direct categories of recycling and reuse establishments targeted by this study for direct data.

Listed below in Table 5-2 are the titles of data tables that follow and a description of the information they contain.

Table 5-2
Guide to Data Tables

Number	Title	Information Contained
Table 5-3	Recycling and Reuse Industry Economic Values and Multipliers	Shows direct, indirect, and induced economic values and multipliers for the 26 categories of recycling and reuse establishments
Table 5-4	Recycling and Reuse Industrial Multipliers Compared to Multipliers for Other Industries	Shows multipliers for the recycling and reuse industry as compared to multipliers for other major industrial sectors
Table 5-5	Summary of Recycling & Reuse Industry Effects on Own-Source State Government Revenues	Shows state taxes, charges and fees, miscellaneous revenues, and total state revenues associated with direct and total economic values for the 26 categories of recycling and reuse establishments

Table 5-3
Recycling and Reuse Industry Economic Values and Multipliers

	Jobs[1]				Jobs Multiplier		Personal Income (in $ Millions)				Income Multiplier		Industrial Output (in $ Millions)				Output Multiplier		Value Added (in $ Millions)				Value Added Multiplier	
	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II	Direct	Indirect	Induced	Total	Type I	Type II
Recycling Collection																								
1. Government Staffed Residential Curbside Collection	700	59	236	995	1.08	1.42	19	2	6	27	1.11	1.44	31	4	17	51	1.13	1.67	24	3	10	37	1.11	1.51
2. Private Staffed Residential Curbside Collection	1,060	59	368	1,487	1.06	1.40	31	2	9	42	1.06	1.37	46	5	26	77	1.12	1.68	35	3	15	54	1.09	1.53
Subtotal	1,760	118	604	2,482	1.07	1.41	49	4	16	69	1.08	1.40	76	9	42	128	1.12	1.68	60	6	25	90	1.10	1.52
Recycling Processing																								
3. Compost and Miscellaneous Organics Producers	1,248	173	424	1,846	1.14	1.48	33	5	11	48	1.15	1.49	78	13	30	122	1.17	1.55	46	7	18	71	1.16	1.55
4. Materials Recovery Facilities (MRFs)	1,281	723	595	2,599	1.56	2.03	25	18	13	55	1.71	2.21	148	50	35	233	1.34	1.58	68	27	21	115	1.39	1.69
5. Recyclable Material Wholesalers	7,593	2,618	4,701	14,911	1.34	1.96	257	59	92	408	1.23	1.59	2,393	557	950	3,900	1.23	1.63	405	77	136	617	1.19	1.53
Subtotal	10,122	3,514	5,720	19,356	1.35	1.91	314	82	115	512	1.26	1.63	2,619	620	1,015	4,254	1.24	1.62	518	111	174	803	1.21	1.55
Recycling Manufacturing																								
6. Glass Container Manufacturing Plants	(D)	(D)	(D)	(D)	1.56	2.16	(D)	(D)	(D)	(D)	1.53	1.98	(D)	(D)	(D)	(D)	1.28	1.49	(D)	(D)	(D)	(D)	1.48	1.89
7. Glass Product Producers (other recycled uses)	791	413	363	1,567	1.52	1.98	19	13	9	41	1.69	2.18	121	37	25	183	1.30	1.51	36	20	15	71	1.57	1.99
8. Nonferrous secondary smelting and refining mills	997	881	976	2,853	1.88	2.86	44	29	21	94	1.67	2.14	490	85	58	632	1.17	1.29	65	45	35	145	1.69	2.23
9. Nonferrous product producers	2,849	2,014	2,315	7,178	1.71	2.52	127	73	58	257	1.57	2.03	841	235	158	1,233	1.28	1.47	207	109	94	410	1.52	1.98
10. Nonferrous foundries	9,557	3,051	4,915	17,523	1.32	1.83	330	104	126	560	1.32	1.70	1,079	325	344	1,748	1.30	1.62	459	154	204	817	1.34	1.78
11. Paper and Paperboard Mills/Deinked Market Pulp Producers	5,772	4,078	4,422	14,272	1.71	2.47	249	138	113	500	1.55	2.01	1,568	420	308	2,296	1.27	1.46	445	208	182	835	1.47	1.88
12. Paper-based Product Manufacturers	1,807	89	447	2,343	1.05	1.30	36	3	12	51	1.09	1.41	84	12	31	127	1.14	1.51	48	5	19	72	1.11	1.50
13. Pavement Mix Producers (asphalt and aggregate)	1,446	1,188	1,229	3,863	1.82	2.67	70	39	32	140	1.56	2.02	281	104	86	471	1.37	1.68	159	52	51	262	1.32	1.64
14. Plastics Reclaimers	561	335	299	1,194	1.60	2.13	16	11	8	36	1.69	2.18	47	14	10	72	1.30	1.51	20	14	11	45	1.68	2.20
15. Plastics Converters	13,003	7,757	6,919	27,679	1.60	2.13	360	247	177	785	1.69	2.18	2,361	718	495	3,574	1.30	1.51	553	375	288	1,216	1.68	2.20
16. Rubber Product Manufacturers	186	27	53	266	1.14	1.43	4	1	1	6	1.23	1.59	9	3	4	15	1.28	1.69	4	1	2	8	1.31	1.81
17. Steel mills	20,699	31,759	28,070	80,528	2.53	3.89	1,344	1,077	701	3,122	1.80	2.32	9,215	3,151	1,917	14,283	1.34	1.55	1,775	1,640	1,139	4,553	1.92	2.56
18. Iron and Steel foundries	18,963	7,402	14,238	40,603	1.39	2.14	1,005	241	362	1,608	1.24	1.60	2,753	673	988	4,414	1.24	1.60	1,173	355	585	2,113	1.30	1.80
19. Other Recycling Processors/Manufacturers	1,028	580	478	2,086	1.56	2.03	30	22	15	67	1.71	2.21	170	57	40	267	1.34	1.58	80	31	24	135	1.39	1.69
Subtotal	77,659	59,573	64,724	201,956	1.77	2.60	3,635	1,998	1,635	7,268	1.55	2.00	19,018	5,833	4,464	29,316	1.31	1.54	5,025	3,008	2,649	10,681	1.60	2.13
Reuse/Remanufacturing																								
20. Computer and Electronic Appliance Demanufacturers	17	6	4	28	1.38	1.64	<1	<1	<1	1	2.46	3.17	2	1	<1	3	1.48	1.68	<1	<1	<1	1	2.30	3.02
21. Motor Vehicle Parts (used)	2,358	682	876	3,916	1.29	1.66	53	25	22	100	1.47	1.90	253	78	61	392	1.31	1.55	66	36	36	137	1.54	2.10
22. Retail Used Merchandise Sales	4,200	1,125	1,167	6,492	1.27	1.55	70	33	30	133	1.47	1.90	238	84	82	404	1.35	1.70	139	50	48	238	1.36	1.71
23. Tire Retreaders	576	162	236	974	1.28	1.69	16	5	6	27	1.31	1.69	64	14	17	94	1.22	1.48	30	8	10	47	1.26	1.59
24. Wood Reuse	1,232	1,097	797	3,126	1.89	2.54	35	36	21	91	2.04	2.63	178	98	56	331	1.55	1.87	50	46	33	129	1.93	2.60
25. Materials Exchange Services	10	10	10	30	2.02	3.05	1	<1	<1	1	1.49	1.92	3	1	1	4	1.26	1.51	1	<1	<1	2	1.61	2.19
26. Other Reuse	368	382	276	1,026	2.04	2.79	13	11	7	32	1.88	2.42	64	30	19	114	1.47	1.77	20	18	11	49	1.89	2.46
Subtotal	8,761	3,464	3,367	15,592	1.40	1.78	187	110	87	384	1.59	2.05	801	305	236	1,342	1.38	1.68	305	159	140	603	1.52	1.98
Total All Groups	98,302	66,668	74,416	239,386	1.68	2.44	4,185	2,195	1,853	8,233	1.52	1.97	22,515	6,767	5,758	35,040	1.30	1.56	5,907	3,283	2,987	12,178	1.56	2.06

[1] Includes all full and part time jobs (not full-time equivalents).
(D) - Data not disclosed due to a limited number of establishments in this business category and the need to avoid revealing data that could identify a single business. Data is not included in totals.

