File 1327

VALUE ADDED TO RECYCLABLE MATERIALS IN THE NORTHEAST

Prepared for

THE NORTHEAST RECYCLING COUNCIL
Council of State Governments
Brattleboro, Vermont 05301

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SECTION 1

EXECUTIVE SUMMARY

1.1 PURPOSE OF STUDY

Under contract to the Northeast Recycling Council (NERC), Roy F. Weston, Inc. (WESTON®) developed an analysis of the value added to material recovered from the municipal solid waste stream through processing of recyclables and manufacturing using feedstocks from recycled sources in the Northeast region. The purpose of the study is to quantify the economic activity associated with recycling in the region, which will aid in the promotion of investment in the recycling industry.

NERC is a non-profit, non-partisan organization directed and supported by its member states: Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont. NERC's primary goal is the development and stimulation of markets for recyclable materials. In the course of pursuing this goal, NERC has recognized the lack of quantitative information regarding the recycling industry which hinders efforts to involve the economic development and investment communities in the development of new and expanded facilities for recycling processing and manufacturing. This study is designed to address that lack of quantitative information by providing the basis for understanding the nature and extent of economic activity in the recycling industry in the Northeast.

The study is a comprehensive analysis of economic activity associated with recycling, covering a wide range of materials, processes, and geographic areas. The comprehensive nature of the study meant that data had to be gathered and compiled in a way that has not been done previously. As a result, many areas were encountered in which data was lacking and procedures had to be devised to fill these gaps. Therefore, this study represents an important step forward in developing an understanding of the economic activity associated with recycling. There are, however, many areas in which future data gathering could refine the analysis and improve its accuracy.

In reviewing this report, it is important to recognize that this study was designed to improve the understanding of economic activity associated with recycling. The report is not designed as a solid waste management planning tool, and the results do not indicate anything about the economic viability of recycling or its costs relative to other solid waste management activities. In addition, since the exact nature of the analysis varies in its details from material-to-material, comparisons between materials should only be made with a full understanding of the nature of the analyses performed.

What the report does provide is state-by-state and material-by-material data on quantities of recycled material processed and manufactured and the level of economic activity associated with that processing and manufacturing.

1.2 SUMMARY OF APPROACH

The methodological approach utilized in this study is described in Section 2 of this report. The key aspects of that approach are as follows:

- The difference in value of a material before and after a given process is used to quantify the economic activity associated with that process. For instance, if the value of a material is $20 per ton at the start of a process and $50 per ton at the end of the process, $30 per ton of value has been added. If 100 tons go through that process, it is estimated that $3,000 of value has been added, representing $3,000 of economic activity.

- Recycling activities are divided into two categories: processing and manufacturing. Processing involves accepting material as collected and producing as an end-product a material that is technically equivalent to virgin material. Thus, for example, plastics processing includes all activities after collection through the production of plastic pellets that can be used in manufacturing. This could include multiple firms: for instance, one that separates and bales the plastics, and one that produces pellets. In fact, these two types of activities were divided into two stages of processing, and this was done for a number of materials. Manufacturing includes activities to produce a wholesale product from the virgin-equivalent end-product of processing. Continuing the example of plastics, this includes production of plastic sheet.

- The amount of recyclable material processed and utilized in manufacturing is estimated by determining tons-per-employee processing and manufacturing rates for different categories of processors and manufacturers, and applying these rates to estimates of total employment in each of these categories. The processing and manufacturing rates were determined through surveying of processors and manufacturers. The estimates of employment by category were prepared by state Departments of Labor, using lists of firms prepared by NERC.

- The following criteria were utilized to guide decisions in filling data gaps and making adjustments to the methodology: 1) select approaches likely to produce conservative results; 2) be conceptually consistent from one approach to the next; and 3) select approaches with a precision that matches that of the known data.

1.3 SUMMARY OF RESULTS

Some of the key findings contained in this report are as follows:

- Approximately 103,400 people are employed in firms that process recyclables or use them in manufacturing in the Northeast region. This represents 2.7 percent of the approximately 3.8 million jobs in the manufacturing sector in 1991 for the same ten-state region. A state-by-state breakdown of recycling employment is shown in Figure 1-1, and a comparison with total manufacturing employment is presented in Table 1-1.

FIGURE 1-1

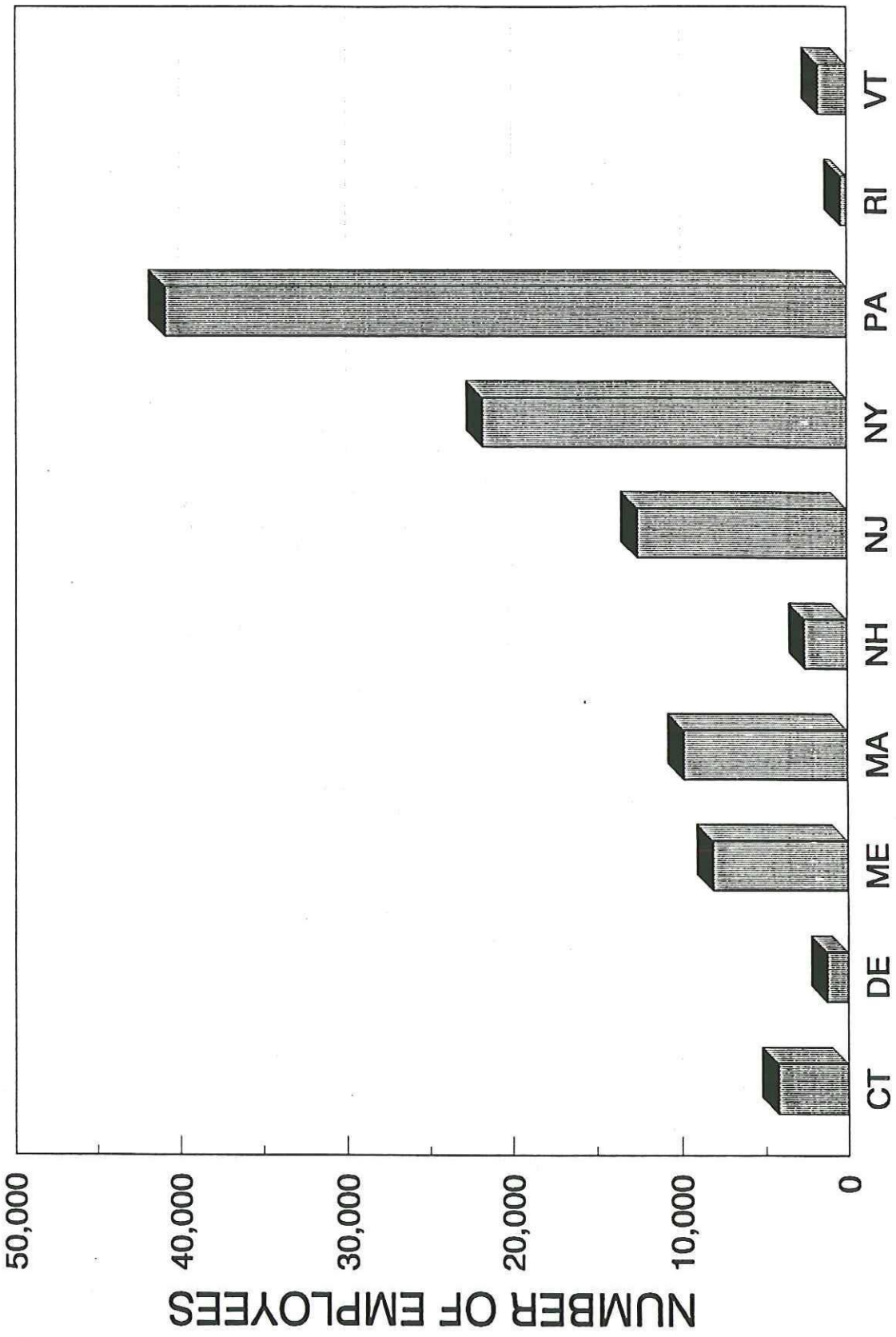

RECYCLING EMPLOYMENT BY STATE
NUMBER OF EMPLOYEES
0
10,000
20,000
30,000
40,000
50,000
CT
DE
ME
MA
NH
NJ
NY
PA
RI
VT

Table 1-1

Summary of Recycling Employment

	CT	DE	ME	MA	NH	NJ	NY	PA	RI	VT	TOTALS
Paper Processing	138	323	60	377	30	434	1,668	351	15	20	3,416
Paper Manufacturing	1,794	65	7,190	6,102	1,827	3,595	10,734	15,814	0	815	47,936
Glass Processing	0	0	0	0	0	58	71	72	0	24	225
Glass Manufacturing	309	0	0	285	0	2,180	1,874	3,943	0	0	8,591
Plastic Processing	90	15	0	258	68	308	533	1,280	45	91	2,688
Plastic Manufacturing	273	536	0	1,118	137	145	735	3,498	0	91	6,533
Metal Processing	588	143	207	527	205	1,336	2,494	2,506	96	87	8,189
Ferrous Manufacturing	153	0	0	45	0	1,350	568	2,775	0	0	4,891
Non–Ferrous Manufacturing	59	0	0	45	0	1,609	60	4,497	0	0	6,270
Aluminum Manufacturing	0	0	0	45	0	142	441	2,296	0	0	2,924
Yard Waste Processing	44	0	132	275	0	23	27	0	44	0	545
Tire Processing	17	0	50	33	17	20	170	94	0	17	418
Tire Manufacturing	40	26	0	65	0	10	18	100	20	0	279
Textile Processing	19	0	57	100	19	38	546	316	38	0	1,133
Multi–material Processing	737	174	416	549	280	1,301	1,853	3,351	120	594	9,375
TOTAL EMPLOYMENT	4,261	1,282	8,112	9,824	2,583	12,549	21,792	40,893	378	1,739	103,413
MANUFACTURING SECTOR EMPLOYMENT TOTALS (1)	339,000	62,000	98,000	490,000	86,000	591,000	1,054,000	962,000	95,000	43,000	3,781,000
RECYCLING AS PERCENT OF MANUFACTURING	1.3%	2.1%	8.3%	2.0%	3.0%	2.1%	2.1%	4.3%	0.4%	4.0%	2.7%

NOTES:
(1) Source: 1993 Statistical Abstract for the United States

- Material-by-material employment totals are presented in Figure 1-2. Approximately 25 percent of the recycling employment in the region is in processing firms, and 75 percent is in manufacturing firms. Paper manufacturing is the leading recycling employer, with approximately 48,000, or 46 percent of the total regional recycling employment. Multi-material processors are the next largest contributor to employment, with approximately 9 percent of total recycling employment. The percentage of total recycling employment associated with each material is illustrated in Figure 1-3.

- Figure 1-4 presents a summary of material quantities processed and manufactured. Approximately 9.1 million tons of paper are processed annually in the region, which is the largest quantity of material processed. Approximately 6.6 million tons per year of metal are processed, along with 1.5 million tons of yard waste, and 900,000 tons of glass.

- Approximately 10 million tons per year of metal products are manufactured from scrap metal, including 5.8 million tons of ferrous metal products, 3 million tons of non-ferrous metal products, and 1.1 million tons of aluminum products. Approximately 3.6 million tons per year of paper are produced from wastepaper sources. In addition, about 1.8 million tons of scrap tires are used annually in the manufacturing of products.

- Over $7.2 billion of value is added to recyclables in the region through processing and manufacturing. A summary of value is presented in Table 1-2, along with the state-by-state totals of manufacturing value added, for comparison. This represents approximately 2.6 percent of the total value added by the manufacturing sector in the region.

- Figure 1-5 presents the value added results by material and processing/manufacturing stage. In this graphic, the values added for paper by the second stage of processing and manufacturing have been combined to eliminate an anomaly created by the assumption regarding the split between processing and manufacturing. The total value added for each material is shown in Figure 1-6, and on a state-by-state basis in Figure 1-7.

It is important to recognize that many detailed calculations and adjustments were made to produce the results summarized above. Therefore, to gain a full understanding of the meaning of the results, the full report should be read.

FIGURE 1-2

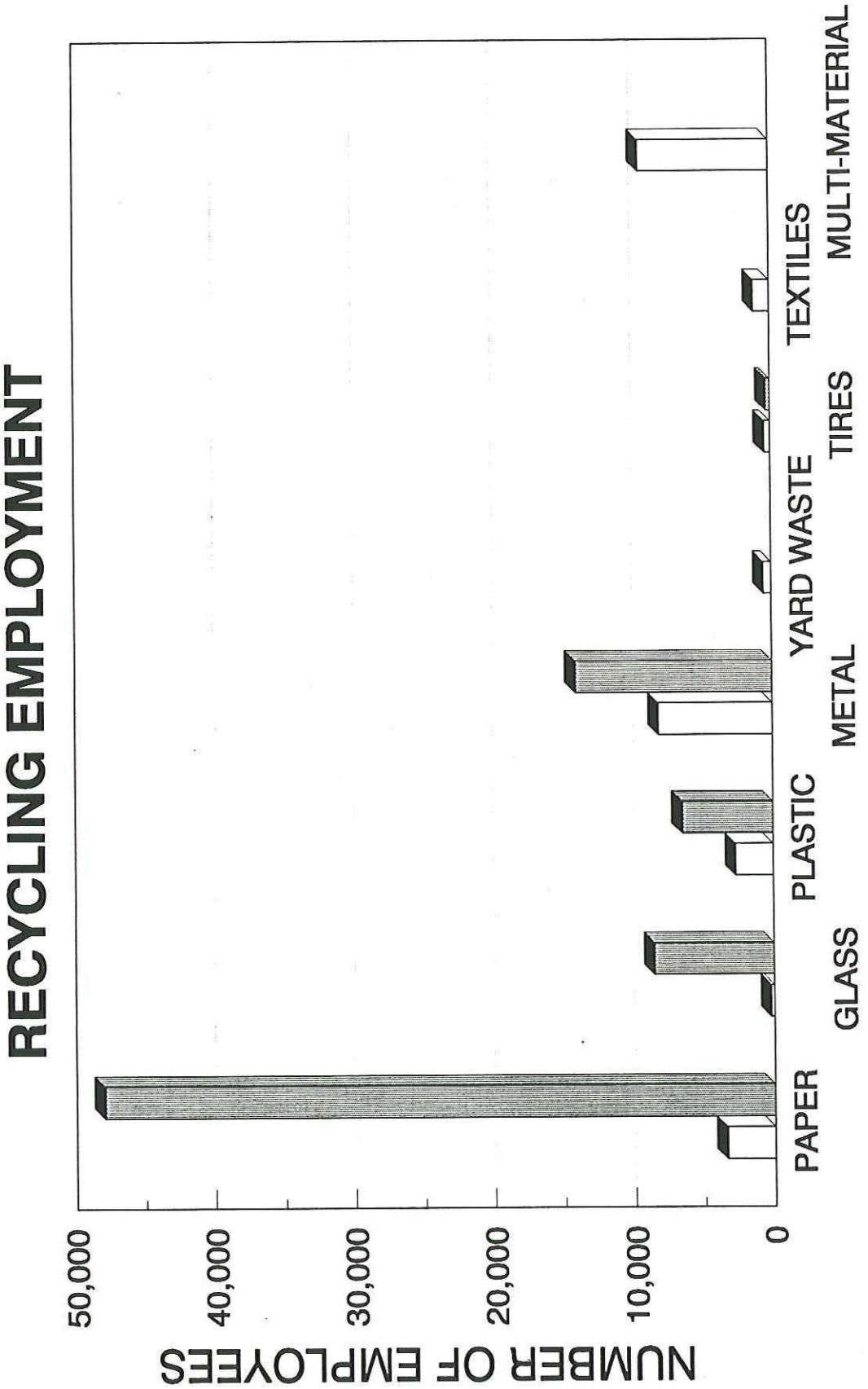

RECYCLING EMPLOYMENT
NUMBER OF EMPLOYEES
50,000
40,000
30,000
20,000
10,000
0
PAPER
GLASS
PLASTIC
METAL
YARD WASTE
TIRES
TEXTILES
MULTI-MATERIAL
PROCESSING
MANUFACTURING

