Section 4
RECYCLING INDUSTRY ECONOMIC VALUES IN IOWA

4.1 Introduction

In 1996 a framework for estimating the statewide economic impacts or values from recycling activities in Iowa was developed. That framework was repeated and refined in 2001, and again applied in this Study. There are three elements necessary for assessing recycling industry economic values: (1) reliable survey information of specific industries; (2) reliable recycling industry expertise; and (3) a set of protocols for translating recycling industry information into standard industrial measures of economic activity. This section focuses on applying the last element.

Measures of regional economic values may be estimated with the use of input-output (I-O) models of the area of study. I-O models are highly detailed accountings of the flow of commodities and finished goods among industries and ultimately, to final consumers. The model that we use in our assessment is called Implan Pro™. It contains detailed information on up to 509 commodity production sectors as well as consuming institutions and households[1]. The foundation data that are used in this model are updated annually, so the modeling structure is highly reflective of the existing economy in the area that is being studied.

At the heart of the I-O model are measures of which industries *use* specific commodities and which industries *make* those commodities, along with an accounting of their presence in an area of study. With the industrial composition of a region known and documented, successive rounds of transactions stemming from an initial purchase or the sale of a commodity or some other economic event can be summed to provide an estimate of:

1. **Direct values** (usually firm or activity specific);
2. **Indirect values** (inter-industry linkages as measured by purchases of intermediate commodities – these purchases are also call industrial inputs);
3. **Induced values** (economic change driven by personal consumption – these values are also called household values); and

[1] The modeling system and data that were used for previous studies were manufactured and distributed by the IMPLAN company, but were configured under the U.S. Standard Industrial Classification (SIC) System. Beginning in 2004, IMPLAN systems converted to the new North American Industrial Classification System (NAICS).

4. **Total values** (the sum of 1 through 3) for all industries "impacted" by the economic event in the region under study.

Four standard economic values are estimated for the following:

- **Total industrial output** as a measure of gross sales.
- **Value added** is comprised of all income from employee compensation, payments to sole proprietors, income from investments, and indirect tax payments to governments (sales, excise, and use taxes) that are part of the production process.
- **Labor income** represents the value of all wages, salaries and salary-like benefits paid to workers. It also includes the normal payments to ownership and management that are made to sole proprietors. Labor income is a subset of value added.
- **Jobs in the region** are defined as the number of positions that exist in an industry, not the number of working persons. Because many people hold more than one job, there are more jobs in an economy than there are employed persons.

4.2 Methodology

For purposes of this Study, "economic impact" is where a discernible and measurable change in economic activity in a region is occurring. These changes come about, primarily, from three types of occurrences:

1. Commodity production intended primarily for export either starts-up or closes-down. This includes traditional industrial sales along with tourism and recreation activities that depend on spending from visitors. This can also include higher level service provision, such as regional or national medical centers, where a large fraction of services that are delivered accrue to persons living outside of the local trade area.
2. The development of industries locally that are substituted for historical imports, or "import substitution". Much of recycling can often take the form of import substitution.
3. Focused and significant government institutional spending. Examples include state or federal hospitals and specialty schools, higher-education facilities, military bases, and prisons. Each of these represent a consolidation of public spending in a small area that provides public goods that are significantly in excess of local needs.

When the industrial activity that we are measuring clearly fits into one of these three categories, for the purposes of this Study, we characterize this activity as "economic impact". If the activity does not fit into one of these three groupings for purposes of this Study, we characterize this activity as an "economic value".

The processing of recycled commodities, either as producer inputs or as final goods, generally does not "fit" standard industrial groups. A few instances, such as paperboard, metals, and aluminum manufacturing have historically strong inter-industrial linkages with the byproducts or the waste streams of other industries. Other

commodities such as glass, plastics, construction and demolition materials, and organics processing are not well-represented in standard industrial groupings or are lost or subsumed with much larger sectors that are dominated by industries that do not use recycled feedstocks.