Table 5-4
Recycling and Reuse Industrial Multipliers Compared to Multipliers for Other Industries

	Output		Jobs		Personal Income		Value Added	
	Type I	Type II	Type I	Type II	Type I	Type II	Type I	Type II
Recycling and Reuse	*1.30*	*1.56*	*1.68*	*2.44*	*1.52*	*1.97*	*1.56*	*2.06*
Agriculture	1.32	1.66	1.20	1.43	1.31	1.71	1.32	1.72
Mining	1.28	1.56	1.45	2.06	1.36	1.78	1.25	1.55
Construction	1.39	1.84	1.39	1.89	1.34	1.75	1.46	2.08
Manufacturing	1.42	1.74	1.97	2.87	1.58	2.09	1.62	2.18
Transportation, Communications, & Utilities	1.35	1.71	1.57	2.26	1.44	1.91	1.35	1.74
Trade	1.25	1.68	1.16	1.45	1.22	1.60	1.20	1.58
Financial, Insurance, & Real Estate	1.24	1.48	1.41	1.89	1.41	1.88	1.20	1.40
Services	1.35	1.90	1.24	1.62	1.26	1.66	1.34	1.90
Government	1.08	1.76	1.04	1.44	1.04	1.35	1.04	1.50

Table 5-5
Summary of Recycling & Reuse Industry Effects on Own-Source State Government Revenues

	Direct Effects (in $ Millions)				Total Effects (in $ Millions)			
	All State Taxes	Charges & Fees	Miscellaneous Revenues	Total Revenues	All State Taxes	Charges & Fees	Miscellaneous Revenues	Total Revenues
Recycling Collection								
1. Government Staffed Residential Curbside Collection	1.11	0.20	0.16	1.48	1.60	0.29	0.23	2.12
2. Private Staffed Residential Curbside Collection	1.82	0.33	0.26	2.42	2.50	0.45	0.36	3.31
Subtotal	2.94	0.53	0.42	3.89	4.10	0.75	0.59	5.43
Recycling Processing								
3. Compost and Miscellaneous Organics Producers	1.93	0.35	0.28	2.56	2.87	0.52	0.41	3.81
4. Materials Recovery Facilities (MRFs)	1.49	0.27	0.21	1.97	3.30	0.60	0.47	4.37
5. Recyclable Material Wholesalers	15.25	2.77	2.19	20.21	24.23	4.41	3.48	32.11
Subtotal	18.67	3.40	2.68	24.75	30.40	5.53	4.36	40.29
Recycling Manufacturing								
6. Glass Container Manufacturing Plants	0.87	0.16	0.13	1.16	1.73	0.31	0.25	2.29
7. Glass Product Producers (other recycled uses)	1.13	0.20	0.16	1.49	2.46	0.45	0.35	3.26
8. Nonferrous secondary smelting and refining mills	2.62	0.48	0.38	3.48	5.60	1.02	0.80	7.42
9. Nonferrous product producers	7.53	1.37	1.08	9.98	15.29	2.78	2.19	20.26
10. Nonferrous foundries	19.59	3.56	2.81	25.97	33.28	6.05	4.78	44.11
11. Paper and Paperboard Mills/Deinked Market Pulp Producers	14.81	2.69	2.13	19.63	29.69	5.40	4.26	39.36
12. Paper-based Product Manufacturers	2.15	0.39	0.31	2.85	3.03	0.55	0.44	4.02
13. Pavement Mix Producers (asphalt and aggregate)	4.13	0.75	0.59	5.48	8.34	1.52	1.20	11.06
14. Plastics Reclaimers	0.97	0.18	0.14	1.29	2.12	0.39	0.30	2.81
15. Plastics Converters	21.42	3.90	3.07	28.39	46.64	8.48	6.70	61.83
16. Rubber Product Manufacturers	0.23	0.04	0.03	0.30	0.36	0.07	0.05	0.48
17. Steel mills	79.84	14.52	11.46	105.82	185.47	33.73	26.63	245.84
18. Iron and Steel foundries	59.71	10.86	8.57	79.15	95.53	17.37	13.72	126.61
19. Other Recycling Processors/Manufacturers	1.80	0.33	0.26	2.39	3.98	0.72	0.57	5.28
Subtotal	216.81	39.43	31.13	287.37	433.53	78.85	62.24	574.62
Reuse/Remanufacturing								
20. Computer and Electronic Appliance Demanufacturers	0.01	<0.01	<0.01	0.01	0.03	0.01	<0.01	0.04
21. Motor Vehicle Parts (used)	3.13	0.57	0.45	4.14	5.93	1.08	0.85	7.86
22. Retail Used Merchandise Sales	4.18	0.76	0.60	5.54	7.92	1.44	1.14	10.49
23. Tire Retreaders	0.94	0.17	0.14	1.25	1.60	0.29	0.23	2.12
24. Wood Reuse	2.05	0.37	0.30	2.72	5.41	0.98	0.78	7.17
25. Materials Exchange Services	0.04	0.01	0.01	0.05	0.07	0.01	0.01	0.09
26. Other Reuse	0.77	0.14	0.11	1.02	1.87	0.34	0.27	2.48
Subtotal	11.12	2.02	1.60	14.74	22.82	4.15	3.28	30.25
Total All Groups	249.54	45.39	35.83	330.76	490.85	89.28	70.47	650.60

5.3 INTERPRETATION OF RESULTS

This section is intended to aid readers in interpreting the results of the tables in the previous section.

Economic values are most accurate at the business category level. Summing totals by groups of recycling or reuse activity for the state as a whole (as has been done in the tables) results in some degree of duplicated accounting of economic activity. This is true for any set of industrial assessments in any input-output modeling scenario – it is not a problem with recycling, per se, nor with this study, but arises simply because of the many business categories that are included in this study.

For example, direct sales by a raw commodity processor represent an input purchase by an industry producing a finished good for sale. A large portion of the raw commodity processor's direct sales is already reflected in the finished good industry's input purchases. In this case, then, aggregation biases the economic values in the subtotals and totals upwards. As a general rule, the higher the Type I multiplier (which is a measure of how strongly a firm depends on supplier inputs), the higher the probability of aggregation bias in reporting subtotals and totals. This is an inherent "Catch 22" in input-output modeling: to eliminate aggregation bias of this sort, the industries must be lumped together in the construction of the model so that inter-industrial transactions are properly accounted and the resulting multipliers are properly dampened. Doing so, however, eliminates the industrial detail that is desired.

Nevertheless, subtotals and totals have been produced so that relative comparisons can be made. Users of these findings, however, must be cautious to avoid claims about the recycling and reuse industry that may be unwarranted given that there is some degree of inflation in the subtotals or totals. Based on other modeling experience, it is believed that aggregation bias may have inflated the subtotals and totals by up to 15 percent, and possibly higher. It is important to note that this bias is associated with any total that is derived from indirect and induced information, including total economic activity, subtotal/total multipliers, and total government tax revenues. Alternatively, **totals derived only from direct information and government tax revenues derived from direct economic activity do not include bias**.

Multipliers reveal potential changes in the regional economy attributable to a change in direct activity in a particular industry in that same economy. Multipliers can be instructive for anticipating economic growth, in the case of a new or expanding firm, and economic decline, in the case of a plant closing. Economic multipliers are often misunderstood and therefore improperly used. Developers, planners, and decision-makers frequently use national level multipliers that are produced by the U.S. Bureau of Economic Analysis (BEA) as points of comparison. These multipliers are called RIMS II (Regional Input-Output Multiplier System), and they are widely used by development groups to support economic investment or public spending. Multipliers are available for over 500 industries in the categories of earnings, employment, and industrial output. Many users, however, mistakenly apply these statistics because they:

- Fail to account for regional production and cost of living differences (detailed multipliers are available at the state and county level, but project promoters often rely on national averages due to costs);
- Use the wrong multiplier to describe a phenomenon (multipliers for different categories of economic activity can vary substantially); or
- Seek to promote industries with the largest multipliers possible without consideration of either the appropriateness of the application or of the actual scope of local production.

The reader can be assured that this study produced Type I and Type II multipliers that are specific to Ohio and are not directly derivative of national averages.

Before making any comparisons among multipliers, it is important to understand what influences them. Firms with strong linkages to area supplying firms or that pay relatively high wages may yield comparatively higher multipliers. Firms that are otherwise not linked strongly to local suppliers or that pay lower than average wages will usually produce lower multipliers. More urbanized areas and states with larger and more diversified economies have, on the average, much higher multipliers than less populated, more rural states for the same types of businesses.

Given the above guides to interpreting the data, there are several general conclusions that can be drawn from the results:

- Ohio steel mills, wood reuse, and other reuse establishments tended to have higher multipliers than establishments in other recycling and reuse business categories.
- Ohio recycling and reuse industry multipliers compare favorably to multipliers of other broad industrial sectors of the State's economy, in many cases exceeding them.
- Investments in local recycling collection and processing and policies that encourage recycling and reuse yield significant total state government revenues from taxes, charges, fees, and miscellaneous revenues. For example, 88 percent of Ohio's total recycling industry tax revenues arise from recycling manufacturing establishments and their indirect and induced economic activity.