FIGURE 1-3

EMPLOYMENT BY MATERIAL CATEGORY

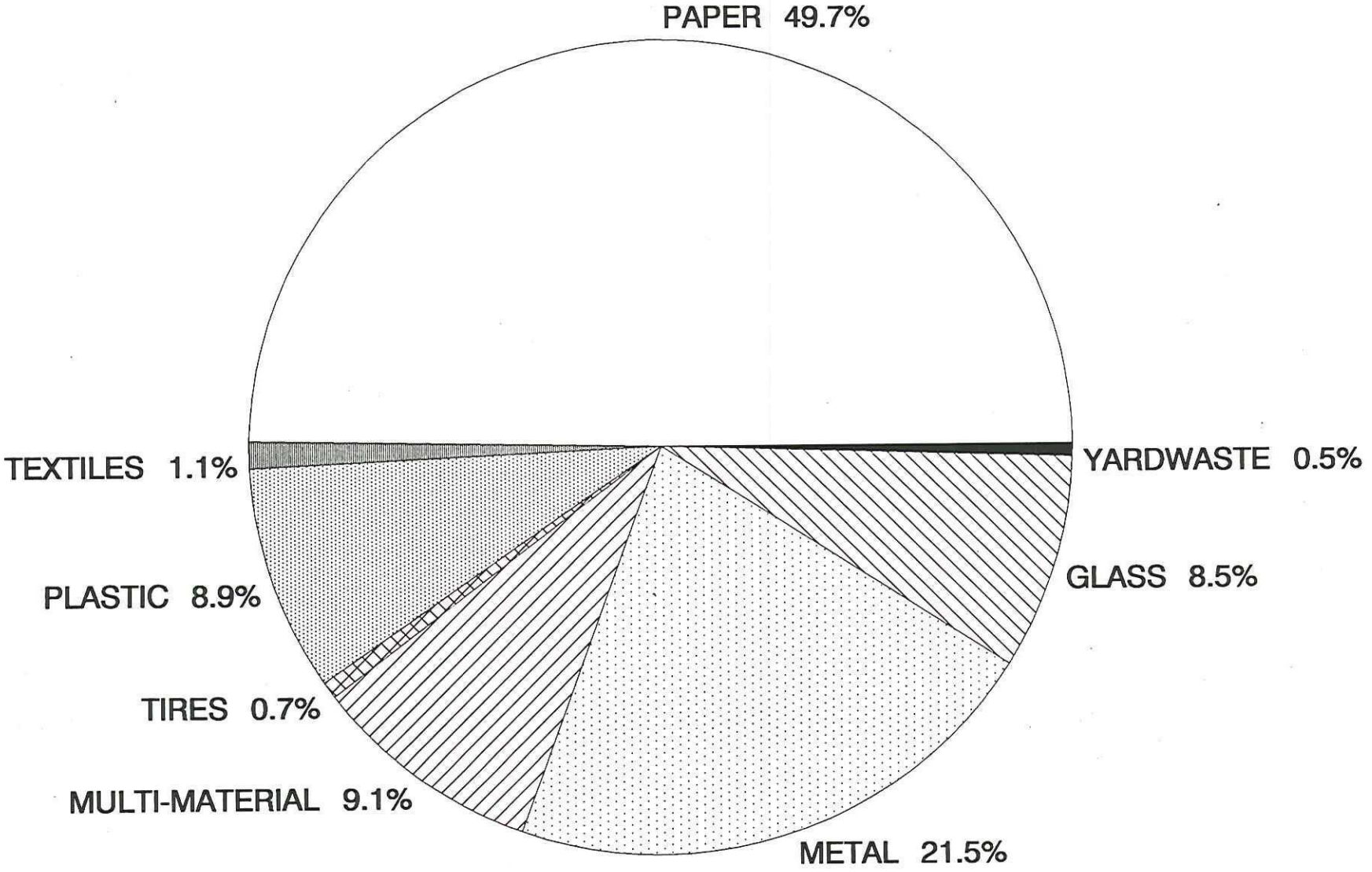


FIGURE 1-4

QUANTITIES PROCESSED AND MANUFACTURED

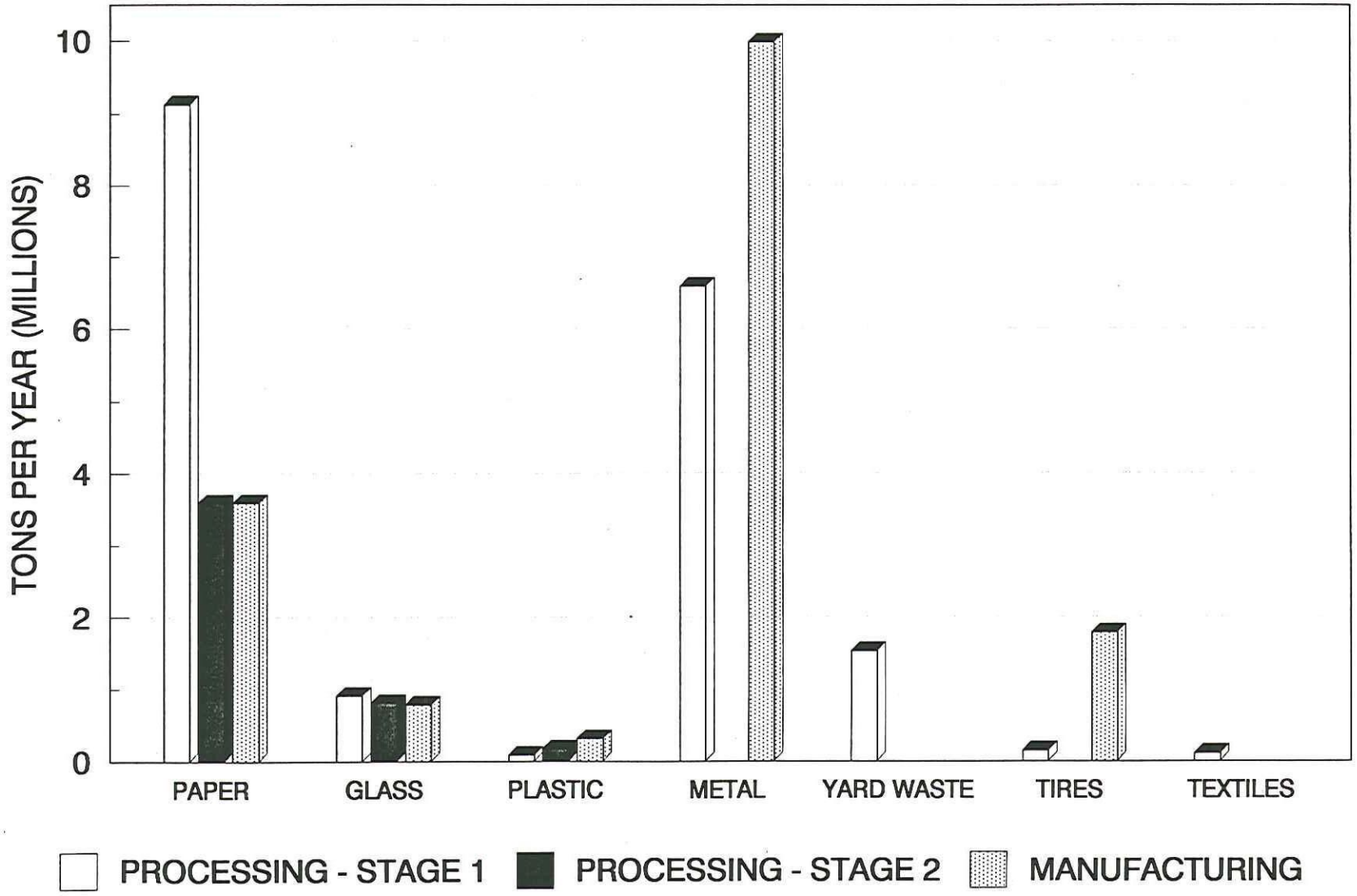


Table 1-2

Summary of Value Added

	CT VALUE ADDED (in 000's)	DE VALUE ADDED (in 000's)	ME VALUE ADDED (in 000's)	MA VALUE ADDED (in 000's)	NH VALUE ADDED (in 000's)	NJ VALUE ADDED (in 000's)	NY VALUE ADDED (in 000's)	PA VALUE ADDED (in 000's)	RI VALUE ADDED (in 000's)	VT VALUE ADDED (in 000's)	REGION VALUE ADDED (in 000's)
Paper Processing – 1st Stage	$40,709	$22,905	$22,159	$42,876	$14,439	$80,577	$162,823	$172,440	$6,286	$28,634	$593,848
Paper Processing – 2nd Stage	$183,972	$1,123	$114,560	$200,517	$98,194	$304,387	$333,958	$403,167	$0	$40,914	$1,680,793
Paper Manufacturing	($75,682)	$374	($33,340)	($70,838)	($31,813)	($80,704)	($59,126)	($65,909)	$0	($5,115)	($422,153)
TOTALS – PAPER	$148,999	$24,402	$103,379	$172,555	$80,820	$304,260	$437,655	$509,698	$6,286	$64,433	$1,852,488
Glass Processing – 1st Stage	$411	$97	$232	$306	$156	$725	$1,033	$1,868	$67	$331	$5,226
Glass Processing – 2nd Stage	$0	$0	$0	$3,456	$0	$5,618	$6,877	$6,974	$0	$2,325	$25,249
Glass Manufacturing	$13,471	$0	$0	$12,425	$0	$42,777	$50,337	$82,894	$0	$0	$201,904
TOTALS – GLASS	$13,882	$97	$232	$16,187	$156	$49,120	$58,247	$91,736	$67	$2,656	$232,379
Plastic Processing – 1st Stage	$902	$213	$509	$672	$343	$1,593	$2,269	$4,103	$147	$727	$11,480
Plastic Processing – 2nd Stage	$3,567	$594	$0	$10,224	$2,695	$12,206	$21,122	$50,726	$1,783	$3,606	$106,524
Plastic Manufacturing	$4,837	$9,496	$0	$19,807	$2,427	$2,569	$13,022	$61,972	$0	$1,612	$115,741
TOTALS – PLASTIC	$9,306	$10,303	$509	$30,704	$5,465	$16,368	$36,413	$116,801	$1,930	$5,946	$233,745
Metal Processing	$69,959	$16,950	$26,537	$61,341	$24,671	$154,400	$281,210	$300,716	$11,418	$16,263	$963,464
Ferrous Manufacturing	$37,477	$0	$0	$15,500	$0	$465,005	$195,646	$955,747	$0	$0	$1,669,375
Non–ferrous Manufacturing	$10,762	$0	$0	$8,208	$0	$293,482	$10,944	$820,246	$0	$0	$1,143,641
Aluminum Manufacturing	$0	$0	$0	$12,885	$0	$40,660	$126,274	$657,517	$0	$0	$837,335
TOTALS – METAL	$118,197	$16,950	$26,537	$97,934	$24,671	$953,546	$614,074	$2,734,225	$11,418	$16,263	$4,613,816
Yard Waste Processing	$6,365	$0	$19,096	$39,783	$0	$3,327	$3,906	$0	$6,365	$0	$78,843
Tire Processing	$1,406	$0	$4,136	$2,730	$1,406	$1,654	$14,062	$7,734	$0	$1,406	$34,536
Tire Manufacturing	$16,614	$10,799	$0	$26,998	$0	$4,154	$7,476	$41,535	$8,307	$0	$115,883
TOTALS – TIRES	$18,020	$10,799	$4,136	$29,728	$1,406	$5,808	$21,539	$49,269	$8,307	$1,406	$150,418
Textile Processing	$647	$0	$1,941	$3,406	$647	$1,294	$18,594	$10,761	$1,294	$0	$38,584
TOTALS – ALL MATERIALS	$315,416	$62,552	$155,830	$390,296	$113,166	$1,333,723	$1,190,427	$3,512,491	$35,668	$90,704	$7,200,274
VALUE ADDED BY MANUFACTURING SECTOR (1)	$23,832,000	$4,231,000	$5,428,000	$34,472,000	$5,647,000	$44,332,000	$81,625,000	$64,942,000	$5,140,000	$3,163,000	$272,812,000
RECYCLING AS PERCENT OF MANUFACTURING SECTOR	1.3%	1.5%	2.9%	1.1%	2.0%	3.0%	1.5%	5.4%	0.7%	2.9%	2.6%