The flow of industrial activity in recycling industrial analysis begins with collecting recyclable materials, processing them into industrial inputs or intermediate raw materials, and the end-use of processed recycled commodities in the production of final goods intended for household or institutional consumption. Information from a survey of collectors, commodity processors, and end-users was collected in late 2006 and early 2007. These data were used to manually change our I-O model to identify the industrial values of recycling in Iowa and their implicit relationships. In effect, we introduced these industries into our model and manipulated the other industries and institutions represented to mathematically acknowledge them. We also linked these industrial activities together. Collection is an industrial input for recycling commodity processing. Recycled commodity processing, by particular commodity type, is an input to specific end-use manufacturing.

Data for this Study were collected for collection, processing, and end-use manufacturing for the following commodities:

- All Paper
  - All other paper
  - OCC
- Plastics
- Glass
- Metals
  - All other metals
  - Aluminum
- Wood Scrap
- Organic Matter
- C&D Materials
- Used Tires
- End-of-Life Electronics

The survey data of estimated tonnage collected, processed, or consumed, along with sales, employees, and employee compensation were compiled and introduced into our modeling system to assess both the economic impacts of commodity production and the estimated economic value to the state of Iowa of end-use manufacturing activities.

4.3 Study Assumptions

As in the previous studies, there are several assumptions that are implicit in the economic modeling:

- The types of materials that are collected by kind and by source (residential and commercial) documented in the survey are indicative of the overall statewide distribution of recyclable materials that are collected.
- All recycled commodities that are collected and sold within the state are processed by in-state industries.
- All brokering activities along any continuum of recycling industry activity are subsumed within the purchase prices paid for the recycled commodity either by the processor or by the end-user.
- The prices received per commodity by collectors and by processors are based on reported regional market averages.
- The appropriate point for economic impact analysis for recycling is at the processor level because that is the point at which initial value is added to the recycled commodity, although the overall economic values of end-use industrial activity and of recycling equipment manufacture are documented and reported. Exported sales of collected recyclable material are also considered economic impacts in that they represent sales in excess of statewide industrial demand.
- All incremental benefits that may accrue as a result of recycling collection activities are considered nominal when compared to the collection activities associated with these materials if they were not diverted from disposal.

4.4 Establishing a Baseline

4.4.1 Paper, Plastics, Glass, Metals, and Wood

Table 4-1 itemizes the base values that were used to modify and compile the I-O model for Iowa and its recycling-related industries. These summaries align with previous studies and do not include organics, C&D debris, used tires, and end-of-life electronics (electronics). The allocations of the collected commodities were derived from the survey information and by follow-up phone-calls with key industrial groups.

By our estimate, it was determined that 1.2 million tons of recyclable commodities were collected in Iowa in 2005. Residential collections accounted for approximately 300,000 tons, and commercial collections accounted for approximately 900,000 tons. The majority of collected material, by weight, was paper. In 2005, paper accounted for approximately 49 percent of all commodities collected. Of the total tons collected, 178,514 tons were exported, leaving 1,021,486 tons (85 percent) available to in-state processors, as shown in Table 4-1.

Table 4-1
Estimated Recycled Commodities Collected by Type and Source
(2007 Study)[1,2]

Material Types	Total Tons Collected[3]	Residential Tons Collected	Commercial Tons Collected	Total Tons Exported	Net Iowa	Expected 2005 Gross Receipts
All Paper	587,853	146,963	440,890	42,264	545,589	$25,569,005
OCC	159,218	39,804	119,413	9,592	149,625	6,079,214
All Other Paper	428,636	107,159	321,477	32,672	395,964	19,489,790
Plastics	46,804	11,701	35,103	12,495	34,309	12,754,101
Glass	147,532	36,883	110,649	84,104	63,428	3,085,338
Metals	224,460	56,115	168,345	13,965	210,495	111,659,888
Aluminum Cans	30,205	7,551	22,654	8,226	21,979	33,788,015
All Other Metal	194,255	48,564	145,691	5,739	188,516	77,871,873
Wood Scrap	193,352	48,338	145,014	25,686	167,665	6,187,259
Total	1,200,000	300,000	900,000	178,514	1,021,486	$159,255,591

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.
[3] Estimated from extrapolating 2005 survey results.