6 RECOMMENDATIONS FOR FUTURE STUDIES

This section summarizes the recommendations for replicating the study in future years. Recommendations are:

- Carefully review changes in definitions from the SIC classification system to the NAICS system when utilizing U.S. Census data. Whereas this study utilized data based on the SIC system, future studies will need to utilize data based on NAICS. Although definitions for most categories remain unchanged, changes to a few categories are worth noting. For example, the SIC system classifies materials recovery facilities (MRFs) under SIC 4953, Refuse Systems, which includes landfills and other waste handling facilities. The new NAICS system code, 56292, is specifically for MRFs. Therefore, the data for MRFs may be gathered by examining Census data rather than through surveys. An example of a category for which it may be more difficult to utilize existing data is nonferrous secondary smelting and refining mills. The NAICS definition for this category includes a few miscellaneous activities, such as alloying of zinc paste, that were not included in the SIC definition and should not be included in estimates of recycling-related activities.
- Narrow the definition of compost and organics producers and find listings of facilities through sources other than the Downing and Associates list[19]. Although the Downing and Associates list was thorough and complete, the definition of compost and organics was very broad, resulting in a large number of listings that were municipal mulching operations or only a small portion of a larger facility, such as a MRF or transfer station. *BioCycle* regularly publishes lists of various types of composting programs. Although it typically publishes only the program name, city, and state, it may be possible to make special arrangements to gain more detailed contact information.
- Make every attempt before mailing surveys to correctly classify establishments. Due to the diverse nature of the sources used to compile the database and the lack of classification for some electronic lists, a large number of establishments were misclassified, resulting in additional efforts during the surveying process and a smaller number of establishments in some categories than was initially expected.
- Redesign the survey form to allow one establishment to be classified in more than one category and allow the employment, payroll, and receipts amounts to be divided among the selected categories.
- Conduct more and better research on the industrial characteristics of recycling and reuse firms to improve the explanatory power of I-O models. This research should focus on the following areas:

[19] Please refer to Appendix B for a listing and evaluation of all sources used.

- Improving input-output tables (use, make, total requirements) for critical recycling and reuse industries so that inter-industrial transactions are better understood. Furthermore, constructing similar tables for non-recycling industries will allow better comparisons between recycling and non-recycling businesses.
- Tracking the throughput of major recycling commodities at state levels to the production of a final industrial or household good. For many industries there is not good information on the propensity of recyclables being purchased, processed, and manufactured into a consumer good within a state or region.
- Identifying critical costs associated with the flow of recycled products into goods for final use.

Finally, follow-up studies that would be useful should be considered, including:

- Additional research to better document intermediate input statistics for recycling businesses and to enable comparisons between recycling and non-recycling businesses in the same industry;
- Estimating the amount of economic activity that can be attributed to public policy since House Bill 592 was passed in 1988; and
- Determining the amount of growth over today's baseline (as measured through this report) that could be realized by additional levels of recycling and reuse.

APPENDIX A
DESCRIPTION OF RECYCLING AND REUSE BUSINESS CATEGORIES

Table A-1 provides detailed descriptions of 30 recycling and reuse business categories, grouped into 3 industry segments. The table is intended to comprehensively include all business establishments undertaking recycling and reuse economic activities, as defined in Section 2. Note that recycling processors and manufacturers are grouped into a single industry segment. This is because many of the establishments in these categories undertake both processing and manufacturing.

Table A-1 lists *Standard Industrial Classification* (SIC) codes for each category. These codes were identified by comparing each category to the official definitions listed in the *Standard Industrial Classification Manual, 1987*, prepared by the Executive Office of the President, Office of Management and Budget. Note that in most cases, the listed SIC category also includes businesses not involved in recycling and reuse. Beginning in 1997 the SIC system will gradually be phased out and replaced by the new *North American Industry Classification System* (NAICS), which is harmonious with systems used in Mexico and Canada, in accordance with the North American Free Trade Agreement. Table A-1 also lists the NAICS codes that correspond to the traditional SIC codes. Where the NAICS categories differ significantly, the new category name is provided. Notable changes in the NAICS system include a new category for material recovery facilities, and a division of SIC 4953, Refuse Systems into separate categories for haulers and disposal facility operators handling hazardous, solid and other wastes.

Table A-1 Descriptions of Industry Segments and Business Categories of the Recycling and Reuse Industries

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Collection	**1. Government Staffed Residential Curbside Collection** 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.	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)
	2. Private Staffed Residential Curbside Collection Private sector establishments which provide recycling collection services to residential waste generators, sometimes under contract to municipal or state government agencies. The primary activity of many of these establishments is waste hauling.	4212 Local Trucking Without Storage	562111 Solid Waste Collection (without disposal)

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Processing and Manufacturing	**3. Compost and Miscellaneous Organics Producers** Establishments which 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. This category also includes vermiculture.	2875 Fertilizers (mixing only)	325314 Fertilizers (mixing only)
	4. Materials Recovery Facilities Establishments that accept mixed and/or source separated recyclables, typically from municipal curbside and drop-off collection programs. Activities include sorting, baling, grinding, densifying and/or brokering recyclables for wholesale distribution. May also segregate recyclables from mixed solid waste. This category is intended to be defined consistently with the new NAICS category for materials recovery facilities.	4953 Refuse Systems	56292 Material Recovery Facilities
	5. Recyclable Material Wholesalers Establishments which process recycled materials by sorting, grading, densifying, removing contaminants and otherwise preparing the materials for shipment to manufacturing facilities for use in industrial production. Examples include paper stock dealers and scrap metal processors. These establishments may also provide recycling collection services. This category is intended to be defined consistently with the new NAICS category for recyclable material wholesalers.	5093 Scrap & Waste Material Wholesalers	42193 Recyclable Material Wholesalers
	6. Glass Container Manufacturing Plants Establishments that produce finished glass containers for shipment to bottlers, using recycled glass cullet as a feedstock. May also undertake beneficiation activities on site.	3221 Glass Containers	327213 Glass Containers
	7. Glass Product Producers (other recycled uses) Establishments which produce products other than containers, using recycled glass as a feedstock. Examples include fiberglass, decorative tiles, glassware, and construction blocks.	3229 Pressed and Blown Glass and Glassware	327212 Pressed and Blown Glass and Glassware
	8. Nonferrous Secondary Smelting and Refining Mills 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. Note that primary smelters of nonferrous metals, excluding aluminum and copper, process scrap in addition to virgin materials. Primary aluminum and copper smelters do not process scrap.	3341 Secondary smelting and refining of nonferrous metals 3339 Primary smelting and refining of nonferrous metals, except copper and aluminum	331314, 331423, 331492 Miscellaneous Secondary Nonferrous Smelting, Refining and Alloying.
	9. Nonferrous Product Producers Establishments that produce a wide range of intermediate products through extrusion processes, primarily from billet manufactured in smelting operations. Many of these plants may also operate in-house casting operations which process unrefined nonferrous scrap.	3351 - 3356 Miscellaneous Nonferrous Products	331421, 331315, 331315, 331316, 331319 Miscellaneous Nonferrous Products

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Processing and Manufacturing (Continued)	**10. Nonferrous Foundries** Establishments that produce castings and die-castings of various nonferrous metals and alloys. Note that many manufacturers of specific end products (e.g., automobiles) may operate foundries and purchase scrap.	3363 - 3369 Nonferrous Foundries	331521 – 331528 Nonferrous Foundries
	11. Paper and Paperboard Mills/Deinked Market Pulp Producers Establishments that produce first stage intermediate paper and paper board 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.	2621 Paper Mills 2631 Paperboard Mills	322121 Paper Mills (Except newsprint) 322122 Newsprint Mills 322123 Paperboard Mills
	12. Paper-based Product Manufacturers Establishments that produce paper products other than traditional paper and paperboard products, using discarded paper as a feedstock. Examples include cellulose insulation, molded fiber products, construction board, hydro-seeding mulch or animal bedding.	2679 Miscellaneous Converted Paper and Paperboard Products	322299 Other Converted Paper Product Manufacturing (egg cartons, molded pulp) 325221 Cellulose Organic Fiber Manufacturing
	13. Pavement Mix Producers (asphalt and aggregate) Establishments which produce asphalt paving mix and aggregate for use in road construction using recycled pavement, asphalt, rubber modified asphalt and/or glass, in addition to virgin materials.	2951 Asphalt paving mixtures and blocks	324121 Asphalt paving mixtures and blocks
	14. Plastics Reclaimers Establishments that produce plastic pellets or granulated plastic suitable for use by plastics product manufacturers. Activities include separating, washing, grinding, flaking and/or pelletizing. This category also includes establishments that manufacture intermediate products directly from unprocessed recycled plastic, such as plastic lumber products.	3087 Custom Compounding of Purchased Plastics Resins 3085 Plastics Bottles Mfg.	325991 Custom Compounding of Purchased Plastics Resins 42261 Plastics Bottles Mfg.
	15. Plastic Converters Establishments that produce intermediate plastic products (e.g., molded products and components, sheet and fiber) using recycled pellets or granulated plastic as a feedstock.	3081 – 3083, 3086 Miscellaneous Plastics Products	3261 Plastics Product Manufacturing