NOTES:
(1) Source: 1993 Statistical Abstract of the United States

FIGURE 1-5

VALUE ADDED

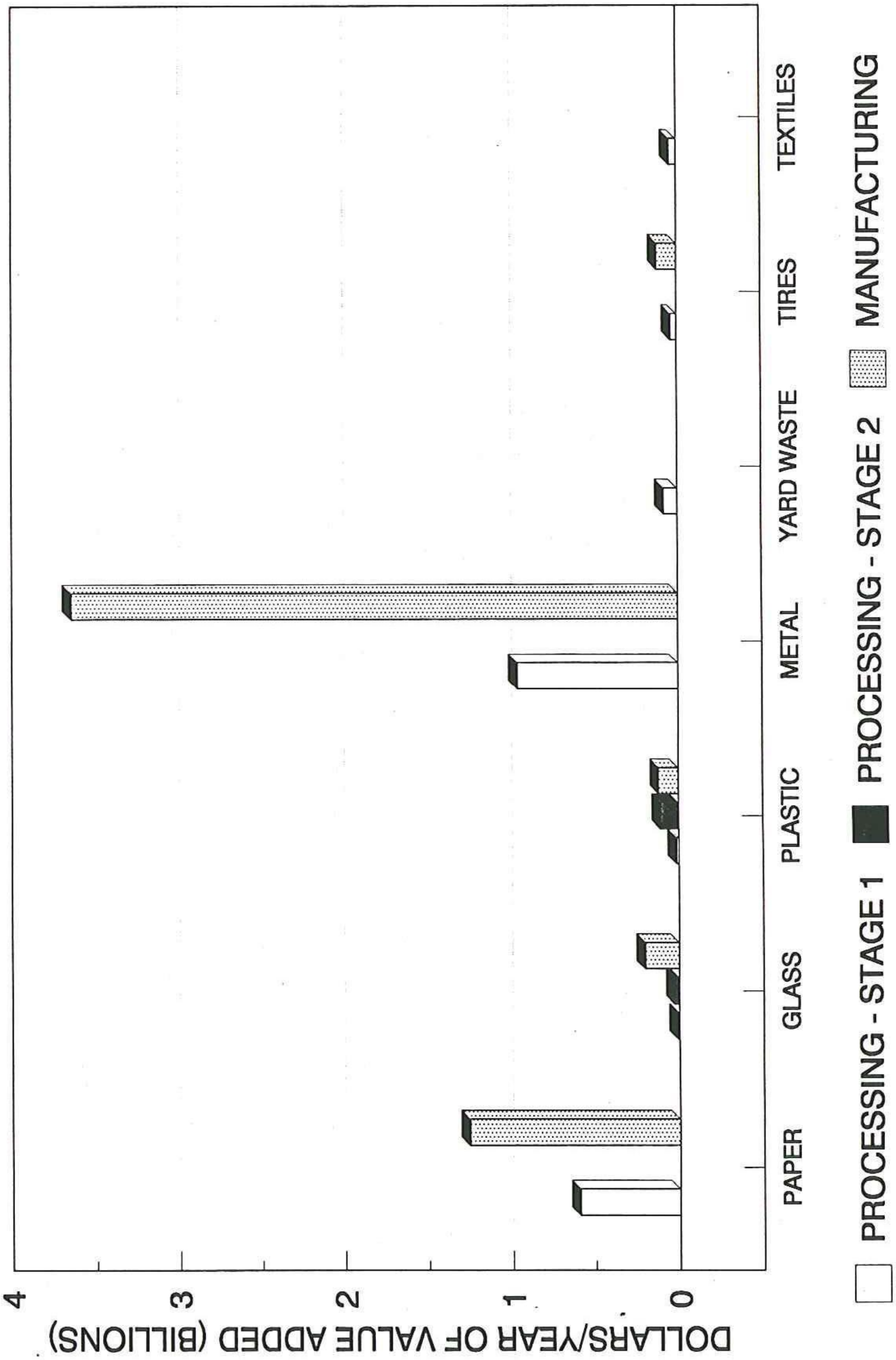


FIGURE 1-6

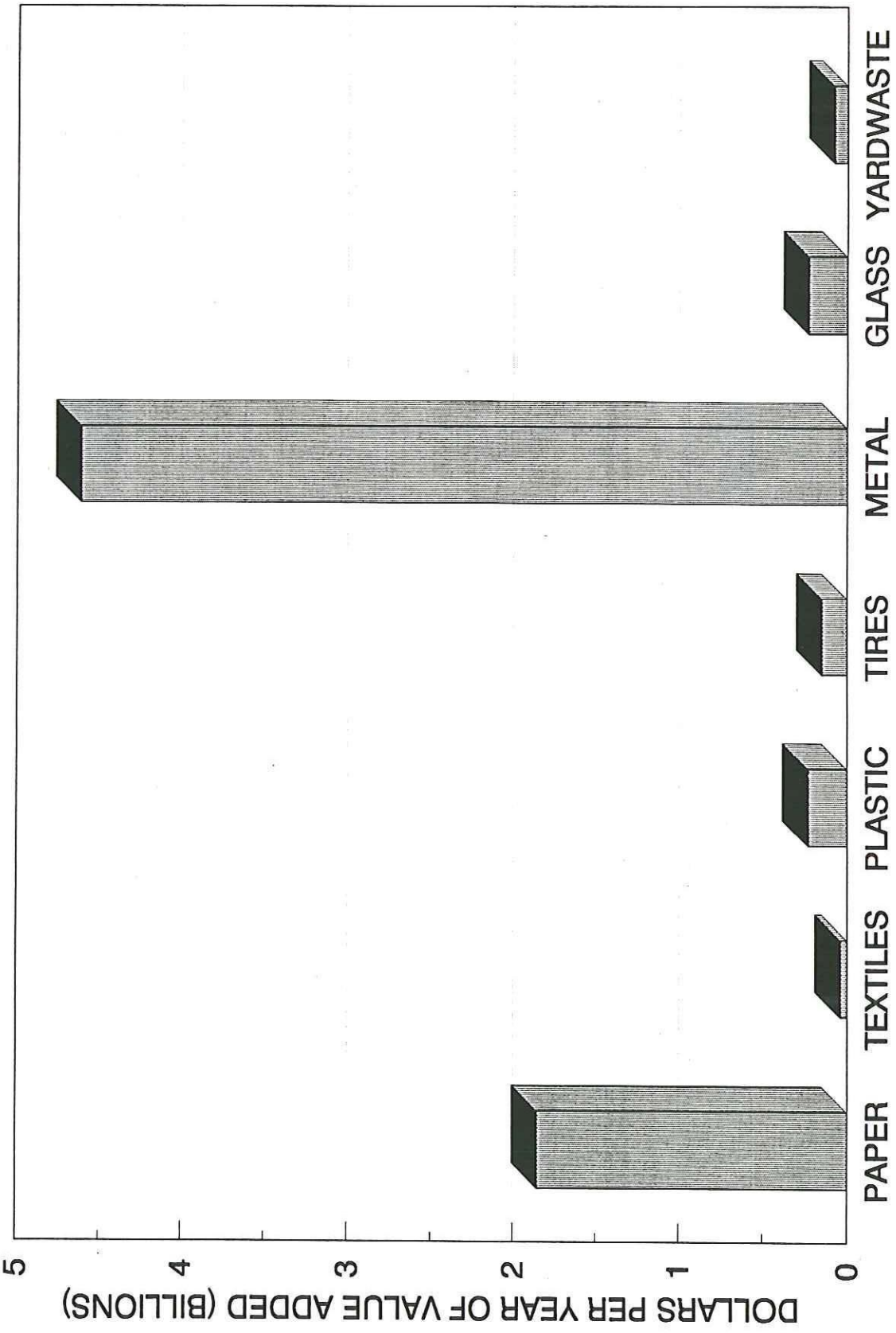
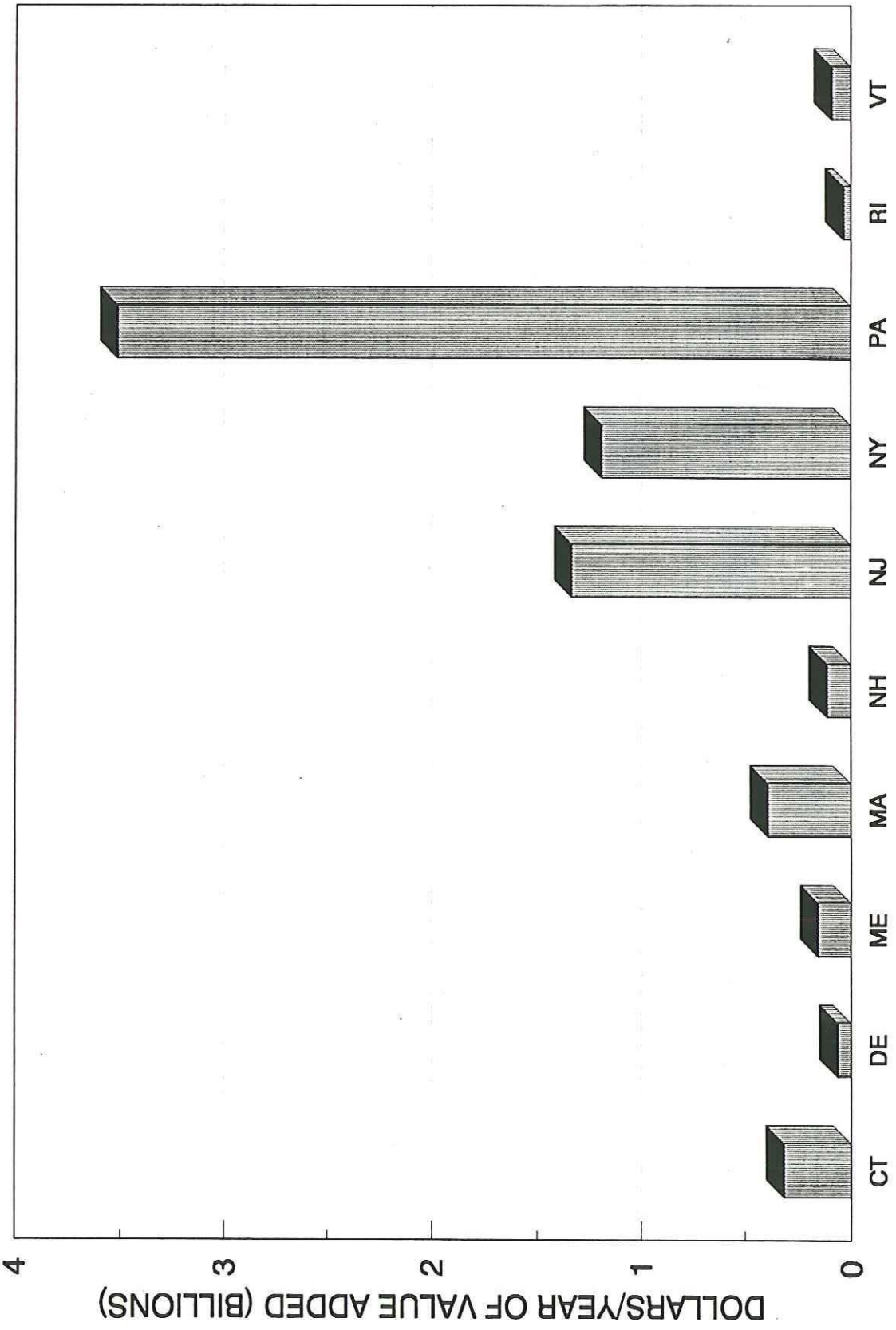

VALUE ADDED BY MATERIAL CATEGORY
DOLLARS PER YEAR OF VALUE ADDED (BILLIONS)
0
1
2
3
4
5
PAPER
TEXTILES
PLASTIC
TIRES
METAL
GLASS
YARDWASTE

FIGURE 1-7

VALUE ADDED BY STATE



SECTION 2

OVERVIEW OF METHODOLOGY

2.1 CONCEPTUAL APPROACH

Value added, as the term is used in this study, is a measurement of economic activity, and for this study is focused on the economic activity associated with recycling. There are two major conceptual approaches to the measurement of value added: one uses the increase in value of material as it progresses through stages of an industry as the measure of economic activity, and the second approach uses employment as the measure of economic activity. The primary approach in this study is the increase in material value, in which value added is measured by tracking the increase in prices paid for recyclable materials as they progress through the stages of recycling.

For each material and each recycling stage the value added, on a per-ton basis, is determined by calculating the difference between the price paid for the material at the start of the stage and the price paid after that stage. Recyclable material is assumed to have zero value prior to collection, and the value added during collection and processing is considered in aggregate, since these are often integrated functions preformed by the same companies. Thus, if the price for a certain material is $30 per ton after processing, it is assumed that $30 per ton of value has been added to the material through collection and processing. Similarly, if the same material has a price of $50 per ton after intermediate manufacturing, then it is calculated that $20 per ton of value had been added during manufacturing. By applying these per-ton figures to estimates of the quantities processed and manufactured, the total value added is determined.

It should be noted that although the value added through collection is included within the analysis (although it is combined with the value added through processing), all of the economic activity associated with collection is not included. This is because some of the economic activity associated with collection of recyclables does not add value, or at least does not add value equivalent to the cost of the activity. In other words, a community may invest $80 per ton to collect a certain recyclable material, but its value to a processor may still be zero. In this instance, the $80 per ton of economic activity is not included in the value added analysis.

This situation is a byproduct of the material value approach to the analysis. Only those activities which directly increase the value of a material are accounted for. This is a conservative approach to measuring economic activity associated with recycling.

2.2 ANALYTICAL BOUNDARIES

The starting point of this analysis is the point at which material is collected, and the value of all materials is assumed to be zero at that point. Since the purpose of this study is to quantify the economic activity associated with recycling and at this stage no economic activity has occurred, it is appropriate to assign the materials a value of zero, even though

certain materials may have some value at the point of collection (and some materials may be considered to have a negative value at this stage).

The ending points for the analysis of value added are more difficult to establish. Materials go through the processing and manufacturing stages differently, and there are also "philosophical" differences about what is appropriate to include as a recycling activity. The philosophical issues generally revolve around the question of how far along the manufacturing processes should one proceed before the determination that this is the end of the recycling activity. For instance, with relation to plastics, there is no disagreement that the processing of plastics to separate them and produce baled material is a recycling activity. In addition, the production of plastic pellets from the recycled feedstock is also generally agreed upon as appropriate to include in an economic analysis of recycling. However, if a toy manufacturer uses the plastic pellets to manufacture toys, should the economic activity associated with the toy manufacturing be included in this analysis?

The determination of appropriate end-points for analysis required considerable time and effort. Input was received from a review team of NERC staff and members at several points during the development of the analysis, and as a result of this input, as well as the information gathered during the analysis, the end-points established evolved over time. One of the key concepts used in the discussion of end-points was virgin equivalency. We have defined virgin equivalency as the point at which recycled materials have been processed to the point of achieving technical equivalency to virgin materials. In other words, this is the point at which, at least theoretically, virgin or recycled material could be used interchangeably, and thus any processing or manufacturing done after this point is not related to the fact that the material came from a recycled source. In the case of plastics, as discussed above, the pellets produced would be the point of virgin equivalency.

Originally, the approach was to utilize virgin equivalency as the end-point for all materials. This is a conservative approach, as some businesses that depend on recycled feedstocks would not be included. It was also found to be difficult to apply in certain instances. Paper is one example. Intermediate manufacturing (production of a material required for final manufacturing) and final manufacturing (production of a wholesale product) are often integrated into a single facility. Thus, in many instances in paper manufacturing there is no production of an intermediate virgin equivalent product (such as steel sheet in the case of ferrous metal) that is produced, sold and transferred to another facility. Even internal to a paper manufacturing facility it would be difficult to define the point at which a virgin material could be substituted for the recycled material, particularly without conducting a facility-by-facility analysis. Thus, for paper it was decided that the wholesale product that emerges from paper mills will be used as the end point for the determination of value added.

As analysis proceeded, and more feedback was received from the review team, it was determined that the notion of virgin equivalency would be applied as the end-point for processing, and that manufacturing would include the next stage of economic activity after achieving virgin equivalency. The result of this determination is that there are several materials for which there are two stages of processing: paper, plastics, and glass. In the first stage, an intermediate product is produced that can be sold or transferred, but has not yet

reached the stage of virgin equivalency. In the second stage of processing, the material is taken from this intermediate stage to virgin equivalency. For paper and plastics, the first stage of processing involves separation of materials and baling. In the case of glass, the first stage involves sorting by color. In the second stage of processing, the following are the end-points for these materials:

- Paper: A pulp that could be substituted for a pulp produced from virgin fiber is considered the end-point for processing. This is generally called deinked market pulp.

- Plastic: Pellets of a single resin are considered the end-point for processing.

- Glass: The end-point for processing is furnace-ready cullet since this material is the closest product to a virgin equivalent.

A summary of the end-points for processing and manufacturing is presented in Table 2-1.

There are also geographical boundaries to consider in this analysis. These boundaries correspond to the boundaries of the NERC region. However, since the goal is to measure economic activity within the region, whether or not that activity is attributable to the region's own wastes, these boundaries apply only to the location of the economic activity to be included or excluded and not to the source of recyclable material. In other words, in this analysis if a processing facility is located within the region, the value added by that facility will be included in the analysis even if the source of the material processed was outside of the region. Thus, one only needs to consider the location of facilities in determining which activities to include, and not the source of the recyclable material.

2.3 DETERMINATION OF QUANTITIES PROCESSED AND MANUFACTURED

Very little comprehensive quantitative data exists regarding recycled materials processed and manufactured. While there is a great deal of data available for individual components of the recycling industry, there is a lack of comprehensive data that is or can be compiled on a regional basis in a meaningful way. This is particularly true because the "recycling industry" is not a single industry and is diverse in nature. This was known at the start of the project through WESTON's other work and was confirmed by NERC members who indicated the lack of data necessary to support the analysis of value added. Therefore, quantitative data had to be assembled and generated specifically for this study before the analysis of value added could be performed.

The ideal approach to compiling the quantitative data needed would be to utilize data already synthesized for each material on a national or state-by-state basis. This data might then have to be broken down into sub-categories, but it would avoid the need to aggregate data from a myriad of sources. Unfortunately, the data needed to support this top-down approach does not exist, with the exception of paper manufacturing and, to a lesser degree, glass manufacturing. As a result, a bottom-up approach was developed, using data gathered from processors and manufacturers and extrapolating it through the use of employment data.

Table 2-1

Summary of End-Points For Recycling Stages

MATERIAL	MATERIAL STATUS AFTER PROCESSING	MATERIAL STATUS AFTER MANUFACTURING	EXPLANATION
PLASTICS	PET PELLETS HDPE PELLETS		Pellets represent a material equivalent to virgin. Manufacturing end–points, if any, will depend on specific manufacturers identified.
FERROUS METAL	SHREDDED WHITE GOODS BALED STEEL CANS BALED FERROUS SCRAP UNBALED FERROUS SCRAP	STEEL SHEET STEEL INGOT CAST STEEL	White goods are typically shredded during processing, while tin cans are typically baled. Other ferrous metals can be shipped to mills baled or unbaled. Detinners produce No. 1 detinned bundle as an end–product. Steel mills can produce steel sheets or ingots, while foundries produce cast steel.
PAPER	PULP SUBSTITUTES	NEWPRINT PRINTING & WRITING PAPER PACKAGING/IND. CONVERTING TISSUE KRAFT PAPERBOARD SEMI–CHEMICAL PAPERBOARD RECYCLED PAPERBOARD CONSTRUCTION PAPER/BOARD	Pulp substitutes represent a material equivalent to virgin. One or more types of pulp substitues will be used for all grades of paper, depending on availability of price information. Many types of paper are manufactured using recycled feedstocks, but the grades shown here are the ones for which quantitative data has been compiled.
GLASS	CLEAR CULLET (Furnace Ready) BROWN CULLET (Furnace Ready) GREEN CULLET (Furnace Ready) MIXED CULLET (Furnace Ready)	BEVERAGE CONTAINERS GLASSPHALT	Color–separated cullet is produced during processing. The vast majority of glass is used to produce beverage containers, so this will be the end–point considered for color–separated cullet. To the extent that glassphalt manufacturers are identified, the value added to mixed color cullet in this process can be estimated.
ALUMINUM CANS	BALED UBC FLATTENED UBC	ALUMINUM SHEET	Processing of aluminum cans typically results in baled or flattened cans. The vast majority of used aluminum cans are made into aluminum sheet.
NON–FERROUS SCRAP	BALED SCRAP UNBALED SCRAP		Non–ferrous scrap is handled in a variety of ways, since it represents a range of materials. If the major use of non–ferrous scrap in manufacturing in the region can be identified, that can be used as the end–point for manufacturing.
YARD WASTE	COMPOST		Compost is the end–point of yard waste processing, with no manufacturing stage. Only that compost which is sold will be included in the analysis.
TIRES	RETREADS SHREDDED TIRES CRUMB RUBBER	RUBBER MODIFIED ASPHALT	Only those tires shredded and crumbed for recycling or reuse will be counted. Production of rubber modified asphalt may not be signifcant enough to include.
TEXTILES	BALED TEXTILES UNBALED TEXTILES	RAGS USED CLOTHING	To the extent that baled or unbaled textiles are sorted and resold at the wholesale level for use as rags or used clothing, this "manufacturing" activity will be included.