Assuming that all of the collected tonnage was sold at reported regional prices (i.e., commodity indices), the expected receipts for these recyclable materials are $159.3 million. A large fraction of that total, 70 percent, is in the metals sector. All collected paper was expected to generate $25.6 million in receipts, plastics another $12.8 million, wood scrap $6.2 million, and glass $3.1 million.

As a refinement to previous studies in Iowa, we have determined that the value of recycled commodities that are collected in Iowa and exported outside of the state represents receipts that otherwise would not have been received but-for the recycling activity in Iowa. Hence, the value of the exports is considered an economic impact and a summary of those values will be presented later in this section.

Table 4-2 displays the estimate of the total amount of recyclable commodities that are actually processed in Iowa. These distributions were derived from the survey of processors and end-users in Iowa. The totals are assumed to be, by commodity, representative of the distribution of processors activities in Iowa. Characteristics of C&D debris, organics, used tires, and electronics processing are discussed later in this section.

Table 4-2
Estimated Recycled Commodities Processed by Type and Source
(2007 Study)[1,2]

Material Types	Iowa Suppliers[3] Tons	Imported Tons	All Suppliers Tons	Expected 2005 Gross Receipts
All Paper	545,589	36,039	581,628	$36,987,435
OCC	149,625	7,265	156,891	11,296,117
All Other Paper	395,964	28,774	424,737	25,691,318
Plastics	34,309	14,607	48,916	17,928,088
Glass	63,428	72	63,499	1,125,407
Metals	210,495	28,858	239,353	119,531,111
Aluminum Cans	21,979	31	22,010	25,531,670
All Other Metal	188,516	28,827	217,343	93,999,441
Wood Scrap	167,665	25,518	193,183	5,022,769
Total	1,021,486	105,093	1,126,579	$180,594,810

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.
[3] Data is derived from Table 4-1 and is extrapolated from 2005 survey results.

We estimate that the total amount of processed recycled commodities in Iowa in 2005 was 1,126,579 tons. As with collections, paper processing amounted to the preponderance of the tonnage at 53 percent. All metals accounted for 21 percent, and wood scrap accounted for 16 percent. Total expected receipts for these processed goods were quite large, given average per ton prices in effect at the time. In 2005, these processed commodities, if sold at regional average prices, would have amounted to nearly $181 million. Metals accounted for nearly $120 million of the total (66 percent), followed by paper at $37 million, plastics at nearly $18 million, wood scrap at $5 million, and glass at $1 million.

We have allocated the total amount of collections that are sold in-state to Iowa processors as 1,021,486 tons, compared with an estimated 105,093 tons that were purchased from out-of-state suppliers. We estimate in Table 4-2 that 90.7 percent of the commodities that are processed in these industries come from in-state resources.

Table 4-2 is very important to the subsequent modeling activities. The gross sales by major commodity become the industrial output that is entered into the I-O model. In short, the expected sales accounted for in Table 4-2 are the same amounts that the economic impact assessment will report when summed. The models were also created so that there is industrial-level sensitivity to both the amounts and costs of labor, as indicated in the survey.

4.4.2 C&D Debris, Organics, Used Tires, and Electronics Processing

There were several other categories of recycled commodity processing that were measured in the survey. The processing of C&D debris, the processing of organic matter into compost or other uses, electronic equipment de-manufacturing, and used tire processing represent important, but not as well documented, dimensions of recycling in Iowa.

C&D wastes are not well documented in terms of their collection, processing, and end-use. For example, most asphalt is simply collected, crushed, and quickly reapplied during the construction of a new roadway. Recovered concrete often becomes clean fill or is used for erosion control. Efforts have been made to re-process wood, drywall, sheet rock, and asphalt shingles, though instances of usage do not appear well documented in the state.

Of the nearly 21,000 tons of C&D material reported collected, roughly 75% was asphalt, concrete, and drywall. Of the 207,236 tons of C&D reported as processed, 71 percent was concrete, almost 28 percent was asphalt, and less than 2 percent was asphalt shingles.

With regard to organic waste, nearly all of the landfills in Iowa actively divert yard trimmings and other organic matter into public or private composting operations. The finished material is often simply given to the public for residential benefit, used for erosion control, or applied as a soil amendment on public land. Thus, much of the collection, diversion, processing, and distribution of this material falls outside traditional economic industrial activities.