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Recycling Processing and Manufacturing (Continued)	**16. Rubber Product Manufacturers** Establishments that produce first-stage intermediate products or end products using crumb rubber as a feedstock.	3069 Miscellaneous fabricated rubber products 3011 Tires and inner tubes 3021 Rubber and plastics footwear 3052 Rubber & plastics hose & belting 3053 Gaskets, packing and sealing devices	3262 Rubber Product Manufacturing
	17. Steel Mills Basic oxygen furnaces (BOF) producing raw steel in various forms using a mix of scrap and molten iron made in blast furnaces from scrap and raw materials (iron ore, coke, limestone) and also electric arc furnaces (EAF) using scrap. Products from EAF mills are primarily slabs, billets or rebar. Products from BOF mills are primarily flat or rolled products. Activities include grading scrap, detinning, refining and product fabrication. Additional fabrication and assembly of final stage products may occur at these facilities.	3312 Steel works, Blast Furnaces and Rolling Mills	331111 Iron and Steel Mills
	18. Iron and steel foundries 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.	3321 - 3325 Iron and Steel Foundries	331511 – 331513 Iron and Steel Foundries
	19. Other recycling processors and manufacturers Other recycling processors and manufacturers, not elsewhere classified. May include used oil refiners, household hazardous waste processors, agricultural facilities or landscapers using ash or paper mill sludge, engineering applications of tires, and other users of materials not elsewhere classified.	Varied.	Varied.

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Reuse and Remanufacturing	**20. Computer and Electronic Appliance Demanufacturers** Establishments that sort, classify, grade and remanufacture used electronic appliances, primarily computers. Remanufacture may encompass entire appliances or components. These establishments may also recycle materials not suitable for remanufacture.	5065 Electronic Parts, NEC 7378 Computer Maint. and Repair	421690 Other Electronic Parts & Equipment Wholesale 811212 Computer & Office Machine Repair and Maintenance
	21. Motor Vehicle Parts Establishments that clean, sort, inspect and remanufacture used motor vehicle parts.	5015 Wholesale Used Motor Vehicle Parts	42114 Motor Vehicle Parts (Used) Wholesale
	22. Retail Used Merchandise Sales Establishments that operate retail sales facilities dedicated to reused products. Activities may include providing drop-off or pick-up collection services for used products; cleaning, repairing and otherwise preparing products for resale. Includes "thrift" stores, reusable product depots, reuse centers and product-specific stores such as used clothing and used sporting goods, not elsewhere classified.	5932 Used Merchandise Stores (retail)	45331 Used Merchandise Stores (excluding pawn shops)
	23. Tire Retreaders Establishments that sort, clean, buff and remanufacture used tires by adding new tread. These establishments produce crumb rubber as a by-product.	7534 Tire Retreading and Repair Shops	326212 Tire Retreading
	24. Wood Reuse Establishments that produce graded lumber and/or finished goods by cleaning, grading, and otherwise processing used wood. Includes establishments that purchase used, damaged pallets and remanufacture for reuse. Does not include establishments whose primary product is fuel.	2448 Wood Pallets and Skids 2499 Wood Products, NEC	32192 Wood Container and Pallet Manufacturing 321999 Wood Products, NEC
	25. Materials Exchange Services Establishments which provide listings and otherwise facilitate the reuse of products and materials, primarily by commercial and industrial establishments.	7389 Business Services NEC	54199 All Other Professional, Scientific, and Technical Services
	26. Other Reuse Establishments, not elsewhere classified, which purchase used equipment or merchandise and remanufacture, clean and otherwise prepare the used products for distribution.	5082-5084 Wholesale Machinery, Equipment, and Supplies	42181-42183 Wholesale Machinery, Equipment, and Supplies

Industry Segment	Business Categories in Segment	Typical SIC Code Assignments	Typical NAICS Code Assignments
Support Businesses	**27. Recycling and Reuse Equipment Manufacturers and Vendors** Establishments that produce the primary equipment used by recycling businesses. Includes all significant equipment used by collection and intermediate processing establishments, such as trucks, balers, conveyors, magnets, automated sortation devices, grinders, choppers, etc. Also includes specialized equipment used specifically to accommodate recycled materials in manufacturing processes, or to process or remanufacture used products. Examples include plastic bottle washing, sorting and pelletizing systems, wastepaper deinking systems, tire processing equipment, glass bottle washing systems, etc. This category does not include standard processing and manufacturing equipment not specifically designed for recycling or reuse.	3511 - 3599 Industrial Machinery and Equipment	333 Machinery Manufacturing
	28. Consulting and Engineering Services Establishments that provide technical research and development services and engineering services to recycling collectors and intermediate processors, and reuse establishments, and which provide specialized services essential to the recycling or reuse process in manufacturing facilities. Examples include engineering services to develop deinking plants, composting facilities and plastics processing facilities. Broad consulting services to government or non-profits which does not directly support establishments listed above are not included.	8733 Noncommercial Research Organizations 8711 Engineering services 8742 Management consulting services	54133 Engineering Services 541611- 541614 Management Consulting Services
	29. Brokers Establishments that purchase recycled materials or reusable products for purposes of resale without processing or otherwise adding value. Includes export brokerage services.	5093 Scrap and Waste Material Wholesalers 5099, 5199 Commodity Contract Brokers and Dealers 4731 Shipping brokers	52314 Commodity Brokerage 48851 Freight Transportation Arrangement
	30. Transporters Establishments that transport recovered materials or reusable products to intermediate processing facilities and/or processing and end-use facilities by air, truck, sea or rail.	4011 – 4499 Freight Services	481 – 484 Air, Rail, Water, and Truck Transportation

APPENDIX B
DATA SOURCES

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
1	*Paper Matcher*	American Forest & Paper Association	Paper and paperboard mills, paper dealers, recycling centers		✓	Used to estimate percentage of mills consuming recovered paper for existing data adjustments.
2	*Wood Recycling Directory - 1996*	American Forest & Paper Association	C&D processors, miscellaneous organic products, compost producers	✓		Used for building survey contact list.
3	*Handler/Reclaimer Database*	American Plastics Council	Plastics handlers, reclaimers		✓	Used to estimate employment and establishments for plastics reclaimers.
4	*ARM Directory and Buyers Guide*	American Recycling Markets	Collectors, intermediate processors, processors, manufacturers, brokers and equipment dealers	✓		Used for building survey contact list.
5	*1998-1999 Directory*	Asphalt Recycling and Reclaiming Association	Aggregate producers and pavement mix, specialized reuse and recycling equipment manufacturers, consulting and engineering services	✓		Used for building survey contact list of aggregate and pavement mix producers.
6	*Recycling Product News*	Baum Publications	Recycling equipment manufacturers	✓		Used for building survey contact list of equipment manufacturers.
7	*Manufacturer Database (Access)*	Cellulose Insulation Manufacturers Association	Cellulose insulation manufacturers	✓		Used for building survey contact list for paper-based product manufacturers
8	*Reuse/Recycling of Glass Cullet for Non-Container Uses*	Dane County DPW	Manufacturers of recycled glass products other than containers	✓		Used for building survey contact list for glass product producers (other recycling uses).
9	*Product and Equipment Specifications Reports*	Downing & Associates	Compost and wood waste, recycling and solid waste equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
10	*Organics Mailing List*	Downing & Associates	Compost and wood waste, recycling and solid waste	✓		3,800 listings, comprehensive source.
11	*Markets List*	Glass Packaging Institute (GPI)	Glass beneficiation facilities/Glass container plants; Glass container manufacturing plants	✓		Used for building survey contact list for glass container manufacturing plants.
12	*MRF Yearbook*	Governmental Advisory Associates	MRFs and mixed waste processing facilities in US	✓		Used for building survey contact list for MRFs.
13	*Harris Directory*	The Harris Reports	Miscellaneous processing and manufacture, remanufacturing and wholesale sales, materials exchange services (focused on building, interior, garden products). Contains 1,000 records.	✓		Used for building survey contact list for reuse.
14	*Lockwood Post Directory of the Pulp Paper and Allied Trades*	Miller Freeman Publishing, Inc.	Pulp & paper mills, converting plants, paper merchants/distributors, wastepaper stock suppliers		✓	Used to estimate percentage of mills consuming recovered paper for existing data adjustments.
15	*Molded Pulp Product Manufacturers*	Molded Pulp Environmental Association	Molded pulp producers	✓		Used for building survey contact list for paper-based product manufacturers.
16	*Member List*	North American Insulation Manufacturing Association	Fiberglass insulation producers	✓		Used for building survey contact list for glass product producers (other recycling uses).
17	*Ohio's Recycling Opportunities Directory*	Ohio Department of Natural Resources	Collection/processing sites statewide	✓		Used for building survey contact list for multiple categories.