In this approach, processing and manufacturing rates per employee are derived and applied to employment data in order to estimate the quantities of each material processed or manufactured. For each material a processing rate and a manufacturing rate are determined through surveys of processors and manufacturers (in combination with data of this type gathered previously). These rates can then be applied to the number of employees processing or manufacturing that material in each state.

In order to gather the employment data a database of recycling processors and manufacturers was compiled by a NERC intern (Carolyn Gradinsky), utilizing a variety of sources. For each state and each material a listing was developed of firms processing that material and manufacturing using that material. The listings for each state were sent to the Departments of Labor for each of the states for them to assemble employment data. The employment data gathered was incorporated into this study. The employment data gathered (as well as the way in which data gaps were filled) is described later in this report.

WESTON has recently completed a quantitative analysis of recycling in Massachusetts that involved the determination of processing rates per employee for a number of materials. This data was utilized in this study and as a result the surveying of recycling firms could focus on manufacturers and the processor types for which no data was available from the Massachusetts study. In addition, since it was known that the most significant contributor to value added in the region would likely be paper, approximately half of the total surveying time was devoted to paper manufacturers. The results of the surveying and the determination of processing and manufacturing rates are described later in this report.

The employment data and the processing and manufacturing rates were then combined to estimate the quantities of recyclable materials processed and used in manufacturing. This is done by multiplying the employment total for a particular state, material and recycling stage by the processing or manufacturing rate for that material. The only materials for which this approach was not utilized were for paper and glass. Since tonnage data has been compiled on a state-by-state basis for paper and glass manufacturing, this data was used in conjunction with survey results to characterize manufacturing without the use of a per-employee rate. The estimates of quantities of material processed and manufactured are described in Section 3 of this report.

2.4 CALCULATION OF VALUE ADDED

Once material quantities have been estimated, the additional data needed are prices for each material at the end of each processing and manufacturing stage. Data was gathered from national publications which publish prices paid for various recyclable and manufactured materials. To the extent possible, long-term averages for prices paid in the region were utilized. When sufficient data was available, two years of data were averaged, in order to minimize the impact of short-term deviation in price for a particular material.

The difference in value, on a per-ton basis, was calculated between each recycling stage for each material. For instance, if a material had a value of $30 per ton after the first stage of processing, $50 per ton after the second stage of processing, and $100 per ton after manufacturing, the following differentials would be determined: $30, $20 and $50 per ton.

The material would have increased in value $30 per ton during the first stage of processing, since it started out with a value of zero. It would have gained $20 per ton in value during the second stage of processing ($50 minus $30), and $50 per ton during manufacturing ($100 minus $50). Each of these differentials is applied to the quantity of material in that recycling stage.

It is important to recognize that the tonnage in each recycling stage is not linked to the tonnage in any other stage. Thus, there are typically different quantities of material estimated in each stage. This is because recyclable material often crosses state and national boundaries as it progresses through the stages of recycling. Since we are concerned only with the location of the recycling activity and not the source of the material, the quantity of a certain material processed in a state has nothing to do with the amount of the material manufactured in that state. Thus, care must be taken to apply the appropriate tonnage estimate to the appropriate value added differential. The results of this analysis are described in Section 4 of this report.

SECTION 3

DETERMINATION OF QUANTITIES RECYCLED

3.1 INTRODUCTION

In Section 2 of this report the methodological approach to the value added analysis is described. During actual application of the methodology numerous adjustments and modifications were made in order to accommodate the particular nature or lack of data derived. In this section the manner in which recyclable quantities were actually determined is described, along with the results. The determination of value added is described in Section 4.

In making the adjustments to methodology and filling the various data gaps encountered, judgement has to be applied. In order to guide these judgements, the following criteria were used:

- to the greatest extent possible, consult with NERC staff and members in the determination of approach;
- utilize adjustments and assumptions that are likely to produce conservative results;
- maintain conceptual consistency between adjustments and assumptions; and
- recognize the level of precision of the known data so that highly refined and complex assumptions or methodologies are not developed if they are not supported by the precision of the data.

3.2 DERIVATION OF EMPLOYMENT DATA

The first step in the quantification of materials recycled is a determination of employment. This is because the means for deriving quantities of material recycled involves application of processing and manufacturing rates to employment totals. As described in the methodological approach, lists of processors and manufacturers of recyclable materials were developed for each state by a NERC intern. These lists are presented in Appendix A of this report. The initial set of lists had separate categories for each material, with processors and manufacturers of each material presented separately. However, the lists had to be modified because of the manner in which employment data was to be developed.

The intent of the lists was to be able to determine the total number of employees that process each material and manufacture each material, on a state-by-state basis. The employment data was to be requested from state Departments of Labor that maintain files of employment data. However, it was known that in many states, due to confidentiality, employment data for individual firms could not be released, and if a category contained less than three firms, the total employment for that category could not be released.

Therefore, in order to ensure that employment for all firms was tabulated, the lists were modified to combine categories so as to ensure that there were at least three firms in each category.

In most instances employment data could not be determined for all firms. The Departments of Labor generally indicated a total employment for a particular category, and noted how many firms were missing from the total calculated. There are a number of reasons that a firm could be missing from the employment data tabulated. These include a misspelled company name, a firm operating under a different name, a firm going out of business, or a firm owned by another company.

Since considerable effort was expended during the compilation of the lists to ensure that the companies on that list were actual recycling businesses, it was deemed appropriate to try to adjust the state-supplied data to account for the missing firms. This was generally done by using an average employment per firm for the particular type of processor or manufacturer in question, based on data available through surveys of firms, and the employment data provided by the states for firms that were included. Thus if a total employment for glass manufacturers was given for a particular state, and it was noted that two firms on the list could not be located in the state's employment database, the average employment for glass manufacturers would be multiplied by two, and this total would be added to the state-reported total.

Although the manner in which gaps in employment data were filled is not the most conservative approach possible, we believe it is appropriate for a number of reasons. First, as mentioned previously, there was a strong belief that the firms on the list represented companies that were in existence and functioning. Thus, ignoring the data gaps would likely result in an underestimate of employment. Second, it has been pointed out by industry associations and others that some recycling businesses were not included in the lists developed. This means that any over-estimate of employment caused by filling data gaps would be at least partially offset by the employment missing due to certain firms not getting onto the lists. Third, an industry association has stated its belief that the employment data from Departments of Labor does not include all labor from small businesses, which would also offset any over-estimation caused by filling data gaps. Lastly, in compiling the data on average size of firms, a large number of firms were included in the average. In addition, as more firms were added to the list included in determining the average, the average changed only slightly. This is indicative of a statistically valid average.

The results of the estimates of employment for the region are provided in Table 3-1. The adjustments and assumptions used in preparing the estimates of employment are described in the footnotes to the table. The types of adjustments made (in addition to estimating employment for firms not included in state data) include dividing metal manufacturing employment into the three metal categories needed for the value added analysis; splitting an aggregated list of firms with more than one type of firm into the appropriate categories; incorporating survey data as appropriate; and using average employment per firm and number of firms in a list to estimate totals for lists for which states could provide no employment data.

Table 3-1

Summary of Employment Estimates

	CT	DE	ME	MA	NH	NJ	NY	PA	RI	VT	TOTALS
Paper Processing	138	323 [12]	60 [5]	377	30 [5]	434	1,668	351 [31]	15 [5]	20	3,416
Paper Manufacturing	1,794	65	7,190	6,102	1,827 [6]	3,595	10,734	15,814 [32]	0	815	47,936
Glass Processing	0	0	0	0	0	58	71	72 [1]	0	24 [1]	225
Glass Manufacturing	309 [14]	0	0	285 [20]	0	2,180	1,874	3,943	0	0	8,591
Plastic Processing	90 [10]	15 [10]	0	258	68 [7]	308	533	1,280 [33]	45 [10]	91	2,688
Plastic Manufacturing	273 [15]	536	0	1,118	137 [7]	145	735	3,498 [34]	0	91	6,533
Metal Processing	588	143	207	527	205	1,336	2,494	2,506 [35]	96 [27]	87	8,189
Ferrous Manufacturing	153 [16]	0	0	45 [2]	0	1,350 [24]	568 [29]	2,775 [36]	0	0	4,891
Non-Ferrous Manufacturing	59 [24]	0	0	45 [2]	0	1,609 [25]	60	4,497 [36]	0	0	6,270
Aluminum Manufacturing	0	0	0	45 [2]	0	142 [26]	441 [30]	2,296 [36]	0	0	2,924
Yard Waste Processing	44 [17]	0	132 [17]	275 [22]	0	23	27	0	44 [17]	0	545
Tire Processing	17 [3]	0	50 [3]	33 [3]	17 [3]	20 [13]	170	94 [37]	0	17 [3]	418
Tire Manufacturing	40 [18]	26	0	65 [21]	0	10 [13]	18	100 [18]	20 [18]	0	279
Textile Processing	19 [8]	0	57 [8]	100	19 [8]	38	546	316	38 [8]	0	1,133
Multi-material Processing	737 [38]	174 [11]	416	549	280 [9]	1,301	1,853	3,351 [38]	120 [28]	594 [4]	9,375
TOTAL EMPLOYMENT	4,261	1,282	8,112	9,824	2,583	12,549	21,792	40,893	378	1,739	103,413

NOTES:

General: Employment totals reported by states were adjusted to reflect estimated employment for firms not included in totals.

(1) Based on average employment of glass processors (24) and number of processors in state
(2) Total metal manufacturing employees split into 3 categories
(3) Based on average employment of tire processors (16.5) and number of processors in state
(4) 635 employees less estimated employment for glass and tire processors
(5) Based on average employment of paper processors (15) and number of processors in state
(6) 1857 employees less estimated paper processor employment
(7) 205 employees assumed to be split 1/3 processing, 2/3 manufacturing
(8) Based on average employment of textile processors (19) and number of processors in state
(9) 316 employees, less estimated employment for tire and textiles processors
(10) Based on average employment of plastic processors (15) and number of processors in state
(11) 165 employees plus estimated employment for one multi-material firm (24) not included in 165, less estimated employment for plastic processing
(12) 388 employees, less estimated paper manufacturing employment
(13) Aggregate of 30 employees for tire processing and manufactuing, split 2/3 processing, 1/3 manufacturing based on number of firms
(14) Based on average employment of glass manufacturers (309) and number of manufacturers in state
(15) Based on average employment of plastic manufacturers (91) and number of manufacturers in state .
(16) Aggregate estimate of 506 employees, less estimates for yard waste processing and glass manufacturing
(17) Based on average employment of yard waste processors (22) and number of processors in state
(18) Based on average employment of tire manufacturers (20) and number of manufacturers in state
(19) Aggregate estimate of 756 employees, less estimate for textile processing
(20) One glass manufacturer with known employment (285), other manufacturers identified not processing post-consumer cullet
(21) Single tire manufacturer identified during survey with employment reported to be 65
(22) Two firms with known employment (165), 5 assumed at average size of yard waste processors (22)
(23) Based on average employment of non-ferrous manufacturers (59) and number of manufacturers in the state
(24) Based on average employment of ferrous manufacturers (225) and number of manufacturers in state
(25) Aggregate of 3,101 employees for metal manufacturers, less estimates for ferrous and aluminum manufacturers
(26) Based on average employment of aluminum manufacturers (71) and number of manufacturers in state
(27) Based on average employment of metals processors (12) and number of processors in state
(28) Based on average employment of multi-material processors (24) and number of processors in state
(29) Two manufacturers with known employment, one assumed at average employment for ferrous metal manufacturers (225)
(30) Three manufacturers with known employment, one assumed at average employment for aluminum manufacturers (71)
(31) Seventeen firms with known employment, plus eight firms with emplyment based on average size of paper processors (15)
(32) Employment extrapolated from 34 to 40 firms based on known employment total for 34 firms.
(33) Known employment for 12 firms, five firms assumed to have average employment per firm of plastic processors (15)
(34) Known employment for 16 firms, three firms assumed to have average employment per firm of plastic manufacturers (91)
(35) Known employment for 143 firms, forty firms assumed to have average employment per firm of metal processors (12)
(36) Employment total of 9568 split 29% ferrous, 47% non-ferrous, 24 % aluminum, based on number of firms of each type
(37) Eleven firms with known total employment, five firms assumed to have average employment of tire processors (16.5)
(38) Seventy firms with known total employment, fifty one firms assumed to have average employment of multi-material processors (24)

The net result of this analysis is that for the ten states there are approximately 103,000 employees in firms processing recyclables and using recycled feedstocks in manufacturing. Pennsylvania is the largest employer, followed by New York, and then the three states of New Jersey, Massachusetts, and Maine (which have virtually identical employment totals). Manufacturing accounts for approximately 68 percent of the total employment in the region, and paper manufacturing accounts for approximately 67 percent of all manufacturing employment (or approximately 48 percent of total employment).

3.3 DEVELOPMENT OF PROCESSING AND MANUFACTURING RATES

Processing and manufacturing rates per employee need to be determined in order to enable use of employment data in the determination of quantities of recyclables processed and used in manufacturing. These rates were developed through surveying of processors and manufacturers in the region. Firms were contacted by telephone and asked to provide the number of employees in the firm (or at the particular facility being contacted if it was a firm with multiple locations) and the quantity of recyclable material processed or used in manufacturing per year. These two data items allow calculation of a processing or manufacturing rate per employee.

If a contact at a firm was forthcoming with this information, he or she was asked additional questions regarding the nature of the processes utilized at their facility, and the nature and value of the end-products produced. While there were many contacts made in which significant information was provided, it is the nature of this type of data gathering exercise that the majority of the contacts made resulted in no information at all. Many firms are reluctant to provide information because they believe that the type of information being requested is confidential, particularly with regard to the quantity of material processed or manufactured. In other instances they are unwilling to spend the time to gather the information, or it is not possible to make contact with a person who could provide the information desired.

It was important to prioritize the data gathering activity because of the effort required to gather the information. Since WESTON had conducted a similar exercise in Massachusetts focusing on processors of recyclables, gathering data from the types of firms already surveyed in the Massachusetts study was of the lowest priority. This allowed the data gathering for this project to focus on the manufacturers and those types of processors not already analyzed in the Massachusetts study. In addition, data gathering from paper manufacturers received the highest priority, since it was likely that paper manufacturing would be the component of the recycling industry that would contribute most significantly to the total value added through recycling in the region.

Thus, the approach to data gathering was to ensure that tonnage and employment data was derived from a minimum of three firms in each category (including the Massachusetts data) and to devote the rest of the data gathering effort to paper manufacturing firms. This resulted in approximately 50 percent of the total data gathering effort being devoted to paper manufacturing. It should be noted that at least one attempt was made to contact every manufacturer in every material category in the region, and the additional effort

devoted to paper manufacturing meant that time could be devoted to follow-up contacts to maximize the data gathered from this group of firms.

Table 3-2 summarizes the results of the surveying of processors and manufacturers. It can be seen that in three instances, the desired minimum of three firms providing data was not achieved: gas processors, non-ferrous manufacturers and tire manufacturers. In both instances the very small number of firms in the category meant that even with multiple attempts at data gathering it was not possible to gather data from three firms. While the small sample size used to derive the manufacturing rate for these categories means less confidence in the precision of the rate, the fact that there are so few firms of these types in the region indicates that the total contribution of these categories to the regional value added is less significant than for many of the other categories. As a result, the lack of precision in the manufacturing rates is of less concern than it would be for a major contributor to total value added.