From the survey data, of the 80,454 tons of collected organic wastes, nearly 84 percent were yard trimmings, 16 percent were other organic by-products, and food residuals made up less than one percent. Of the 291,837 tons reported as processed, 59 percent were classified as other organic by-products, 37 percent yard trimmings, and 4 percent food residuals.

End-of-life electronics are disassembled into their useful and recoverable components in which motors, compressors, scrap plastic and metals, and circuit boards are separated and re-used or re-manufactured. The survey results indicated 634 tons of end-of-life electronics were collected and 522 tons were processed.

Processors of used tires remove the bead steel and shred the tires into varying sizes for a multitude of uses. Some of the tire products are used as tire-derived aggregate for engineering applications, playground fill, or athletic and walkway surfaces, and a large fraction is used as fuel. In 2005, approximately 56,965 tons of tires were collected from within Iowa and 29,994 tons of Iowa tires were processed. This equates to

nearly 5.7 million tires collected and 3.0 million tires processed.[2] The total quantities of tires collected and processed (tons from Iowa plus tons from outside Iowa) were even higher, as shown below in Table 4-3.

Table 4-3 shows the survey results for C&D debris, organics, and electronics collection and processing, plus state tire collection and processing data. All quantities include both tons from Iowa and outside of Iowa, collected and processed.

Table 4-3
Survey Results for C&D, Organics, and Electronics Collection and Processing
Plus State Tire Data
(2007 Study)[1,2]

	Collection		Processing	
	Tons	Percent of Category	Tons	Percent of Category
CONSTRUCTION & DEMOLITION	20,969	100.0%	207,236	100.0%
Asphalt	4,979	23.7%	57,112	27.6%
Concrete	5,382	25.7%	146,411	70.6%
Drywall	5,781	27.6%	-	-
Carpet	36	0.2%	118	0.1%
Carpet Pad	539	2.6%	-	-
Asphalt Shingles	2,742	13.1%	3,595	1.7%
Other Mixed C&D	1,510	7.2%	-	-
ORGANICS	80,454	100.0%	291,837	100.0%
Food	500	0.6%	11,071	3.8%
Yard Trimmings	67,273	83.6%	107,799	36.9%
Other Organic	-	0.0%	172,967	59.3%
Other Organic By-products	12,681	15.8%	-	-
ELECTRONICS	634	100.0%	522	100.0%
TIRES[3]	87,685	100.0%	39,970	100.0%

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.
[3] Source of tire data: IDNR. Survey data from this Study was not used to determine quantities of tires collected and processed, because not all collectors and processors responded to the survey. Rather, State data was used, because the State has more accurate figures due to the regulated reporting requirements for tires.

[2] Source: IDNR. Survey data from this Study was not used to determine quantities of tires collected and processed, because not all collectors and processors responded to the survey. Rather, State data was used, because the State has more accurate figures due to the regulated reporting requirements for tires. It should also be noted that in 2005, the collection numbers were unusually large because approximately one million tires were abated from a tire pile and the numbers were counted as 2005 numbers.

The size of these industries in Iowa is difficult to determine from the survey data alone. As such, we will infer the size of these specific industry processors as functions of national statistics. The procedures for those allocations are discussed in Section 4.6.2, the economic impacts of processing recyclable commodities summary.

4.5 Recycled Commodity Processing and Linkages

For purposes of this Study, the economic value of a commodity is determined when the commodity is transformed into an intermediate good. Recyclable commodities are transformed into an input for further production at the processing stage. This is where the commodities receive their first significant added value and the processed commodities are then used in the production of a final good.