Resource Number	Resource/Directory	Source Organization	Types of Data/Businesses Included	Resource Use		How Used
				Survey	Existing Data	
18	*Ohio's Secondary Markets for Recycled Materials*	Ohio Department of Natural Resources	Intermediate processors of recyclables	✓		Used for building survey contact list for multiple categories.
19	*1997 Summary of Solid Waste Management in Ohio*	Ohio Environmental Protection Agency	Recycling tonnage data.		✓	Used for throughput estimates.
20	*Scrap Tire and Rubber Users Directory*	Recycling Research Institute	Tire and rubber recyclers, equipment providers, general info	✓		Used for building survey contact list for rubber product manufacturers.
21	*Buyers Guide 1998*	Recycling Today Magazine	Equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
22	*Mailing List*	Resource Recycling, Inc	Over 41,000 records in numerous categories	✓		Used for building survey contact list.
23	*1996 Directory of U.S. and Canadian Scrap Plastics Processors and Buyers*	Resource Recycling, Inc	Commercial recycling collectors and intermediate processors, Plastics processing and manufacture, Specialized reuse and recycling equipment manufacturers, Brokers	✓		Used for building survey contact list.
24	*1997-98 Equipment Directory*	Resource Recycling, Inc	Recycling collection and intermediate processing equipment manufacturers, specialized reuse and recycling equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
25	*1998 SMA Membership Directory*	Steel Manufacturers Association	Steel mills, Iron and steel foundries, Specialized reuse and recycling equipment manufacturers		✓	Contact and facility information for SMA members; good information on electric arc furnaces.
26	*Member List*	Used Oil Management Association	Used oil processors	✓		Only five members; National Oil Recyclers Assoc. is a better resource.
27	*Standard Statistical Establishments List (SSEL)*	US Census Department	Covers all businesses		✓	Good resource for categories with corresponding SIC codes.
28	*Census of Manufactures*	US Census Department	Various manufacturing industries		✓	Contains more detail than *SSEL* on production workers and value added by manufacture for selected industries. Useful for estimates.
29	*Current Industrial Reports – Manufacturing Profiles*	US Census Department	Various manufacturing industries		✓	Contains some data on material throughput. Useful for estimates.
30	*Electronics Reuse and Recycling Directory*	US EPA	Electronic appliance demanufacturers. Includes donation, reuse, remanufacture, recycling of computers.	✓		Used for building survey contact list for computer and electronic equipment demanufacturers.
31	*Mineral Commodity Reports*	US Geological Survey	Ferrous and non-ferrous metals recycling statistics		✓	Used for scrap consumption (throughput) data.
32	*1997 WASTEC Products and Services Directory*	Waste Equipment Technology Association	Recycling collection and intermediate equipment processing manufacturers, specialized reuse and recycling equipment manufacturers, Consulting and engineering services	✓		Used for building survey contact list for equipment manufacturers.
33	*Resource 1998*	Waste News	Equipment guide, waste focus	✓		Used for building survey contact list for equipment manufacturers.
34	*1997 World Wastes Buyers' Guide Edition*	World Wastes	Collectors and intermediate processors, Recycling collection and intermediate processing equipment manufacturers, Specialized reuse and recycling equipment manufacturers	✓		Used for building survey contact list for equipment manufacturers.
35	*Recycling Directory*	Yellow Page Publishers Association (YPPA)	Commercial recycling centers and intermediate processors, Paper processing and manufacture, Brokers which deal with old directories	✓		Used for building survey contact list for paper-based product manufacturers.

Appendix C - Sample of Raw Data from
U. S. Census Bureau's *Standard Statistical Establishments List*

Number of Firms, Establishments, Employment, Annual Payroll, and Estimated Receipts for specified 4 digit SIC's for all States by Employment Size of Firm

						Employment Size of Firm								
STATE	SIC			TYPE OF DATA	TOTAL	0	1-4	5-9	10-19	<20	20-99	100-499	<500	500+
OH	2611	Pulp mills	01	Firms	3	0	0	0	0	0	2	1	3	0
OH	2611	Pulp mills	03	Establishments	3	0	0	0	0	0	2	1	3	0
OH	2611	Pulp mills	05	Employment	231	0	0	0	0	0	[b]	[c]	231	0
OH	2611	Pulp mills	07	Annual Payroll ($1,000)	8121	0	0	0	0	0	(D)	(D)	8121	0
OH	2611	Pulp mills	09	Estimated Reciepts ($1,000)	64399	0	0	0	0	0	(D)	(D)	64399	0
OH	2621	Paper mills	01	Firms	14	2	0	1	1	4	0	2	6	8
OH	2621	Paper mills	03	Establishments	15	2	0	1	1	4	0	2	6	9
OH	2621	Paper mills	05	Employment	5830	[a]	0	[a]	[a]	[a]	0	[c]	[c]	[i]
OH	2621	Paper mills	07	Annual Payroll ($1,000)	246903	(D)	0	(D)	(D)	(D)	0	(D)	(D)	(D)
OH	2621	Paper mills	09	Estimated Reciepts ($1,000)	1550644	(D)	0	(D)	(D)	(D)	0	(D)	(D)	(D)
OH	2631	Paperboard mills	01	Firms	11	0	0	0	1	1	2	0	3	8
OH	2631	Paperboard mills	03	Establishments	16	0	0	0	1	1	2	0	3	13
OH	2631	Paperboard mills	05	Employment	1731	0	0	0	[a]	[a]	[c]	0	[c]	[g]
OH	2631	Paperboard mills	07	Annual Payroll ($1,000)	73329	0	0	0	(D)	(D)	(D)	0	(D)	(D)
OH	2631	Paperboard mills	09	Estimated Reciepts ($1,000)	501790	0	0	0	(D)	(D)	(D)	0	(D)	(D)
OH	3221	Glass containers	01	Firms	1	0	0	0	0	0	0	0	0	1
OH	3221	Glass containers	03	Establishments	1	0	0	0	0	0	0	0	0	1
OH	3221	Glass containers	05	Employment	[e]	0	0	0	0	0	0	0	0	[e]
OH	3221	Glass containers	07	Annual Payroll ($1,000)	(D)	0	0	0	0	0	0	0	0	(D)
OH	3221	Glass containers	09	Estimated Reciepts ($1,000)	(D)	0	0	0	0	0	0	0	0	(D)
OH	3312	Blast furnace and steel mills	01	Firms	39	5	10	4	3	22	1	3	26	13
OH	3312	Blast furnace and steel mills	03	Establishments	45	5	10	4	3	22	1	3	26	19
OH	3312	Blast furnace and steel mills	05	Employment	23069	[a]	[a]	[b]	[b]	[b]	[b]	[f]	922	22147
OH	3312	Blast furnace and steel mills	07	Annual Payroll ($1,000)	1204396	(D)	(D)	(D)	(D)	(D)	(D)	(D)	41151	1163245
OH	3312	Blast furnace and steel mills	09	Estimated Reciepts ($1,000)	7651530	(D)	(D)	(D)	(D)	(D)	(D)	(D)	299102	7352428
OH	3321	Gray and ductile iron foundries	01	Firms	69	3	4	9	4	20	21	15	56	13
OH	3321	Gray and ductile iron foundries	03	Establishments	77	3	4	9	4	20	21	16	57	20
OH	3321	Gray and ductile iron foundries	05	Employment	13586	[a]	[a]	[b]	60	122	974	3123	4219	9367
OH	3321	Gray and ductile iron foundries	07	Annual Payroll ($1,000)	665630	(D)	(D)	(D)	1422	3105	25406	94388	122899	542731
OH	3321	Gray and ductile iron foundries	09	Estimated Reciepts ($1,000)	2196651	(D)	(D)	(D)	4517	11493	78701	350425	440619	1756032
OH	3322	Malleable iron foundries	01	Firms	2	0	1	0	1	2	0	0	2	0
OH	3322	Malleable iron foundries	03	Establishments	2	0	1	0	1	2	0	0	2	0
OH	3322	Malleable iron foundries	05	Employment	[a]	0	[a]	0	[a]	[a]	0	0	[a]	0
OH	3322	Malleable iron foundries	07	Annual Payroll ($1,000)	(D)	0	(D)	0	(D)	(D)	0	0	(D)	0
OH	3322	Malleable iron foundries	09	Estimated Reciepts ($1,000)	(D)	0	(D)	0	(D)	(D)	0	0	(D)	0
OH	3324	Steel investment foundries	01	Firms	16	0	0	2	1	3	4	5	12	4
OH	3324	Steel investment foundries	03	Establishments	16	0	0	2	1	3	4	5	12	4
OH	3324	Steel investment foundries	05	Employment	[g]	0	0	[a]	[a]	[b]	198	503	[f]	1701
OH	3324	Steel investment foundries	07	Annual Payroll ($1,000)	(D)	0	0	(D)	(D)	(D)	5257	17961	(D)	56612
OH	3324	Steel investment foundries	09	Estimated Reciepts ($1,000)	(D)	0	0	(D)	(D)	(D)	15142	52905	(D)	172728
OH	3325	Steel foundries, nec	01	Firms	34	1	6	5	1	13	13	4	30	4
OH	3325	Steel foundries, nec	03	Establishments	35	1	6	5	1	13	13	4	30	5
OH	3325	Steel foundries, nec	05	Employment	3927	[a]	[a]	[b]	[a]	58	470	694	1222	2705
OH	3325	Steel foundries, nec	07	Annual Payroll ($1,000)	134221	(D)	(D)	(D)	(D)	1473	13749	23780	39002	95219
OH	3325	Steel foundries, nec	09	Estimated Reciepts ($1,000)	471941	(D)	(D)	(D)	(D)	7471	43195	91338	142004	329937
OH	3341	Secondary nonferrous metals	01	Firms	21	1	0	3	3	7	8	2	17	4
OH	3341	Secondary nonferrous metals	03	Establishments	22	1	0	3	3	7	9	2	18	4