Table 3-2 shows that the range in processing and manufacturing rates per employee is rather large. This is expected, given the many different materials and processes included. It is important to recognize, however, that the per employee rates are an intermediate set of data necessary for the next stage of analysis, but should not be considered an end result. It is also important to note that manufacturing rates were not determined for paper or glass manufacturing. This is because quantitative data has already been compiled for these industries such that the application of per employee rates is not necessary.

3.4 DETERMINATION OF QUANTITIES PROCESSED AND USED IN MANUFACTURING

The employment data compiled can be combined with the processing and manufacturing rates per employee to calculate the quantities of recyclables processed and used in manufacturing in the region. The results of this analysis are summarized in Table 3-3. For paper processing and manufacturing and glass and multi-material processing, specialized approaches were developed. These are discussed in greater detail below. All other categories of processing and manufacturing involved simple multiplication of per-employee rates and employment totals.

In determining the quantity of recyclables used in manufacturing, it is important to recognize that estimates were made of the quantities of recycled feedstocks used in manufacturing and not the total output from facilities that accept recycled material. This is critical because many manufacturing facilities that utilize recycled material use it as a portion of their total feedstock. Thus, if a facility used 20,000 tons of recycled feedstock and 80,000 tons of virgin feedstock to produce 100,000 tons of end-product (assuming no loss of material), this study only tracked the value added to the 20,000 tons of recycled feedstock, and the other 80 percent of production was not considered. This ensures that the value added calculation does not take "credit" for manufacturing processes not associated with recycled material.

Table 3-2

Summary of Processing and Manufacturing Rates Per Employee

Type of Firm	Number of Firms Providing Data[1]	Average Tons/ Employee/Year
Paper Processors	9	703
Paper Manufacturers	49	[2]
Glass Processors	2	3,100
Glass Manufacturers	5	[2]
Metal Processors	50	709
Ferrous Manufacturers	3	1,196
Aluminum Manufacturers	3	385
Non-Ferrous Manufacturers	1	480
Plastic Processors	3	64.2
Plastic Manufacturers	6	48.2
Yard Waste Processors	7	2,992
Tire Processors	8	352
Tire Manufacturers	2	6,390
Textile Processors	7	97.3
Multi-Material Processors	3	906

NOTES:

(1) Includes data from "Collection and Analysis of Quantitative Data Concerning Recyclables Processing in Massachusetts" by Roy F. Weston, Inc., February 1994.

(2) Ton per employee rates not utilized in determining total tonnage of paper or glass manufactured.

Table 3-3

Estimates of Quantities of Recyclables Processed and Manufactured

	CT	DE	ME	MA	NH	NJ	NY	PA	RI	VT	TOTALS
Paper Processing: 1st Stage											
Tons/Empl./Yr	703	703	703	703	703	703	703	703	703	703	
Employees	138	323 [12]	60 [3]	377	30 [3]	434	1,868	351 [32]	15 [3]	20	3,416
Total tons	97,014	227,069	42,180	265,031	21,090	305,102	1,172,604	246,753	10,545	14,060	2,401,448
Paper Manufacturing											
Tons/Empl./Yr											
Employees	1,794	65	7,190	6,102	1,827 [3]	3,595	10,734	15,814 [32]	0	815	47,936
Total tons	393,200	2,400	244,846	428,560	209,868	650,580	713,760	861,680	0	87,445	3,592,320
Glass Processing											
Tons/Empl./Yr	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	3,100	
Employees	0	0	0	0	0	58	71	72 [1]	0	24 [1]	225
Total tons	0	0	0	110,598 [32]	0	179,800	220,100	223,200	0	74,400	808,098
Glass Manufacturing											
Tons/Empl./Yr											
Employees	309 [14]	0	0	285 [29]	0	2,160	1,874	3,943	0	0	8,591
Total tons	52,213 [29]	0	0	48,157 [29]	0	165,800 [31]	195,100 [31]	321,290 [31]	0	0	782,560
Plastic Processing											
Tons/Empl./Yr	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	64.2	
Employees	90 [10]	15 [10]	0	258	68 [7]	308	533	1,280 [37]	45 [10]	91	2,688
Total tons	5,778	963	0	16,564	4,366	19,774	34,219	82,176	2,889	5,842	172,570
Plastic Manufacturing											
Tons/Empl./Yr	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	
Employees	273 [15]	536	0	1,118	137 [7]	145	735	3,498 [36]	0	91	6,533
Total tons	13,159	25,835	0	53,866	6,603	6,989	35,427	168,604	0	4,386	314,891
Metal Processing											
Tons/Empl./Yr	709	709	709	709	709	709	709	709	709	709	
Employees	588	143	207	527	205	1,336	2,494	2,508 [33]	96 [28]	87	8,189
Total tons	416,892	101,387	146,763	373,643	145,345	947,224	1,768,246	1,778,754	68,064	61,683	5,808,001
Ferrous Manufacturing											
Tons/Empl./Yr	1,198	1,198	1,198	1,198	1,198	1,198	1,198	1,198	1,198	1,198	
Employees	153 [16]	0	0	45 [3]	0	1,350 [25]	568 [33]	2,775 [40]	0	0	4,891
Total tons	182,988	0	0	53,820	0	1,614,600	679,328	3,318,565	0	0	5,849,301
Non-Ferrous Manufacturing											
Tons/Empl./Yr	480	480	480	480	480	480	480	480	480	480	
Employees	59 [24]	0	0	45 [3]	0	1,609 [26]	60	4,497 [40]	0	0	6,270
Total tons	28,320	0	0	21,600	0	772,320	28,800	2,158,541	0	0	3,009,581
Aluminum Manufacturing											
Tons/Empl./Yr	385	385	385	385	385	385	385	385	385	385	
Employees	0	0	0	45 [3]	0	142 [27]	441 [34]	2,298 [40]	0	0	2,924
Total tons	0	0	0	17,325	0	54,670	169,785	884,083	0	0	1,125,863
Yard Waste Processing											
Tons/Empl./Yr	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	
Employees	44 [17]	0	132 [17]	275 [22]	0	23	27	0	44 [17]	0	545
Total tons	123,200	0	369,600	770,000	0	64,400	75,600	0	123,200	0	1,526,000
Tire Processing											
Tons/Empl./Yr	352	352	352	352	352	352	352	352	352	352	
Employees	17 [3]	0	50 [3]	33 [3]	17 [3]	20 [13]	170	94 [41]	0	17 [3]	418
Total tons	5,984	0	17,600	11,616	5,984	7,040	59,840	32,912	0	5,984	146,960
Tire Manufacturing											
Tons/Empl./Yr	6,390	6,390	6,390	6,390	6,390	6,390	6,390	6,390	6,390	6,390	
Employees	40 [18]	26	0	65 [21]	0	10 [13]	18	100 [18]	20 [18]	0	279
Total tons	255,600	166,140	0	415,350	0	63,900	115,020	639,000	127,800	0	1,782,810
Textile Processing											
Tons/Empl./Yr	97.3	97.3	97.3	97.3	97.3	97.3	97.3	97.3	97.3	97.3	
Employees	19 [5]	0	57 [5]	100	19 [5]	38	548	316	38 [5]	0	1,133
Total tons	1,849	0	5,546	9,730	1,849	3,697	53,126	30,747	3,697	0	110,241
Multi-material Processing											
Tons/Empl./Yr	906	906	906	906	906	906	906	906	906	906	
Employees	737 [19]	174 [11]	416	549	280 [3]	1,301	1,853	3,351 [42]	120 [29]	594 [4]	9,375
Total tons	667,722	157,644	376,896	497,394	253,680	1,178,706	1,678,818	3,036,006	108,720	538,164	8,493,750
Tons Metal (23)	61,430	14,503	34,674	45,760	23,339	108,441	154,451	279,313	10,002	49,511	781,425
Tons Glass (23)	71,446	16,868	40,328	53,221	27,144	126,122	179,634	324,853	11,633	57,584	908,831
Tons Paper (23)	528,168	124,696	298,125	393,439	200,661	932,358	1,327,945	2,401,481	85,998	425,688	6,718,556
Tons Plastic (23)	6,677	1,576	3,769	4,974	2,537	11,787	16,788	30,360	1,087	5,382	84,938

Table 3-3

Estimates of Quantities of Recyclables Processed and Manufactured (Concluded)

NOTES:
(1) Based on average employment of glass processors (24) and number of processors in state
(2) Total metal manufacturing employees split into 3 categories
(3) Based on average employment of tire processors (16.5) and number of processors in state
(4) 635 employees less estimated employment for glass and tire processors
(5) Based on average employment of paper processors (15) and number of processors in state
(6) 1857 employees less estimated paper processor employment
(7) 205 employees assumed to be split 1/3 processing, 2/3 manufacturing
(8) Based on average employment of textile processors (19) and number of processors in state
(9) 316 employees, less estimated employment for tire and textiles processors
(10) Based on average employment of plastic processors (15) and number of processors in state
(11) 165 employees plus estimated employment for one multi-material firm (24) not included in 165, less estimated employment for plastic processing
(12) 388 employees, less estimated paper manufacturing employment
(13) Aggregate of 30 employees for tire processing and manufactuing, split 2/3 processing, 1/3 manufacturing based on number of firms
(14) Based on average employment of glass manufacturers (309) and number of manufacturers in state
(15) Based on average employment of plastic manufacturers (91) and number of manufacturers in state
(16) Aggregate estimate of 506 employees, less estimates for yard waste processing and glass manufacturing
(17) Based on average employment of yard waste processors (22) and number of processors in state
(18) Based on average employment of tire manufacturers (20) and number of manufacturers in state
(19) Aggregate estimate of 756 employees, less estimate for textile processing
(20) One glass manufacturer with known employment (285), other manufacturers identified do not utilize post-consumer cullet
(21) Single tire manufacturer identified during survey with employment reported to be 65
(22) Two firms with known employment (165), 5 assumed at average size of yard waste processors (22)
(23) Total tonnage of multi-material processors split into material categories based on data from facilities reporting material quantities
(24) Based on average employment of non-ferrous manufacturers (59) and number of manufacturers in the state
(25) Based on average employment of ferrous manufacturers (225) and number of manufacturers in state
(26) Aggregate of 3,101 employees for metal manufacturers, less estimates for ferrous and aluminum manufacturers
(27) Based on average employment of aluminum manufacturers (71) and number of manufacturers in state
(28) Based on average employment of metals processors (12) and number of processors in state
(29) Based on average employment of multi-material processors (24) and number of processors in state
(30) Estimate of New England cullet use prepared by Resource Management Associates, split between Massachusetts and Connecticut based on glass manufacturing employment
(31) Resource Management Associates estimate
(32) Estimate of total glass processed, less estimate of glass processed by multi-material processors
(33) Two manufacturers with known employment, one estimated based on average employment of ferrous manufacturers (225)
(34) Three manufacturers with known employment, one estimated based on average employment of aluminum manufacturers (71)
(35) Seventeen firms with known employment, plus eight firms with emplyment based on average size of paper processors (15)
(36) Employment extrapolated from 34 to 40 firms based on known employment total for 34 firms.
(37) Known employment for 12 firms, five firms assumed to have average employment per firm of plastic processors (15)
(38) Known employment for 16 firms, three firms assumed to have average employment per firm of plastic manufacturers (91)
(39) Known employment for 143 firms, forty firms assumed to have average employment per firm of metal processors (12)
(40) Employment total of 9568 split 29% ferrous, 47% non-ferrous, 24 % aluminum, based on number of firms of each type
(41) Eleven firms with known total employment, five firms assumed to have average employment of tire processors (16.5)
(42) Seventy firms with known total employment, fifty one firms assumed to have average employment of multi-material processors (24)

3.4.1 Paper Processing and Manufacturing

Processing

The processing of paper was broken down into two stages. In the first stage processors produce sorted paper of various grades (usually baled), and in the second stage paper mills convert that paper into pulp. Two separate sets of analyses were used to estimate the quantities of these materials. To estimate the quantity of paper processed the number of employees at firms processing paper was multiplied by the processing rate for paper. (It is important to note that paper is also processed by multi-material processors, and the estimate of this quantity is discussed in the section on multi-material processing).

In the second stage of processing, the material is being handled by paper mills, and so the quantity of paper processed in the first stage is not necessarily related to the quantity processed in the second stage, and a separate approach is required. The first step in this approach is to determine total wastepaper consumption by paper mills. This was done using the data gathered through surveying of paper mills, as well as data compiled by the American Forest and Paper Association (AFPA), the New York State Department of Economic Development, and the Lockwood-Post Directory.

Table 3-4 summarizes the data compiled from surveys and other sources. The information in the "Other Data" column includes not only mill-by-mill data compiled by New York State, but also AFPA statewide totals for wastepaper consumed. The end-point for the second stage of processing is pulp produced from wastepaper. Since there is no basis for assigning values to pulps produced from different wastepaper sources or for different grades of paper being produced, a single pulp price was utilized in the determination of value added by the second stage of paper processing. At this stage of the analysis, the only quantity that is necessary is the amount of pulp produced.

Based on discussions with NERC staff, NERC members involved in the project, and industry representatives, as well as review of existing literature, it was determined that the most accurate basis for estimating this total quantity of pulp produced was to utilize the AFPA totals for wastepaper consumption for each state. These quantities were reduced by 20 percent, based on the assumption that 20 percent of the incoming wastepaper fiber is lost during processing. In addition, for certain states, AFPA only reports total for a combination of states. Thus, a combined total is reported for Maine, New Hampshire, and Vermont. The combined total of approximately 542,000 tons was split amongst the three states based on the relative mill capacity of each state (as reported in Lockwood-Post). The adjusted statewide totals are reported in Table 3-3.