There are several advantages for using the processing stage to assign the initial highest value of the recycled commodities as opposed to tracking the commodity flow from household or business to collector and on to the processors. First, the value of the commodity at the collection level, in some instances, may be misleading because of the subsidies provided for recyclable materials collection. In short, the values received by consumers or businesses as measured by direct economic welfare gains are unknown. A financial or market value of recycling is not determined until the commodity is sold.[3] Even though we may know the price of commodities sold, we may not know the full amount of public sector investment as compared to the public's overall investment in solid waste disposal. Second, at the collection level, the amount of labor and capital involved with recycling may be overestimated. In general, the labor and capital needs or shifts in capital are still very similar to those needed to process solid waste in landfills. For these reasons, we have characterized collection as a margined economic benefit: this means that for *x* amount of processing sales, only a small increase in specialized labor and capital is needed to ready the commodity supply for distribution to the processors.

For the analysis of Iowa's recycled commodities processing industries, we modified industrial production factors to represent the capital, labor, and value of product sold by each commodity. In short, even though many commodity types may be processed by individual processors, we have created production functions that are sensitive to the characteristics of each commodity. These simulated commodity-processing industries, one for each specified commodity studied, are linked to the collectors (public and private recyclable materials collection), along with the traditional industrial linkages that are necessary for the production of goods (industrial equipment, finance, utilities, transportation, specialized business services, etc.). The value of these linkages was determined by adapting the characteristics of closely-related processing sectors in the original model and by shifting their demand for commodity inputs to the recycled

[3] It is not possible to calculate the economic impacts of the payments communities receive from processors for their recyclable commodities without doing a full cost accounting analysis to calculate the extent to which those payments offset "normal" costs of solid waste collection and disposal. That is why the "value added" activities of the processor become the point where economic impacts begin. However, in the aggregate, we can calculate some recycling collection economic impacts for Iowa in instances where the recycled commodities were exported to an out of state processor.

commodity collectors. Specifically, returns to capital, employee compensation, employment, and industrial output were adjusted relative to the overall value of the commodity sold per ton and the estimated labor needs to produce the product. When the model was re-compiled with these new values, all other industries in Iowa mathematically recognized the existence of the simulated recycling commodity processors.

4.6 The Economic Impacts of Recycling Commodity Processing in Iowa

4.6.1 Paper, Plastics, Glass, Metals, and Wood Processing

Table 4-4 displays the economic impacts of recycling commodity processors in Iowa. This table displays several dimensions of information about Iowa's recycled commodity processing industries including the following:

- Industrial output;
- Value added;
- Labor income; and
- Jobs.

The direct values represent the amounts for the particular industry that we are studying. The direct industrial output for all other paper, for example, is $25.7 million. That number corresponds with the expected receipts for that industry that were displayed in Table 4-2. The indirect values represent industrial inputs into production to produce the direct commodity that we are measuring. Induced activity comes about as a result of workers receiving salaries and wages and converting them into household spending. The sum of all direct, indirect, and induced values in a category yields the total economic value.

The last column is the economic multiplier. The multiplier is simply a ratio of the total economic value in a category to the direct value. It tells us the expected change in the total economy per unit change in the direct value. The jobs multiplier for all other paper is 1.64. It is derived by dividing the total jobs by the direct jobs, or *784 ÷ 478 = 1.64*. This means that for every 100 jobs in the direct industry ("All Other Paper"), 64 additional jobs are expected to be sustained in the regional economy. The labor income multiplier of 1.65, *$17,629,670 ÷ $10,672,397 = 1.65*, means that for every dollar in labor income in the direct sector, $0.65 in additional income is sustained in the rest of the economy. Multipliers explain the current relationship of the regional economy to the industry that we are measuring. Multipliers vary across commodities for the following reasons:

- Industries with very strong linkages to existing firms will generate higher multipliers, whereas firms with low regional linkages will generate lower multipliers;

- Firms that produce a high-value commodity, all other things being equal, will have higher multipliers than others; and
- Firms that provide relatively high compensation will generate high jobs multipliers as their household spending will drive more retail and service consumption in an area.

Table 4-4 shows the unique I-O results for paper, plastics, glass, metals, and wood commodity processors. The "All Other Metals" values accounted for the preponderance of output and jobs. Excepting them, the highest category for industrial output was aluminum at $36.8 million, followed by all other paper at $30.9 million and all plastics at $26.5 million. The economic multipliers are also listed. Overall, the highest average multipliers are found in the aluminum, plastics, and all other metals processing sectors[4]. This is reflective of the comparatively high value of the product produced during the measurement period and the fact that there are strong linkages from collection, to processing, to end-use in the state.