Appendix C - Sample of Raw Data from
U. S. Census Bureau's *Standard Statistical Establishments List*

						Employment Size of Firm								
STATE	**SIC**			**TYPE OF DATA**	**TOTAL**	**0**	**1-4**	**5-9**	**10-19**	**<20**	**20-99**	**100-499**	**<500**	**500+**
OH	3341	Secondary nonferrous metals	05	Employment	1049	[a]	0	22	[b]	66	[e]	[c]	612	437
OH	3341	Secondary nonferrous metals	07	Annual Payroll ($1,000)	36173	(D)	0	250	(D)	1455	(D)	(D)	21417	14756
OH	3341	Secondary nonferrous metals	09	Estimated Reciepts ($1,000)	515698	(D)	0	3088	(D)	15492	(D)	(D)	304557	211141
OH	3363	Aluminum die-castings	01	Firms	30	1	3	1	4	9	14	5	28	2
OH	3363	Aluminum die-castings	03	Establishments	31	1	3	1	4	9	14	5	28	3
OH	3363	Aluminum die-castings	05	Employment	3123	[a]	10	[a]	[b]	77	[f]	1287	[g]	[g]
OH	3363	Aluminum die-castings	07	Annual Payroll ($1,000)	98470	(D)	173	(D)	(D)	2763	(D)	29436	(D)	(D)
OH	3363	Aluminum die-castings	09	Estimated Reciepts ($1,000)	368080	(D)	840	(D)	(D)	10749	(D)	110228	(D)	(D)
OH	3364	Nonferrous die-casting exc. aluminum	01	Firms	20	0	1	2	1	4	10	3	17	3
OH	3364	Nonferrous die-casting exc. aluminum	03	Establishments	20	0	1	2	1	4	10	3	17	3
OH	3364	Nonferrous die-casting exc. aluminum	05	Employment	999	0	[a]	[a]	[a]	38	[e]	[e]	[f]	[c]
OH	3364	Nonferrous die-casting exc. aluminum	07	Annual Payroll ($1,000)	28992	0	(D)	(D)	(D)	1002	(D)	(D)	(D)	(D)
OH	3364	Nonferrous die-casting exc. aluminum	09	Estimated Reciepts ($1,000)	117304	0	(D)	(D)	(D)	3961	(D)	(D)	(D)	(D)
OH	3365	Aluminum foundries	01	Firms	72	4	10	13	11	38	17	11	66	6
OH	3365	Aluminum foundries	03	Establishments	75	4	10	13	11	38	17	12	67	8
OH	3365	Aluminum foundries	05	Employment	4193	[a]	[b]	[b]	140	250	716	1677	2643	1550
OH	3365	Aluminum foundries	07	Annual Payroll ($1,000)	127105	(D)	(D)	(D)	3812	7346	19228	48984	75558	51547
OH	3365	Aluminum foundries	09	Estimated Reciepts ($1,000)	424143	(D)	(D)	(D)	11955	23253	61597	165870	250720	173423
OH	3366	Copper foundries	01	Firms	23	0	6	3	3	12	8	3	23	0
OH	3366	Copper foundries	03	Establishments	23	0	6	3	3	12	8	3	23	0
OH	3366	Copper foundries	05	Employment	671	0	14	21	47	82	278	311	671	0
OH	3366	Copper foundries	07	Annual Payroll ($1,000)	22288	0	534	536	1186	2256	9323	10709	22288	0
OH	3366	Copper foundries	09	Estimated Reciepts ($1,000)	77092	0	1674	1657	3565	6896	31772	38424	77092	0
OH	3369	Nonferrous foundries, nec	01	Firms	10	0	1	3	1	5	1	3	9	1
OH	3369	Nonferrous foundries, nec	03	Establishments	12	0	1	3	1	5	1	3	9	3
OH	3369	Nonferrous foundries, nec	05	Employment	1633	0	[a]	[a]	[a]	32	[b]	[c]	[e]	[g]
OH	3369	Nonferrous foundries, nec	07	Annual Payroll ($1,000)	62222	0	(D)	(D)	(D)	871	(D)	(D)	(D)	(D)
OH	3369	Nonferrous foundries, nec	09	Estimated Reciepts ($1,000)	211780	0	(D)	(D)	(D)	2962	(D)	(D)	(D)	(D)
OH	5015	Motor vehicle parts, used	01	Firms	348	17	168	85	53	323	22	2	347	1
OH	5015	Motor vehicle parts, used	03	Establishments	351	17	168	86	53	324	24	2	350	1
OH	5015	Motor vehicle parts, used	05	Employment	2358	0	410	550	695	1655	[f]	[b]	[g]	[b]
OH	5015	Motor vehicle parts, used	07	Annual Payroll ($1,000)	51698	262	5878	11652	14786	32578	(D)	(D)	(D)	(D)
OH	5015	Motor vehicle parts, used	09	Estimated Reciepts ($1,000)	253146	1305	38711	57418	68269	165703	(D)	(D)	(D)	(D)
OH	5093	Scrap and waste materials	01	Firms	492	47	166	92	79	384	75	16	475	17
OH	5093	Scrap and waste materials	03	Establishments	577	47	166	94	84	391	88	27	506	71
OH	5093	Scrap and waste materials	05	Employment	7593	0	357	640	1107	2104	2690	1371	6165	1428
OH	5093	Scrap and waste materials	07	Annual Payroll ($1,000)	219846	1992	9111	17639	27713	56455	77995	42597	177047	42799
OH	5093	Scrap and waste materials	09	Estimated Reciepts ($1,000)	2392720	21560	149385	250292	298827	720064	779873	439375	1939312	453408
OH	5932	Used merchandise stores	01	Firms	533	73	324	68	29	494	20	11	525	8
OH	5932	Used merchandise stores	03	Establishments	704	73	324	69	33	499	52	67	618	86
OH	5932	Used merchandise stores	05	Employment	4200	0	641	414	353	1408	710	1031	3149	1051
OH	5932	Used merchandise stores	07	Annual Payroll ($1,000)	52027	428	6791	4671	4479	16369	8028	13643	38040	13987
OH	5932	Used merchandise stores	09	Estimated Reciepts ($1,000)	237940	2115	47529	23248	19351	92243	32294	54082	178619	59321

National
Recycling
Coalition
Inc.

April 3, 2000

Dexter Mounts II
President
Ohio Wood Recycling, Inc
2019 Rathnell Rd
Columbus, OH 43207

Subject: U.S. Recycling Economic Information Study

Dear Colleague:

I am writing to ask your assistance in responding to the enclosed, brief survey. This important survey is designed to gather key economic statistics on the nation's recycling and reuse industries.

The survey requests information about your firm's activities involving the processing of recyclable and reusable materials/products, manufacturing of new products from recycled materials, or manufacturing equipment used in the recycling and reuse industries. Additional survey forms have been enclosed if you have more than one facility. (Please use a separate form for each facility.) We want to emphasize that **the information you provide will be held strictly confidential – under no circumstances will company-specific data be released**. Your responses will be aggregated with data provided by other businesses, and only released as aggregated, statewide or industry-wide totals.