Manufacturing

For paper manufacturing the total quantity manufactured is the same as the quantity of pulp produced. Thus, no additional calculations are necessary to determine total paper produced. It should be noted, however, that to actually implement the value added analysis a breakdown of the types of paper produced is necessary. It is at this stage of analysis that the mill-by-mill data is particularly useful, since it allows a specific quantity of paper

Table 3-4

Compilation of Paper Manufacturing Data

		MATERIAL RECEIVED					MATERIAL PRODUCED									SURVEY RESULTS		OTHER DATA		COMBINED DATA	
		MIXED	ONP	OCC	PULP SUBS	HGD	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TONS	EMPLOYEES	TONS	EMPLOYEES	TONS	EMPLOYEES
FEDERAL PAPERBOARD	CT	X	X	X	X	X							X								
KIMBERLY-CLARK	CT				X			X									1,300				1,300
LYDALL	CT		X										X								
RAND-WHITNEY	CT	X	X	X	X	X							X								
SIMKINS	CT	X	X	X	X								X			540,000	67			(1)	67
STONE CONTAINER	CT			X								X				113,620	97			113,620	97
STATE TOTALS																653,620	1,464	491,500	1,794	113,620	1,464
JAMES RIVER	DE				X										X	3,000	65			3,000	65
STATE TOTALS																3,000	65			3,000	65
BOWATER	ME	X	X				X									140	1,400			140	1,400
EASTERN FINE PAPER	ME				X				X						X	13,000	450			13,000	450
GEORGIA PACIFIC	ME				X										X						
JAMES RIVER	ME				X			X													
KEYES FIBER	ME	X	X													35,000	450			35,000	450
LINCOLN PULP AND PAPER	ME				X			X							X						
MADISON	ME														X						
OTIS SPECIALTY	ME	X																			
SCOTT PAPER (SKOWHEGAN)	ME				X			X							X						
SCOTT PAPER (WINSLOW)	ME				X	X															
STATLER	ME			X	X			X								65,000	600			65,000	600
S.D. WARREN	ME	X			X									X	X		1,500				1,500
WOOD FIBER IND.	ME		X							X							175				175
YORKTOWNE PAPER	ME	X	X	X	X				X				X			20,800	60			20,800	60
STATE TOTALS																133,940	4,635			133,940	4,635

Table 3-4

Compilation of Paper Manufacturing Data (Continued)

		MATERIAL RECEIVED					MATERIAL PRODUCED									SURVEY RESULTS		OTHER DATA		COMBINED DATA	
		MIXED	ONP	OCC	PULP SUBS	HGD	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TONS	EMPLOYEES	TONS	EMPLOYEES	TONS	EMPLOYEES
AMERICAN TISSUE	MA				X												77				77
CASCADES DIAMOND	MA		X														250				250
CRANE	MA				X	X											1,300				1,300
CROCKER TECHNICAL	MA					X											52				52
DECORATIVE SPECIALITIES	MA		X		X												200				200
ERVING PAPER	MA				X	X											225				225
ESLEEK MAN.	MA				X	X											125				125
HAVERHILL	MA	X	X	X	X												250				250
INTERNATIONAL PAPER	MA																				
JAMES RIVER (ADAMS)	MA				X										X		115				115
JAMES RIVER (FITCHBURG)	MA	X	X	X					X								212				212
KIMBERLY-CLARK	MA				X										X		325				325
MEAD	MA								X												
MERRIMAC (E. PEPPEREL)	MA	X															118				118
MERRIMAC (LAWRENCE)	MA	X	X						X						X		145				145
NEWARK ATLANTIC	MA	X	X	X	X								X			93,000	120			93,000	120
NEWARK BOXBOARD	MA	X	X	X													65				65
PARSONS	MA														X						
PATRIOT PAPER	MA				X	X									X						
PERKIT FOLDING BOX	MA	X	X	X	X								X				75				75
PWA ROLLAND DECOR	MA								X												
RISING PAPER	MA				X												160				160
SEAMAN PAPER	MA					X									X		100				100
SONOCO	MA	X	X	X	X				X				X				150				150
SOUTHWORTH	MA					X											270				270
STRATHMORE	MA					X											950				950
TEXON	MA					X											120				120
WESTFIELD RIVER	MA				X				X								130				130
STATE TOTALS																93,000	5,534	535,700		93,000	5,534
APC CORP.	NH	X	X	X	X				X							22,865	50			22,865	50
ASHUELOT PAPER	NH				X	X		X	X												
BROWN PRODUCTS	NH			X					X												
COY	NH								X												
GE ROBERTSON	NH	X			X			X								2,500	30			2,500	30
GROVETON PAPERBOARD	NH			X							X				X						
JAMES RIVER (BERLIN)	NH	X	X		X	X															
JAMES RIVER (GROVETON)	NH				X			X							X						
LYDALL	NH				X																
PAPER SERVICE	NH							X													
PAPERTECH	NH	X	X	X	X								X			25,200	55			25,200	55
PENACOOK FIBRE	NH		X	X												1,000	10			1,000	10
STATE TOTALS																51,565	145			51,565	145

Table 3-4

Compilation of Paper Manufacturing Data
(Continued)

		MATERIAL RECEIVED					MATERIAL PRODUCED									SURVEY RESULTS		OTHER DATA		COMBINED DATA	
		MIXED	ONP	OCC	PULP SUBS	HGD	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TONS	EMPLOYEES	TONS	EMPLOYEES	TONS	EMPLOYEES
CAMDEN PAPERBOARD	NJ	X	X	X									X			56,400	72			56,400	72
CUSTOM PAPERS (H'ville)	NJ								X						X						
CUSTOM PAPERS (W. Glen)	NJ				X				X						X		200				200
DAVEY CO.	NJ	X			X						X					23,400	70			23,400	70
GARDEN STATE	NJ		X				X									230,000	300			230,000	300
GARWOOD	NJ												X								
GEORGIA-PACIFIC	NJ		X	X									X								
HOMASOTE CO.	NJ		X							X						28,300	250			28,300	250
JAMES RIVER (GARWOOD)	NJ				X											*	*			*	*
JAMES RIVER (MILFORD)	NJ				X				X						X	4,000	400			4,000	400
LOWE	NJ												X								
MAFCOTE IND.	NJ	X	X	X																	
MARCAL PAPER	NJ				X	X		X								95,000	1,000			95,000	1,000
NEWARK BOXBOARD	NJ	X	X	X									X								
PAPER BOARD SPECIALTIES	NJ	X	X	X	X								X								
RECYCLED PAPER BOARD	NJ	X	X	X									X			65,000	130			65,000	130
SIMKINS IND.	NJ		X	X	X																
USG CORP	NJ	X	X	X	X								X								
STATE TOTALS																502,100	2,422	813,200		502,100	2,422

Table 3-4

Compilation of Paper Manufacturing Data (Continued)

		MATERIAL RECEIVED					MATERIAL PRODUCED									SURVEY RESULTS		OTHER DATA		COMBINED DATA	
		MIXED	ONP	OCC	PULP SUBS	HGD	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TONS	EMPLOYEES	TONS	EMPLOYEES	TONS	EMPLOYEES
ARMSTRONG WORLD	NY		X	X					X								300				300
BIO-TECH	NY							X													
BROWNVILLE SPECIALTY	NY	X	X	X	X								X		X	14,300	60	18,300		14,300	60
BUFFALO PAPERBOARD	NY									X						62,400	100			62,400	100
BURROWS (LITTLE FALLS)	NY				X				X						X			3,800		3,800	
BURROWS (LYONSDALE)	NY				X			X	X						X						
CASCADES NIAGRA	NY			X							X		X			120,000	130	80,000		120,000	130
CHAMPION INT.	NY				X	X															
CLIMAX MFG.	NY	X	X	X	X								X			40,000	85	41,000		40,000	85
COLUMBIA (CHATHAM)	NY												X			21,000	100	25,000		21,000	100
COLUMBIA (WALLOOMSAC)	NY												X			21,000	100	25,000		21,000	100
DECORATIVE SPECIALTY	NY																	1,000		1000	
DOMTAR GYPSUM	NY		X	X	X								X					63,000		63,000	
EASTMAN KODAK	NY																	12,000		12000	
ENCORE	NY							X								100,000	300	72,000		100,000	300
FINCH PRUYN	NY				X										X						
FLOWER CITY	NY							X	X									5,100		5,100	
FORT ORANGE	NY	X	X	X	X	X					X		X			36,000	250	39,000		36,000	250
GEORGIA-PACIFIC	NY					X		X													
HOLLINGSWORTH VOSE	NY																	1,260		1260	
INTERNATIONAL (CORINTH)	NY				X									X		20,000	600	10,800		20,000	600
INTERNATIONAL (OSWEGO)	NY				X										X	2,800	90			2,800	90
INTER. (TICONDEROGA)	NY				X										X			3,000		3,000	
JAMES RIVER (CARTHAGE)	NY	X		X	X			X								39,000	300	60,000		39,000	300
JAMES RIVER (S. GLEN FALLS	NY		X			X		X													
KNOWLTON-WATERTOWN	NY																	150		150	
LAFAYETTE PAPER	NY											X				65,000	57			65,000	57
LYDALL	NY								X							1,800	70			1,800	70
LYONS FALLS	NY														X						
MARTISCO PAPER	NY		X	X					X								23	4,200		4,200	23
MCINTYRE PAPER	NY	X	X					X									25	3,000		3,000	25
MOHAWK PAPER	NY		X		X										X		315	5,000		5,000	315
MOHAWK VALLEY	NY				X				X						X						
NORFOLK PAPER	NY				X				X									38,000		38,000	
NORTH END - FULTON	NY																	500		500	
PACKAGING CORP.	NY		X		X											12,000	130	8,000		12,000	130
RED HOOK PAPER	NY												X			2,880	9	5,000		2,880	9
SCHOLLER TECH.	NY				X				X						X						
SCOTT PAPER	NY				X			X										3,500		3,500	
SONOCO	NY	X	X	X									X			20,000	41	21,000		20,000	41
SPECIALTY PAPERBOARD	NY	X	X	X	X				X												
SPECIALTY (LEWIS)	NY	X	X	X	X				X				X					8,550		8,550	
STEVENS & THOMPSON	NY					X		X										22,800		22,800	
STORA PAPYRUS	NY				X													15,200		15,200	
TAGSONS PAPER	NY	X	X	X	X	X		X								7,200	300	25,200		7,200	300
USG	NY	X	X	X	X								X					36,000		36,000	
STATE TOTALS																585,360	3,385	656,160	0	611,220	3,385

Table 3-4

Compilation of Paper Manufacturing Data (Concluded)

		MATERIAL RECEIVED					MATERIAL PRODUCED									SURVEY RESULTS		OTHER DATA		COMBINED DATA	
		MIXED	ONP	OCC	PULP SUBS	HGD	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TONS	EMPLOYEES	TONS	EMPLOYEES	TONS	EMPLOYEES
AMERICAN PAPER	PA		X	X		X							X								
BRANDYWINE	PA	X	X	X	X				X				X								
CARAUSTAR IND.	PA	X	X	X	X																
CONNELLY CONT.	PA			X								X	X			48,000	65			48,000	65
DAVEY	PA	X			X								X			23,400	64			23,400	64
HENRY MOLDED	PA																				
INTERSTATE CONT.	PA			X									X			9,000	130			9,000	130
INT'L HAMMERMILL (ERIE)	PA				X										X	27,300	1,100			27,300	1,100
INT'L HAMMER. (LOCKHAVEN)	PA				X	X									X		660				660
JEFFERSON SMURFIT	PA	X	X	X	X																
NATIONAL GYPSUM	PA	X	X	X									X								
NEWMAN	PA	X	X	X	X								X			50,000	100			50,000	100
PENNTECH	PA														X						
POPE AND TALBOT	PA					X		X									100				100
PROCTER & GAMBLE	PA				X			X													
READING	PA												X								
ROCK-TENN	PA	X	X	X	X								X			840,000	102			840,000	102
SCOTT PAPER	PA		X		X			X													
SEALED AIR (MODENA)	PA			X	X				X							20,000	28			20,000	28
SEALED AIR (READING)	PA			X					X							20,000	30			20,000	30
SHYROCK	PA	X														6,500	47			6,500	47
SIMPSON	PA				X										X						
SONOCO	PA	X	X	X									X								
STONE CONTAINER	PA	X	X	X		X			X		X		X								
TARKETT	PA									X											
WESTAVCO	PA	X												X	X						
WOODSTREAM	PA																				
YORKTOWNE PAPER	PA	X	X	X	X								X								
STATE TOTALS																1,044,200	2,426	1,077,100		1,044,200	2,426
CPM INC	VT	X	X	X	X				X						X						
PUTNEY PAPER	VT	X	X	X				X	X							11,000	115			11,000	115
ROCK-TENN	VT	X	X	X	X								X			60,000	160			60,000	160
SIMPSON	VT				X				X						X						
SPECIALTY PAPER BOARD	VT	X		X	X				X				X			35,000	250			35,000	250
STATE TOTALS																106,000	525			106,000	525

(1) The 540,000 tons of wastepaper consumption reported by Simkins is believed to be incorrect, based on data available regarding the size and capacity of that mill. Therefore, this quantity was not utilized in the final analysis.

produced by a mill to be related to a type of paper produced. Nine categories of paper production were established, based on the combination of the type of data available regarding production at the mills, and the price data available to assign values to categories of paper product. The nine categories are as follows:

- newsprint,
- tissue,
- kraft paper,
- linerboard,
- kraft board,
- corrugating medium,
- recycled boxboard,
- coated printing and writing paper, and
- uncoated printing and writing paper.

As described earlier, mill-by-mill data was compiled from surveys and literature. As shown in Table 3-4, this data also indicates the type of end-products produced by each mill. Thus, the mill-by-mill data allowed wastepaper consumptions reported for these mills to be assigned to one or more of these end-product categories. In those instances in which mills were reported to produce paper in more than one of the end-product categories, the wastepaper consumption was split evenly between the categories. Since the mill-by-mill data could not be compiled for all mills, a procedure had to be devised to assign the tonnage for the remaining mills to end-product categories.

After pursuing numerous options about how to fill this data gap, it was determined that the best approach involved assuming that the difference between the mill-by-mill total and the AFPA total for each state was in the production of newsprint or tissue, depending on the types of mills in each state. The rationale for this approach is two-fold. First, the AFPA total wastepaper consumption is believed to be the most accurate comprehensive data of this type that is available. Second, since newsprint and tissue have the lowest value of the grades of paper produced, a conservative estimate of value added would result, by assuming that all mills without specific data produce tissue and/or newsprint.

In application, the totals from the mill-specific data were determined, and then the difference between these totals and the AFPA estimates were determined. If the mills for which no specific data were available in a particular state included mills that produced tissue, then all of the calculated differential was applied to the tissue category. The same principle would be applied if the mills with no specific data included mills that produced newsprint. If both newsprint and tissue were produced by the mills without specific data, the differential in totals was split evenly between newsprint and tissue. The results of these assumptions and procedures are summarized in Table 3-5.

Note that in carrying over the results from Table 3-4, data from mills that provided tonnage data was not included in the survey data in Table 3-5, if no information was available regarding the end-products produced by the mill. As a result, the survey data totals in Table 3-5 differ from those in Table 3-4 in certain instances.

WESTON MANAGERS DESIGNERS CONSULTANTS

Table 3-5

Paper Production Estimates

	NEWS	TISSUE	KRAFT PAPER	LINER-BOARD	KRAFT BOARD	CORR. MED.	REC'D BOXBD.	COATED PRINT.	UNCTD PRINT.	TOTALS
CONNECTICUT										
Survey Data (1)	0	0	0	0	0	113,620	0	0	0	113,620
Estimates	0	377,880	0	0	0	0	0	0	0	377,880
Consumption Totals	0	377,880	0	0	0	113,620	0	0	0	491,500
Production Totals	0	302,304	0	0	0	90,896	0	0	0	393,200
DELAWARE										
Survey Data (1)	0	0	0	0	0	0	0	0	3,000	3,000
Estimates	0	0	0	0	0	0	0	0	0	0
Consumption Totals	0	0	0	0	0	0	0	0	3,000	3,000
Production Totals	0	0	0	0	0	0	0	0	2,400	2,400
MAINE										
Survey Data (1)	140	65,000	16,900	0	0	0	10,400	0	6,500	98,940
Estimates	103,559	103,559	0	0	0	0	0	0	0	207,118
Consumption Totals	103,699	168,559	16,900	0	0	0	10,400	0	6,500	306,058
Production Totals	82,959	134,847	13,520	0	0	0	8,320	0	5,200	244,846
MASSACHUSETTS										
Survey Data (1)	0	0	0	0	0	0	93,000	0	0	93,000
Estimates	0	442,700	0	0	0	0	0	0	0	442,700
Consumption Totals	0	442,700	0	0	0	0	93,000	0	0	535,700
Production Totals	0	354,160	0	0	0	0	74,400	0	0	428,560
NEW HAMPSHIRE										
Survey Data (1)	0	2,500	22,865	0	0	0	25,200	0	0	50,565
Estimates	0	211,770	0	0	0	0	0	0	0	211,770
Consumption Totals	0	214,270	22,865	0	0	0	25,200	0	0	262,335
Production Totals	0	171,416	18,292	0	0	0	20,160	0	0	209,868
NEW JERSEY										
Survey Data (1)	230,000	95,000	2,000	28,300	23,400	0	121,400	0	2,000	502,100
Estimates	155,550	155,550	0	0	0	0	0	0	0	311,100
Consumption Totals	385,550	250,550	2,000	28,300	23,400	0	121,400	0	2,000	813,200
Production Totals	308,440	200,440	1,600	22,640	18,720	0	97,120	0	1,600	650,560
NEW YORK										
Survey Data (1)	0	178,050	52,625	62,400	78,000	65,000	293,285	20,000	19,750	769,110
Estimates	0	123,090	0	0	0	0	0	0	0	123,090
Consumption Totals	0	301,140	52,625	62,400	78,000	65,000	293,285	20,000	19,750	892,200
Production Totals	0	240,912	42,100	49,920	62,400	52,000	234,628	16,000	15,800	713,760
PENNSYLVANIA										
Survey Data (1)	0	0	40,000	0	0	24,000	946,400	0	27,300	1,037,700
Estimates	0	39,400	0	0	0	0	0	0	0	39,400
Consumption Totals	0	39,400	40,000	0	0	24,000	946,400	0	27,300	1,077,100
Production Totals	0	31,520	32,000	0	0	19,200	757,120	0	21,840	861,680
VERMONT										
Survey Data (1)	0	5,500	23,000	0	0	0	77,500	0	0	106,000
Estimates	0	3,306	0	0	0	0	0	0	0	3,306
Consumption Totals	0	8,806	23,000	0	0	0	77,500	0	0	109,306
Production Totals	0	7,045	18,400	0	0	0	62,000	0	0	87,445
REGION										
Survey Data (1)	230,140	346,050	157,390	90,700	101,400	202,620	1,567,185	20,000	58,550	2,774,035
Estimates	259,109	1,457,256	0	0	0	0	0	0	0	1,716,365
Consumption Totals	489,249	1,803,306	157,390	90,700	101,400	202,620	1,567,185	20,000	58,550	4,490,400
Production Totals	391,399	1,442,645	125,912	72,560	81,120	162,096	1,253,748	16,000	46,840	3,592,320

(1) Survey data does not include data from mills for which end-product categories were not known. The results for these mills are included in the "Estimates" category.