Our organization, the National Recycling Coalition (NRC), has retained R. W. Beck, Inc., a nationally recognized management consulting firm, to conduct the first ever U.S. Recycling Economic Information Study. As part of the study, R. W. Beck is surveying businesses like yours from throughout the nation.

Once complete, NRC will publish the study results and use them to promote the growth of the recycling and reuse industries. By sharing aggregate statistics with the financial community, the information will be used to help leverage the availability of capital to assist recycling entrepreneurs grow their businesses. By targeting state and federal officials, the information will help secure government action (or inaction) favorable to recycling and reuse businesses. The information will also be useful in educating 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 Tim Buwalda of R. W. Beck at (800) 873-6532. If you wish, you may fax your completed survey to R. W. Beck at (407) 648-8382. We would appreciate a response by April 28, 2000. Thank you for your assistance.

Sincerely,

Will Ferretti
Executive Director,
National Recycling Coalition

National Recycling Coalition Inc.

U. S. Recycling Economic Information Study

Company	Ohio Wood Recycling, Inc
Subsidiary of	
Mailing Address (location where contact can be reached)	2019 Rathnell Rd Columbus, OH 43207
Physical Address (establishment location)	2019 Rathnell Rd Columbus, OH 43207
Establishment Telephone Number	(614) 491-0881 *Ext* _____ Please provide at least an area code that corresponds to the PHYSICAL ADDRESS.
Contact Name	Dexter Mounts II
Title	President
Contact Telephone Number	(614) 491-0881 *Ext* _____
Fax Number	
E-mail Address	

Be sure that the ZIP CODE for the physical address is NOT for a Post Office Box.

If you have any questions about this form or the U. S. Recycling Economic Information Study, please call Tim Buwalda of R. W. Beck at (800) 873-6532.

- Please make any necessary changes and spelling corrections to the information above.
- Our records show that you do not have any additional facilities.
- If we are missing one or more of your facilities, please list them below.

A. Name _____ City/State _____

B. Name _____ City/State _____

C. Name _____ City/State _____

Please return to: Tim Buwalda / R. W. Beck, Inc. / P.O. Box 538817 / Orlando, Florida 32853-8817 / or FAX to (407) 648-8382.

U. S. Recycling Economic Information Study

CONFIDENTIAL SURVEY — no establishment-specific data will be released.

1. Please identify the categories that best match your establishment (check all that apply). Please complete a separate form for each location you have (make extra copies if needed).

ESTABLISHMENT CATEGORIES

	Recycling Collection	Code
	Government-staffed collection	18
	Private-staffed collection	19
	Recycling Processing and Manufacturing	
	Compost/organics processor	1
	Fiberglass insulation producer	2
	Glass container manufacturing plant	3
	Glass product producer (other recycled uses)	4
	Household hazardous waste processor	5
	Materials recovery facility (commingled matls.)	6
	Nonferrous product producer	20
	Nonferrous foundry	21
	Nonferrous smelting or refining mill	22
	Oil processor	7
	Paper, paperboard, or market pulp mill	23
	Paper-based product mfg. (e.g. insulation, bedding)	8
	Pavement mix producer (asphalt or aggregate)	9
	Plastics converter	24
	Plastics reclaimer	10
	Recyclable materials processors (e.g. paper, metal)	25
	Rubber product manufacturer	11
	Steel or Iron foundry	26
	Steel mill	27

	Reuse and Remanufacturing	Code
	Computer/electronic appliance demanufacturer	12
	Equipment or toner cartridge remanufacturer	28
	Motor vehicle parts remanufacturer	29
	Repair shop	30
	Retail used merchandise sales	31
	Tire retreader	32
	Wood reuse or pallet rebuilder	13
	Support Businesses	
	Broker	33
	Consulting/engineering company	34
	Materials exchange services	14
	Recycling and reuse equipment manufacturer	15
	Transporter	35
	Other (describe below)	
	Other recycling processor/manufacturer	16
	Other reuse/remanufacturer	17
	Other (none of the above)	36
	Describe your establishment here:	

2. If you placed a check mark by a category numbered from:

- **1-17**, please continue and complete the remaining three questions on the next page as they apply to your establishment as a recycling, manufacturing (using recycled materials), reuse, or recycling equipment manufacturer. Those questions are not intended to quantify in-house programs that reuse products or recover self-generated scrap materials.

  If you checked two or more categories, please select a single category number from 1-17 that best represents the primary recycling, manufacturing (using recycled materials), reuse, or recycling equipment manufacturing activities conducted by your establishment.

  Please write the establishment category code (1-17) this form is being completed for here: ____

- **18-36** you may stop and return this survey in the postage-paid envelope. Thank you!

U. S. Recycling Economic Information Study

CONFIDENTIAL SURVEY — no establishment-specific data will be released.

3. Establishment Size Information (total this location):

Total Number of Employees:	Most Recent Total Annual Payroll: [1]	Most Recent Total Annual Receipts: [2]
☐ 0 – 9	☐ $0 - $49,999	☐ $0 - $99,999
☐ 10 – 24	☐ $50,000 - $99,999	☐ $100,000 - $249,999
☐ 25 – 49	☐ $100,000 - $149,999	☐ $250,000 - $499,999
☐ 50 - 99	☐ $150,000 – $499,999	☐ $500,000 - $999,999
☐ 100 – 199	☐ $500,000 – $999,999	☐ $1,000,000 - $2,499,999
☐ 200 – 299	☐ $1,000,000 – $2,499,999	☐ $2,500,000 - $4,999,999
☐ 300 – 399	☐ $2,500,000 – $4,999,999	☐ $5,000,000 - $7,499,999
☐ 400 – 499	☐ $5,000,000 – $9,999,999	☐ $7,500,000 – $9,999,999
☐ 500 – 1,000	☐ $10,000,000 – $19,999,999	☐ $10,000,000 - $19,999,999
_____ Please fill in value if greater than 1,000	☐ $20,000,000 – $30,000,000	☐ $20,000,000 - $49,999,999
	$_____ Please fill in value if greater than $30,000,000	☐ $50,000,000 – $74,999,999
		☐ $75,000,000 – $100,000,000
		$_____ Please fill in value If greater than $100,000,000

[1] Payroll includes total salary, hourly pay, bonuses, commissions, sick-leave pay, free meals, and benefits received by employees.
[2] Receipts include revenue of all forms (sales, fees, rents, commissions, interest, dividends) minus all local, state, and federal tax revenue collected.

4. Covered Activities Information (this location):

"**Covered activities**" are all activities that support:

- Transforming scrap materials or products into a recycled raw material
- Transforming recycled raw materials into a first intermediate product (e.g. sheet, fiber, roll)
- Transforming recycled raw materials directly into a finished product
- Preparing used products for reuse
- Manufacturing equipment for the recycling or reuse industries

Covered activities do not include converting a first intermediate product to finished products or preparing materials for fuel use.

Percent of Total Production Labor Time Spent on Covered Activities:	Percent of Total Receipts from Products of Covered Activities:
☐ 0 - 9%	☐ 0 - 9%
☐ 10 - 19%	☐ 10 - 19%
☐ 20 - 29%	☐ 20 - 29%
☐ 30 - 39%	☐ 30 - 39%
☐ 40 - 49%	☐ 40 - 49%
☐ 50 - 59%	☐ 50 - 59%
☐ 60 - 69%	☐ 60 - 69%
☐ 70 - 79%	☐ 70 - 79%
☐ 80 - 89%	☐ 80 - 89%
☐ 90 - 100%	☐ 90 - 100%

If your establishment code is 1-11, please complete the following table (Question 5).

5. Recycling or Recycled Product Manufacturing Annual Processing Information (this location):

Input Materials	Unit of Measure	Input Quantity	Process Outputs		
			Residue Disposed	Prepared or used for fuel	Recycled product or material
Example — oil	*gallons*	*1,000,000*	*5%*	*75%*	*20%*
Paper					
Plastics					
Glass					
Metals					
Tires or rubber					
Construction & demolition debris [1]					
Organics [2]					
Oil or household hazardous waste					
Other					

[1] Includes concrete, asphalt, non-yard wood waste, etc. from construction, demolition, and remodeling of roads and structures.
[2] Includes yard waste, food waste, sludge, land-clearing debris and wood waste including pallets, brush, stumps/tree trunks, sawdust, and mill scrap.

Thank you for completing this survey! Please return it to R. W. Beck in the postage-paid envelope.

Appendix E
Analysis of Survey Results

Survey data from Ohio was analyzed in an attempt to identify the recycling characteristics of the state. Survey data on three variables (number of employees, payroll, and receipts) provided the primary information analyzed.

Survey information obtained from 350 establishments was used to estimate the number of employees[1] involved in recycling activities, as well as the dollar value of recycling payroll and receipts. Based on initial estimates and survey participation responses, R. W. Beck estimated the total number of establishments engaged in recycling activities in the state of Ohio for each of thirteen survey categories. In Ohio, 581 establishments are believed to be involved in recycling activities in these categories.