3.4.2 Glass Processing and Manufacturing

Processing

For glass processing, two stages of processing were assumed, based on the nature of how the material is typically handled. The first stage of processing is assumed to occur at multi-material processing facilities. These facilities sort glass into colors, and although some of them produce cullet from the sorted glass, it was assumed in this analysis that these facilities produce sorted glass. The second stage of processing produces color-sorted cullet that is ready to be used by manufacturers. This second stage of processing is assumed to occur at processing facilities that only handle glass. In some instances, the color-sorted glass from a multi-material processor may go to a second stage processor, but it is likely that in most cases the two stages of processing are going on in parallel, with the multi-material processors and glass processors both selling material to brokers or directly to glass manufacturers.

The derivation of glass quantities processed by multi-material processors is described in Section 3.3.3 of this report. The quantities of glass processed by glass processors (second stage processing) were determined by utilizing the per-employee processing rate defined for these processors, and the state-by-state estimates of employment in this category. The one exception to this is for Massachusetts. In a previous study for Massachusetts, WESTON had quantified the amount of glass processed in the state. This estimate was used, and the amount processed by glass processors was defined as the total estimate less the quantity of glass estimated to be processed by multi-material processors. It is also worth noting that in most states no glass processors were identified. This is because glass processing is often handled at multi-material facilities.

Manufacturing

As with paper manufacturing, an existing source of information contains compiled information on the consumption of recycled material in glass manufacturing. The existing data source is a report titled "Glass Container Markets in the New York Region," prepared in 1992 for the New York State Department of Economic Development by Resource Management Associates. Since it focused exclusively on the glass industry, the New York study contains a more extensive survey of glass manufacturing in the region than could be accomplished within this study. Thus, it was determined that using the data from the New York report was likely to be more accurate than extrapolating from the data gathered during surveys of glass manufacturers during this study.

Thus, the data for glass manufacturing was taken directly from the New York study, with only one adjustment. The tonnage reported for New England in the study had to be split between Connecticut and Massachusetts (the only states in New England with glass manufacturers utilizing glass cullet as a feedstock). The split between these two states was based on the relative employment in glass manufacturing in the two states.

3.4.3 Multi-material Processing

The determination of total tonnage processed by multi-material processors is done in the same manner as all other processors, i.e. application of a per-employee processing rate to the employment totals in this category for each state. However, since these processors handle a variety of materials it is necessary to split the total quantity of material processed into material categories. Only in this way can this data be incorporated into the value added analysis.

As is shown on Table 3-3, the total tonnage processed by multi-material processors is split between glass, metal, paper and plastic based on data from four multi-material processors which reported specific quantities of material processed. Two of these facilities are publicly-owned material recovery facilities and two are commercial firms that process multiple materials. These facilities are located in states with and without bottle bills. By utilizing data from private and public facilities and non-bottle bill and bottle bill states, the average determined is designed to represent the spectrum of multi-material processing. The split in materials is determined as follows:

- paper - 79.1 percent;
- glass - 10.7 percent;
- metals - 9.2 percent; and
- plastic - 1.0 percent.

The mixture of materials from these facilities was assumed to be representative of the mix from all multi-material processors, and on this basis the total tonnage of material processed was assigned to the four material categories. A further breakdown of these quantities into subcategories is discussed in Section 4.

SECTION 4

DETERMINATION OF VALUE ADDED

4.1 APPROACH

With the estimation of tonnages processed and manufactured complete there are three steps left to determine the value added through recycling: 1) establishment of value of materials at each stage of recycling; 2) refinement of material quantities to reflect the categories in which price data is available; and 3) application of the material value estimates to the material quantity estimates to determine total value added.

4.2 VALUE OF MATERIALS

For each material category there are a number of subcategories based on a more specific designation of the type of material and the stage of processing or manufacturing it has achieved. As a result, even though there are only eight major material categories, 41 price categories were defined. These categories are listed, along with the price determined and the data sources, in Table 4-1. In all instances, attempts were made to average price data over a two year period so as to minimize the impacts of temporary shifts in prices. The price information requiring more specific explanation is as follows:

- Weighted Average Baled Paper Price: The prices for baled paper in the five wastepaper categories defined were determined and are used in the calculation of value added in the first stage of processing. In order to determine the value added in the second stage of processing, the differential value between baled paper and pulp must be determined, and as a result, an average price for baled paper is needed. The weighted average price determined is based on the relative quantities of each type of paper processed in the first stage of processing and the price for baled material of each type.

- Weighted Average Plastic Pellet Price: In order to determine the differential value between plastic pellets (the second stage processing output) and the manufacturing output, an average value of plastic pellets must be calculated. This is done based on the mix of plastic pellets processed, and the price for each pellet type.

- Plastic Sheet Price: The type of products produced by plastics manufacturers from recycled feedstock varies widely, and there is no known source of published information regarding the value of these products. Therefore, it was decided to use the value of a plastic product that would conservatively estimate the value added through plastic manufacturing. A plastic manufacturer that produces plastic sheet provided price information for this product. This is believed to represent a price at the low end of prices for products produced by plastics manufacturers, and thus should provide a conservative estimate of value added.

Table 4-1

Material Prices

MATERIAL CATEGORY	PRICE $/TON
Baled ONP	$16.00
Baled OCC	$31.55
Baled Mixed Paper	($1.88)
Baled Pulp Subs	$221.00
Baled HGD	$112.00
Wtd. Avg. Baled Paper Price	$65.11
Pulp	$533.00
Newspaper	$416.33
Tissue	$350.00
Kraft Paper	$598.00
Linerboard	$342.00
Kraft Board	$736.00
Corrugating Medium	$309.00
Recycled Boxboard	$452.00
Coated Printing & Writing	$988.00
Uncoated Printing & Writing	$689.00
Clear Glass	$7.60
Brown Glass	$5.85
Green Glass	$2.75
Clear Cullet	$50.70
Brown Cullet	$37.10
Green Cullet	$15.10
Clear Bottles	$295.00
Brown Bottles	$295.00
Green Bottles	$295.00
Baled HDPE	$143.00
Baled PET	$129.00
HDPE Pellets	$529
PET Pellets	$928
Wtd. Avg. Plastic Pellet Price	$752
Plastic Sheet	$1,120.00
Ferrous Scrap	$84.53
Baled Steel/Tin Cans	$62.60
Wtd. Avg. Ferrous Scrap Price	$83.19
Non–ferrous Scrap	$280.00
Aluminum Scrap	$440.00
Baled Aluminum Cans	$691.00
Wtd. Avg. Alum. Scrap Price	$531.27
Steel Products	$288.00
Secondary Lead	$660.00
Secondary Al. Ingot	$1,275.00
Compost	$51.67
Crumb Rubber	$235.00
Rubber Products	$300.00
Wiping Cloths/Used Clothing	$350.00

SOURCES: Pulp and Paper Week; Recycling Times; Plastic News; and American Metal Market

- Weighted Average Ferrous Scrap and Aluminum Scrap Prices: For ferrous metal and aluminum emerging from processors, two subcategories had to be created for each metal, based on two very distinct types of scrap. For ferrous metal the two categories are steel/tin cans and ferrous scrap; for aluminum they are aluminum cans and aluminum scrap. For each of these metals, the two subcategory prices had to be averaged in order to determine a differential between the scrap price and the price of material produced by manufacturers. The weighted average was determined based on the relative quantities of the two subcategories of metal processed.

- Steel Products: Ferrous manufacturers provided little data regarding the nature of products they produced from recycled feedstock. One product that was known to be produced is reinforcing bar. Since this material has a relatively low value compared to other steel products, it is conservative to assume that all steel produced from recycled material is in the form of reinforcing bar. This is the price data that was utilized.

- Secondary Lead: Non-ferrous manufacturing covers a wide spectrum of metals. Since the mixture of metals is not known, a conservative assumption was made that all non-ferrous manufacturing is in the form of lead. This is conservative due to the low value of lead relative to other non-ferrous metals.

4.3 REFINEMENT OF MATERIAL QUANTITIES

For a number of material categories, the quantities of material processed had to be broken down into subcategories to reflect the differences in price between different types of material. These refinements are summarized below, and the results presented in Table 4-2.

Paper Processed

The total amount of paper processed was determined by summing the estimates of paper processed by firms that just process paper and the paper processed by multi-material processors. This total was then broken down into the five wastepaper categories for which price data was determined based on the mix of paper consumed and exported from the region. In other words the total amount of each of these five paper types consumed by mills in the region and exported from the region was determined. From this it was found, for example, that 21 percent of the total paper consumed in, and exported from, the region was newspaper. It was assumed that 21 percent of total paper processed would be newspaper, since the mix of paper processed should approximate the mix of paper consumed and exported from the region.

Glass Processed

The total quantity of glass processed was divided among the three colors, based on data from processors reporting the quantities of different colors of glass processed. This split of colors was assumed to apply to the second stage of processing and manufacturing, since it reflects the mixture of colors of glass produced.

Table 4-2

Determination of Value Added

	CONNECTICUT		DELAWARE		MAINE		MASSACHUSETTS		NEW HAMPSHIRE		NEW JERSEY	
	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)
Paper Processed – 1st Stage												
Baled ONP	131,913	$2,111	74,223	$1,188	71,804	$1,149	138,937	$2,223	46,789	$749	261,104	$4,178
Baled OCC	230,692	$7,278	129,801	$4,095	125,572	$3,962	242,975	$7,666	81,826	$2,582	456,622	$14,406
Baled Mixed Paper	83,149	($156)	46,785	($88)	45,261	($85)	87,576	($165)	29,493	($55)	164,582	($309)
Baled Pulp Subs	104,405	$23,074	58,745	$12,983	56,831	$12,560	109,964	$24,302	37,032	$8,184	206,656	$45,671
Baled HGD	75,022	$8,402	42,212	$4,728	40,837	$4,574	79,016	$8,850	26,610	$2,980	148,495	$16,631
Subtotals – Paper Proc. 1st Stage	625,182	$40,709	351,765	$22,905	340,305	$22,159	658,470	$42,876	221,751	$14,439	1,237,458	$80,577
Paper Processed – 2nd Stage												
Pulp	393,200	$183,972	2,400	$1,123	244,846	$114,560	428,560	$200,517	209,868	$98,194	650,560	$304,387
Paper Manufactured												
Newspaper	0	$0	0	$0	82,959	($9,679)	0	$0	0	$0	308,440	($35,987)
Tissue	302,304	($55,322)	0	$0	134,847	($24,677)	354,160	($64,811)	171,416	($31,369)	200,440	($36,681)
Kraft Paper	0	$0	0	$0	13,520	$879	0	$0	18,292	$1,189	1,600	$104
Linerboard	0	$0	0	$0	0	$0	0	$0	0	$0	22,640	($4,324)
Kraft Board	0	$0	0	$0	0	$0	0	$0	0	$0	18,720	$3,800
Corrugating Medium	90,896	($20,361)	0	$0	0	$0	0	$0	0	$0	0	$0
Recycled Boxboard	0	$0	0	$0	8,320	($674)	74,400	($6,026)	20,160	($1,633)	97,120	($7,867)
Coated Printing & Writing	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Uncoated Printing & Writing	0	$0	2,400	$374	5,200	$811	0	$0	0	$0	1,600	$250
Subtotals – Paper Manufacturing	393,200	($75,682)	2,400	$374	244,846	($33,340)	428,560	($70,838)	209,868	($31,813)	650,560	($80,704)
TOTALS – PAPER		$148,999		$24,402		$103,379		$172,555		$80,820		$304,260
Glass Processed – 1st Stage												
Clear Glass	36,438	$277	8,603	$65	20,567	$156	27,143	$206	13,843	$105	64,322	$489
Brown Glass	12,146	$71	2,868	$17	6,856	$40	9,048	$53	4,614	$27	21,441	$125
Green Glass	22,863	$63	5,398	$15	12,905	$35	17,031	$47	8,686	$24	40,359	$111
Subtotals – Glass Proc. 1st Stage	71,446	$411	16,868	$97	40,328	$232	53,221	$306	27,144	$156	126,122	$725
Glass Processed – 2nd Stage												
Clear Cullet	0	$0	0	$0	0	$0	56,405	$2,431	0	$0	91,698	$3,952
Brown Cullet	0	$0	0	$0	0	$0	18,802	$588	0	$0	30,566	$955
Green Cullet	0	$0	0	$0	0	$0	35,391	$437	0	$0	57,536	$711
Subtotals – Glass Proc. 2nd Stage	0	$0	0	$0	0	$0	110,598	$3,456	0	$0	179,800	$5,618
Glass Manufactured												
Clear Bottles	26,628	$6,505	0	$0	0	$0	24,560	$6,000	0	$0	84,558	$20,658
Brown Bottles	8,876	$2,289	0	$0	0	$0	8,187	$2,111	0	$0	28,186	$7,269
Green Bottles	16,708	$4,677	0	$0	0	$0	15,410	$4,313	0	$0	53,056	$14,850
Subtotals – Glass Manufacturing	52,213	$13,471	0	$0	0	$0	48,157	$12,425	0	$0	165,800	$42,777
TOTALS – GLASS		$13,882		$97		$232		$16,187		$156		$49,120
Plastic Processed – 1st Stage												
Baled HDPE	2,938	$420	694	$99	1,658	$237	2,189	$313	1,116	$160	5,186	$742
Baled PET	3,739	$482	883	$114	2,111	$272	2,785	$359	1,421	$183	6,601	$851
Subtotals – Plastic Proc. 1st Stage	6,677	$902	1,576	$213	3,769	$509	4,974	$672	2,537	$343	11,787	$1,593
Plastic Processed – 2nd Stage												
HDPE Pellets	2,542	$981	424	$164	0	$0	7,288	$2,813	1,921	$741	8,700	$3,358
PET Pellets	3,236	$2,585	539	$431	0	$0	9,276	$7,411	2,445	$1,953	11,073	$8,847
Subtotals – Plastic Proc. 2nd Stage	5,778	$3,567	963	$594	0	$0	16,564	$10,224	4,366	$2,695	19,774	$12,206
Plastic Manufacturing												
Plastic Sheet	13,159	$4,837	25,835	$9,496	0	$0	53,888	$19,807	6,603	$2,427	6,989	$2,569
TOTALS – PLASTIC		$9,306		$10,303		$509		$30,704		$5,465		$16,368

Table 4-2

Determination of Value Added
(Continued)