The procedure for estimating the total number of establishments in each category consisted of several steps. From the initial count of businesses in each category, a random sample was developed. After examining the survey responses, those that were unrelated, unreachable, duplicate, or out of business were eliminated. Those businesses that were either completely or partially responsive to the survey, as well as those that declined to participate or were uncooperative were counted. Further adjustments were made for businesses that changed from one category to another.

The following example will illustrate the procedure used to develop the final estimate of 241 establishments in category 3, compost and organics processors:

- From the initial list of 419 businesses that were classified as potentially being compost and organics processors, a random sample of 400 was contacted;
- Of these 400, 12 establishments moved out of this recycling category, 24 moved into the category (from other categories) and 186 were eliminated (unrelated, unreachable, duplicate entries, or out of business), leaving 226 establishments in this category.
- To these 226, we added 15 additional establishments, based on the observed "success" rate of the attempted sample and the relative amount of establishments that moved into the category, for a total of 241 establishments.[2]

For each variable (employment, payroll, and receipts), the sample mean, standard deviation, and other related statistics were calculated. Based on the sample size and estimate of the total number of establishments engaged in recycling in this business category, ranges were constructed that should contain the true average value for the

[1] Employee responses were adjusted to a full-time equivalent basis. Thus, two employees each working 50% on recycling activities would be counted as one employee.

[2] Of the 400 establishments we attempted to contact in this category, only 202 correctly belonged in the category. We applied this 51% "success" ratio to the 19 establishments not contacted of the originally estimated 419 establishments, adding 10 establishments. Furthermore, we added another 5 establishments through allocation from a group of unclassified establishments, based on the relative proportion of unclassified establishments that completed a survey and properly belonged in the compost and organics producers category.

typical recycling business in the category[3]. Finally, by multiplying this range by the estimate of the total number of recycling businesses in the category, we obtain a range for the total values for each variable.

Continuing with the previous example, the analysis was as follows:

- 131 establishments provided complete employment, payroll, and receipts data;
- Average number of employees, payroll, and receipts for these 131 responses was calculated;
- Standard deviations and other related statistics necessary to determine a 95% confidence interval for the average of *all* establishments in this business category was calculated; and
- The low, average, and high values for the confidence interval were then multiplied by the estimated total establishments in this category (241) to yield the estimated range of the total number of employees, payroll, and receipts.

To finish this particular example, the sample of 131 establishments employed (on average) 5.2 persons per establishment in recycling activities on a full-time equivalent basis. However, given the sample size and the estimate of the total number of establishments in this business category, the actual average number of employees per establishment might range from a low of 4.3 to a high of 6.1. Thus, while 1,248 employees are expected to be involved in recycling activities for the entire set of 241 establishments in this business category, there may be as few as 1,030 or as many as 1,467.

Another point should also be made regarding small population sampling as it applies to certain categories. Given the small number of total establishments engaged in certain business categories at the state level, the low end of the estimates is often constrained by the fact that it cannot be less than the value already observed in the sample itself. For paper-based product manufacturers, for example, the expected value of 1,807 total employees is bounded by a low estimate of 602 because it is already known, through survey data, that 602 employees work for the establishments sampled in this category. As this issue affects the results, it serves to make certain estimates more accurate than would otherwise be possible. For example, in the most extreme cases, *all* the establishments believed to exist in a given business category were surveyed. For these cases, the *exact* number of people employed, payrolls, and receipts are known because the entire relevant population was surveyed.

[3] Technically speaking, these ranges can be described as 95% confidence intervals.

APPENDIX F

GLOSSARY OF TERMS

AF&PA – American Forest & Paper Association.

All Other Employees – Non-production employees including those engaged in factory supervision above the line-supervisor level. It includes sales (including driver-salespersons), sales delivery (highway truck drivers and their helpers), advertising, credit, collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, financing, legal, personnel (including cafeteria, medical, etc.), professional, and technical employees.

Annual Payroll – Total 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 (e.g., free meals and lodgings) paid during the year to all employees.

APC – American Plastics Council.

Covered Activities – Defined as all activities that support:

- Transforming pre-consumer scrap materials or post-consumer products into a recycled material;
- Transforming recycled materials into a first intermediate product (e.g., sheet, fiber, roll);
- Transforming recycled materials directly into a finished product;
- Preparing used products for reuse; and
- Manufacturing equipment for the recycling or reuse industries.

Covered activities *do not* include converting a first intermediate product to finished or semi-finished products or preparing materials for fuel use.

Direct Effects – Refers to the operational characteristics of the firms or institutions that are studied. This study measured the apparent value of twenty-six categories of recycling and reuse establishments. The direct output of these entities is, therefore, their reported gross sales. The direct jobs are the jobs that the firms that were surveyed in the states listed. The direct personal income contains their reported payments to all employees, plus an additional estimate of benefit values and of returns to sole proprietors. The estimate of benefit values and returns to sole proprietors were based on industrial averages in industries that are similar to the recycling and reuse industries included in this study.

Employment – Employment consists of paid full and part-time employees (counted at equal weight), including salaried officers and executives of corporations. Included are employees on sick leave, holidays, and vacations; not included are volunteers, proprietors and partners of unincorporated businesses.

Establishment – A single physical location where business is conducted or where services or industrial operations are performed. Establishments may government operated as well as privately operated.

GPI – Glass Packaging Institute.

I-O – Input-Output, in relation to economic modeling, refers to econometric models that are based on inter-industrial accounts data that identify the products made within a region and the products consumed by industries and households in that same region. Any industry's or institution's output (usually its gross sales) requires inputs in the form of employees, materials, utilities, capital investments, financing, maintenance, equipment, and services. The probability that a firm purchases its inputs locally is estimated in the I-O model.

Indirect Effects – A measurement of the value of additional economic demands that direct firms or institutions place on supplying industries in a region under study. When firms produce goods or conduct business or when public entities provide public goods or services, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services are necessary to produce the output of direct establishments.

IMPLAN – A basic input-output economic modeling program used in this study that is published by the Minnesota IMPLAN Group, Inc.

Induced Effects – These effects accrue when workers in direct and indirect industries spend their earnings on goods and services in the region. Induced effects can also be called household effects, and the terms are often used interchangeably. When workers in direct and indirect industries purchase goods and services for household consumption, they, in turn, stimulate another layer of the economy. Most induced activity accrues to retail, services, finance, insurance, and housing spending. Because employment is stimulated in these industries as well, *their* demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity.

ISRI – Institute of Scrap Recycling Industries.

Jobs – The number of paid full- and part-time positions (counted at equal weight), not the number of full time equivalents.

Multiplier or Multiplier Effect – A term used when referring to economic effects or economic impacts. There are different kinds of multipliers -- this study reports two types. The *Type I* multiplier identifies the value of direct and indirect transactions -- e.g., the output of a business category and all other output that it purchases from its suppliers in the region – relative to the value of only the direct transactions. The *Type II* multiplier identifies the value of <u>all</u> economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry under study, including the personal spending

of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

NAICS – North American Industrial Classification System, a new system introduced by the U.S. Department of Commerce, Bureau of the Census, in 1997 to classify businesses by their primary industrial activity. It replaces the SIC system and is compatible with systems used in Canada and Mexico.

NERC – Northeast Recycling Council.

Own-Source – Means revenues collected through the state revenue system and not received, for example, as a state disbursement of funds collected through the federal revenue system.

Payroll – Includes the wages and salaries of employees before taxes or other deductions are taken (includes paid vacation, bonuses, commissions, etc.). Does not include employer-paid benefits such as social insurance match, retirement, and medical benefits.

Personal Income – Includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Production Workers – Workers (up through the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and guard services, product development, auxiliary production for plant's own use (e.g., power plant), record-keeping, and other services closely associated with these production operations at the establishment covered by the report. Employees above the working-supervisor level are excluded from this item.

Receipts – Receipts (net of taxes) are defined as the revenue for goods produced, distributed, or services provided, including revenue earned from premiums, commissions and fees, rents, interest, dividends, and royalties. Receipts excludes all revenue collected for local, state, and federal taxes.

REI – Recycling Economic Information.

SIC – Standard Industrial Classification, a classification system used by the U.S. Census Bureau to identify businesses by their primary industrial activity.

SPI – Society of the Plastics Industry.

SRI – Steel Recycling Institute.

SSEL – Standard Statistical Establishment List, a database of economic data maintained by the U.S. Census Bureau.

Total Economic Effects – The sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this study.

Total Industrial Output – For most private industries this is simply gross sales. For public or quasi-public institutions this normally includes all public outlays, along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.

USGS – U.S. Geological Survey.

Value Added – A measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).