	CONNECTICUT		DELAWARE		MAINE		MASSACHUSETTS		NEW HAMPSHIRE		NEW JERSEY	
	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)
Metal Processing												
Ferrous Scrap	368,308	$31,133	89,235	$7,543	139,707	$11,809	322,941	$27,298	129,886	$10,979	812,862	$68,711
Non-ferrous Scrap	33,483	$9,375	8,112	$2,271	12,701	$3,556	29,358	$8,220	11,808	$3,306	73,897	$20,691
Aluminum Scrap	33,483	$14,732	8,112	$3,569	12,701	$5,588	29,358	$12,918	11,808	$5,195	73,897	$32,514
Baled Aluminum Cans	19,133	$13,221	4,636	$3,203	7,257	$5,015	16,776	$11,592	6,747	$4,662	42,227	$29,179
Baled Steel/Tin Cans	23,916	$1,497	5,795	$363	9,072	$568	20,970	$1,313	8,434	$528	52,783	$3,304
Subtotals – Metal Processing	478,322	$69,959	115,890	$16,950	181,437	$26,537	419,403	$61,341	168,684	$24,671	1,055,665	$154,400
Ferrous Manufacturing												
Steel Products	182,988	$37,477	0	$0	0	$0	53,820	$15,500	0	$0	1,614,600	$465,005
Non-ferrous Manufacturing												
Secondary Lead	28,320	$10,762	0	$0	0	$0	21,600	$8,208	0	$0	772,320	$293,482
Aluminum Manufacturing												-
Secondary Ingot	0	$0	0	$0	0	$0	17,325	$12,885	0	$0	54,670	$40,660
TOTALS – METAL		$118,197		$16,950		$26,537		$97,934		$24,671		$953,546
Yard Waste Processing												
Compost	123,200	$6,365	0	$0	369,600	$19,096	770,000	$39,783	0	$0	64,400	$3,327
Tire Processing												
Crumb Rubber	5,984	$1,406	0	$0	17,600	$4,136	11,616	$2,730	5,984	$1,406	7,040	$1,654
Tire Manufacturing												
Rubber Products	255,600	$16,614	166,140	$10,799	0	$0	415,350	$26,998	0	$0	63,900	$4,154
TOTALS – TIRES		$18,020		$10,799		$4,136		$29,728		$1,406		$5,808
Textile Processing												
Wiping Cloths/Used Clothing	1,849	$647	0	$0	5,546	$1,941	9,730	$3,406	1,849	$647	3,697	$1,294
TOTALS – ALL MATERIALS		$315,416		$62,552		$155,830		$390,296		$113,166		$1,333,723

Table 4-2

Determination of Value Added
(Continued)

	NEW YORK		PENNSYLVANIA		RHODE ISLAND		VERMONT		REGION	
	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)
Paper Processed – 1st Stage										
Baled ONP	527,616	$8,442	558,777	$8,940	20,370	$326	92,787	$1,485	1,924,321	$30,789
Baled OCC	922,703	$29,111	977,198	$30,831	35,624	$1,124	162,267	$5,120	3,365,282	$106,175
Baled Mixed Paper	332,573	($625)	352,215	($662)	12,840	($24)	58,486	($110)	1,212,961	($2,280)
Baled Pulp Subs	417,592	$92,288	442,255	$97,738	16,123	$3,563	73,438	$16,230	1,523,041	$336,592
Baled HGD	300,066	$33,607	317,788	$35,592	11,585	$1,298	52,770	$5,910	1,094,401	$122,573
Subtotals – Paper Proc. 1st Stage	2,500,549	$162,823	2,648,234	$172,440	96,543	$6,286	439,748	$28,634	9,120,004	$593,848
Paper Processed – 2nd Stage										
Pulp	713,760	$333,958	861,680	$403,167	0	$0	87,445	$40,914	3,592,320	$1,680,793
Paper Manufactured										
Newspaper	0	$0	0	$0	0	$0	0	$0	391,399	($45,666)
Tissue	240,912	($44,087)	31,520	($5,768)	0	$0	7,045	($1,289)	1,442,645	($264,004)
Kraft Paper	42,100	$2,737	32,000	$2,080	0	$0	18,400	$1,196	125,912	$8,184
Linerboard	49,920	($9,535)	0	$0	0	$0	0	$0	72,560	($13,859)
Kraft Board	62,400	$12,667	0	$0	0	$0	0	$0	81,120	$16,467
Corrugating Medium	52,000	($11,648)	19,200	($4,301)	0	$0	0	$0	162,096	($36,310)
Recycled Boxboard	234,628	($19,005)	757,120	($61,327)	0	$0	62,000	($5,022)	1,253,748	($101,554)
Coated Printing & Writing	16,000	$7,280	0	$0	0	$0	0	$0	16,000	$7,280
Uncoated Printing & Writing	15,800	$2,465	21,840	$3,407	0	$0	0	$0	46,840	$7,307
Subtotals – Paper Manufacturing	713,760	($59,126)	861,680	($65,909)	0	$0	87,445	($5,115)	3,592,320	($422,153)
TOTALS – PAPER		$437,655		$509,698		$6,286		$64,433		$1,852,488
Glass Processed – 1st Stage										
Clear Glass	91,613	$696	165,675	$1,259	5,933	$45	29,368	$223	463,504	$3,523
Brown Glass	30,538	$179	55,225	$323	1,978	$12	9,789	$57	154,501	$904
Green Glass	57,483	$158	103,953	$286	3,723	$10	18,427	$51	290,826	$800
Subtotals – Glass Proc. 1st Stage	179,634	$1,033	324,853	$1,868	11,633	$67	57,584	$331	908,831	$5,226
Glass Processed – 2nd Stage										
Clear Cullet	112,251	$4,838	113,832	$4,906	0	$0	37,944	$1,635	412,130	$17,763
Brown Cullet	37,417	$1,169	37,944	$1,186	0	$0	12,648	$395	137,377	$4,293
Green Cullet	70,432	$870	71,424	$882	0	$0	23,808	$294	258,591	$3,194
Subtotals – Glass Proc. 2nd Stage	220,100	$6,877	223,200	$6,974	0	$0	74,400	$2,325	808,098	$25,249
Glass Manufactured										
Clear Bottles	99,501	$24,308	163,858	$40,030	0	$0	0	$0	399,106	$97,501
Brown Bottles	33,167	$8,554	54,619	$14,086	0	$0	0	$0	133,035	$34,310
Green Bottles	62,432	$17,475	102,813	$28,777	0	$0	0	$0	250,419	$70,092
Subtotals – Glass Manufacturing	195,100	$50,337	321,290	$82,894	0	$0	0	$0	782,560	$201,904
TOTALS – GLASS		$58,247		$91,736		$67		$2,656		$232,379
Plastic Processed – 1st Stage										
Baled HDPE	7,387	$1,056	13,358	$1,910	478	$68	2,368	$339	37,373	$5,344
Baled PET	9,401	$1,213	17,002	$2,193	609	$79	3,014	$389	47,565	$6,136
Subtotals – Plastic Proc. 1st Stage	16,788	$2,269	30,360	$4,103	1,087	$147	5,382	$727	84,938	$11,480
Plastic Processed – 2nd Stage										
HDPE Pellets	15,056	$5,812	36,157	$13,957	1,271	$491	2,571	$992	75,931	$29,309
PET Pellets	19,162	$15,311	46,019	$36,769	1,618	$1,293	3,272	$2,614	96,639	$77,215
Subtotals – Plastic Proc. 2nd Stage	34,219	$21,122	82,176	$50,726	2,889	$1,783	5,842	$3,606	172,570	$106,524
Plastic Manufacturing										
Plastic Sheet	35,427	$13,022	168,604	$61,972	0	$0	4,386	$1,612	314,891	$115,741
TOTALS – PLASTIC		$36,413		$116,801		$1,930		$5,946		$233,745

Table 4-2

Determination of Value Added
(Concluded)

	NEW YORK		PENNSYLVANIA		RHODE ISLAND		VERMONT		REGION	
	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)	TONS	VALUE ADDED (in 000's)
Metal Processing										
Ferrous Scrap	1,480,477	$125,145	1,583,171	$133,825	60,111	$5,081	85,619	$7,237	5,072,318	$428,763
Non-ferrous Scrap	134,589	$37,685	143,925	$40,299	5,465	$1,530	7,784	$2,179	461,120	$129,114
Aluminum Scrap	134,589	$59,219	143,925	$63,327	5,465	$2,404	7,784	$3,425	461,120	$202,893
Baled Aluminum Cans	76,908	$53,143	82,243	$56,830	3,123	$2,158	4,448	$3,073	263,497	$182,076
Baled Steel/Tin Cans	96,135	$6,018	102,803	$6,435	3,903	$244	5,560	$348	329,371	$20,619
Subtotals – Metal Processing	1,922,697	$281,210	2,056,067	$300,716	78,066	$11,418	111,194	$16,263	6,587,426	$963,464
Ferrous Manufacturing										
Steel Products	679,328	$195,646	3,318,565	$955,747	0	$0	0	$0	5,849,301	$1,669,375
Non-ferrous Manufacturing										
Secondary Lead	28,800	$10,944	2,158,541	$820,246	0	$0	0	$0	3,009,581	$1,143,641
Aluminum Manufacturing										
Secondary Ingot	169,785	$126,274	884,083	$657,517	0	$0	0	$0	1,125,863	$837,335
TOTALS – METAL		$614,074		$2,734,225		$11,418		$16,263		$4,613,816
Yard Waste Processing										
Compost	75,600	$3,906	0	$0	123,200	$6,365	0	$0	1,526,000	$78,843
Tire Processing										
Crumb Rubber	59,840	$14,062	32,912	$7,734	0	$0	5,984	$1,406	146,960	$34,536
Tire Manufacturing										
Rubber Products	115,020	$7,476	639,000	$41,535	127,800	$8,307	0	$0	1,782,810	$115,883
TOTALS – TIRES		$21,539		$49,269		$8,307		$1,406		$150,418
Textile Processing										
Wiping Cloths/Used Clothing	53,126	$18,594	30,747	$10,761	3,697	$1,294	0	$0	110,241	$38,584
TOTALS – ALL MATERIALS		$1,190,427		$3,512,491		$35,668		$90,704		$7,200,274

Plastic Processed

As with glass, data from processors reporting the quantities of types of plastics processed, a split between HDPE and PET was determined, and applied during both stages of processing.

Metal Processed

For metals, the material processed by multi-material processors is generally different than that processed by firms that just handle metals. Multi-material processors tend to handle metal containers (aluminum and steel cans) but very little other types of scrap. Therefore, the total metal processed by multi-material processors was split between aluminum cans and steel cans based on data from processors reporting the different quantities of each material handled (44 percent aluminum cans, 50 percent steel cans). For metal processors, the split of material into ferrous, non-ferrous and aluminum scrap categories was based on data from firms reporting quantities by material (85 percent ferrous scrap, with the remaining 15 percent split evenly between non-ferrous and aluminum).

4.4 DETERMINATION OF VALUE ADDED

The determination of value added involves determining the differential value between the starting and ending point of each stage of recycling and multiplying that differential by the quantity of material passing through that stage. In Table 4-2, the results of that calculation are provided for each material subcategory and recycling stage, and a summary of the key value added data is presented in Table 4-3. A total of approximately $7.2 billion of value added has been estimated for the region.

One of the unusual consequences of the assumptions made in the analysis is that the paper manufacturing stage has a negative value added for most states. This is a result of the assumptions made regarding the end of the second stage of processing. The end-point of the second stage of processing is considered pulp. The only published price for pulp is for material that would actually be sold as pulp; however, the value for pulp within a paper mill is actually much less than value for pulp that is produced for sale. As a result, the value for the pulp assumed in this study is higher than the value for many of the paper end-products after manufacturing is complete. Obviously, the manufacturing process after production of pulp is not imparting negative value, otherwise paper mills would simply sell pulp and not bother with the rest of the process.

Thus, while the value added through the second stage of processing and manufacturing may by unrealistic on an individual basis, combined they represent a reasonable estimate of the value added by paper mills. In other words, the value assigned to pulp artificially inflates the value added by the second stage of processing. When one adds in the "negative" value added through manufacturing this high value is adjusted downward to reflect the value actually added by paper mills recycling paper.

Table 4-3

Summary of Value Added

	CT VALUE ADDED (in 000's)	DE VALUE ADDED (in 000's)	ME VALUE ADDED (in 000's)	MA VALUE ADDED (in 000's)	NH VALUE ADDED (in 000's)	NJ VALUE ADDED (in 000's)	NY VALUE ADDED (in 000's)	PA VALUE ADDED (in 000's)	RI VALUE ADDED (in 000's)	VT VALUE ADDED (in 000's)	REGION VALUE ADDED (in 000's)
Paper Processing – 1st Stage	$40,709	$22,905	$22,159	$42,876	$14,439	$80,577	$162,823	$172,440	$6,286	$28,634	$593,848
Paper Processing – 2nd Stage	$183,972	$1,123	$114,560	$200,517	$98,194	$304,387	$333,958	$403,167	$0	$40,914	$1,680,793
Paper Manufacturing	($75,682	$374	($33,340	($70,838	($31,813	($80,704	($59,126	($65,909	$0	($5,115	($422,153
TOTALS – PAPER	$148,999	$24,402	$103,379	$172,555	$80,820	$304,260	$437,655	$509,698	$6,286	$64,433	$1,852,488
Glass Processing – 1st Stage	$411	$97	$232	$306	$156	$725	$1,033	$1,868	$67	$331	$5,226
Glass Processing – 2nd Stage	$0	$0	$0	$3,456	$0	$5,618	$6,877	$6,974	$0	$2,325	$25,249
Glass Manufacturing	$13,471	$0	$0	$12,425	$0	$42,777	$50,337	$82,894	$0	$0	$201,904
TOTALS – GLASS	$13,882	$97	$232	$16,187	$156	$49,120	$58,247	$91,736	$67	$2,656	$232,379
Plastic Processing – 1st Stage	$902	$213	$509	$672	$343	$1,593	$2,269	$4,103	$147	$727	$11,480
Plastic Processing – 2nd Stage	$3,567	$594	$0	$10,224	$2,695	$12,206	$21,122	$50,726	$1,783	$3,606	$106,524
Plastic Manufacturing	$4,837	$9,496	$0	$19,807	$2,427	$2,569	$13,022	$61,972	$0	$1,612	$115,741
TOTALS – PLASTIC	$9,306	$10,303	$509	$30,704	$5,465	$16,368	$36,413	$116,801	$1,930	$5,946	$233,745
Metal Processing	$69,959	$16,950	$26,537	$61,341	$24,671	$154,400	$281,210	$300,716	$11,418	$16,263	$963,464
Ferrous Manufacturing	$37,477	$0	$0	$15,500	$0	$465,005	$195,646	$955,747	$0	$0	$1,669,375
Non–ferrous Manufacturing	$10,762	$0	$0	$8,208	$0	$293,482	$10,944	$820,246	$0	$0	$1,143,641
Aluminum Manufacturing	$0	$0	$0	$12,885	$0	$40,660	$126,274	$657,517	$0	$0	$837,335
TOTALS – METAL	$118,197	$16,950	$26,537	$97,934	$24,671	$953,546	$614,074	$2,734,225	$11,418	$16,263	$4,613,816
Yard Waste Processing	$6,365	$0	$19,096	$39,783	$0	$3,327	$3,906	$0	$6,365	$0	$78,843
Tire Processing	$1,406	$0	$4,136	$2,730	$1,406	$1,654	$14,062	$7,734	$0	$1,406	$34,536
Tire Manufacturing	$16,614	$10,799	$0	$26,998	$0	$4,154	$7,476	$41,535	$8,307	$0	$115,883
TOTALS – TIRES	$18,020	$10,799	$4,136	$29,728	$1,406	$5,808	$21,539	$49,269	$8,307	$1,406	$150,418
Textile Processing	$647	$0	$1,941	$3,406	$647	$1,294	$18,594	$10,761	$1,294	$0	$38,584
TOTALS – ALL MATERIALS	$315,416	$62,552	$155,830	$390,296	$113,166	$1,333,723	$1,190,427	$3,512,491	$35,668	$90,704	$7,200,274

It can be seen from Table 4-3 that paper and metals are the major contributors to value added in the region, accounting for over 82 percent of total value added, split roughly evenly between the two materials. Glass is the next biggest contributor, accounting for approximately 5 percent of regional value added, with plastic and tires contributing approximately 3 percent and 2 percent of the total, respectively. Yard waste processing accounts for another 2 percent of regional value added, and textiles contribute less than one percent to the total.

Splitting the regional value added by processing versus manufacturing, it is found that processing adds approximately $3.7 billion of value regionally, while manufacturing adds approximately $3.5 billion of value. This split is skewed, however, by the difficulty in assigning an appropriate value to the end-point for the second stage of paper processing. The assumptions inflate the value added through processing of paper and deflate the value added through paper manufacturing, since paper manufacturing (defined as the processes after production of pulp) is calculated to subtract value rather than add it. If paper manufacturing were assumed to add zero value (instead of negative value), processing would contribute $3.3 billion of value and manufacturing would add $3.9 billion of value.

The value added totals by state can be evaluated. Pennsylvania is the largest contributor to total value added, primarily as a result of the large amount of metal processing and manufacturing in the state. New Jersey is the second largest contributor to total value added.