Table 4-4
Estimated Economic Impacts of Iowa's Recycled Commodity Processing Industries
(2007 Study)[1]

Old Corrugated Containers	Direct	Indirect	Induced	Total[2]	Multiplier
Industrial Output($)	11,296,117	1,630,255	1,030,026	13,956,398	1.24
Value Added($)	7,746,271	2,124,261	1,619,478	11,490,011	1.48
Labor Income($)	4,245,103	1,823,142	1,371,741	7,439,986	1.75
Jobs	181	79	55	315	1.74
All Other Paper	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	25,691,318	3,089,808	2,131,441	30,912,567	1.20
Value Added($)	18,651,373	4,390,265	3,650,361	26,691,999	1.43
Labor Income($)	10,672,397	3,819,556	3,137,718	17,629,670	1.65
Jobs	478	174	133	784	1.64
Plastics	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	17,928,088	3,881,071	4,686,795	26,495,953	1.48
Value Added($)	5,092,339	1,184,202	1,768,847	8,045,388	1.58
Labor Income($)	946,732	609,889	877,070	2,433,691	2.57
Jobs	41	27	36	105	2.53

[4] The total multiplier that is produced by our modeling system is called a Type "SAM" multiplier. It is driven primarily by assumptions about income growth and consumption in the industry and the region that we are studying. In previous studies, we used a multiplier that was called a Type II multiplier. The advantage of the Type "SAM" multiplier is that it measures transactions among households and other institutions as components of the economy under study and represents a more comprehensive description of linked economic activity in an area.

Table 4-4 (continued)
Estimated Economic Impacts of Iowa's Recycled Commodity Processing Industries
(2007 Study)[1]

Glass	Direct	Indirect	Induced	Total[2]	Multiplier
Industrial Output($)[3]	2,305,071	789,488	559,535	3,654,094	1.59
Value Added($)	1,405,071	825,716	302,760	2,533,547	1.80
Labor Income($)	1,538,610	770,917	288,441	2,597,967	1.69
Jobs	77	39	14	129	1.69
Aluminum	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	25,531,670	6,816,749	4,455,801	36,804,220	1.44
Value Added($)	6,702,254	1,649,899	1,346,918	9,699,070	1.45
Labor Income($)	806,992	641,170	499,092	1,947,254	2.41
Jobs	27	21	16	63	2.39
All Other Metal	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	93,999,441	27,131,987	17,133,938	138,265,365	1.47
Value Added($)	28,802,350	10,056,386	7,803,499	46,662,235	1.62
Labor Income($)	7,033,621	6,041,449	4,543,346	17,618,417	2.50
Jobs	228	199	139	565	2.48
Wood Scrap	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	5,022,769	724,886	320,529	6,068,184	1.21
Value Added($)	6,074,846	2,056,671	1,089,570	9,221,088	1.52
Labor Income($)	4,477,106	1,922,780	1,012,479	7,412,364	1.66
Jobs	202	88	43	334	1.65
All Commodities	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	180,594,810	44,064,243	29,818,064	254,477,117	1.41
Value Added($)	74,974,504	22,287,401	17,581,434	114,843,339	1.53
Labor Income($)	29,720,560	15,628,902	11,729,887	57,079,348	1.92
Jobs	1,233	627	435	2,295	1.86

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.
[3] Industrial output for glass does not match the gross sales value in Table 4-2 as all of the other values do. This sector, owing to low prices, appears to not cover its costs; hence, the processing is done at a loss considering all factor inputs. This value represents the total estimated costs of production (or processing), not its receipts.

4.6.2 C&D Debris, Organics, Used Tires, and Electronics Processing

Table 4-5 provides totals for the C&D debris, organics, used tires, and electronics processing industries in Iowa. As was mentioned previously, the survey results did

not give us a definitive characterization of the overall size of these activities in Iowa, especially on the processing side where the economic impacts are compiled. As in the 2001 study, we infer these sectors' activities from national statistics and used the following apportioning factors to characterize these sectors:

- C&D figures in Iowa are heavily weighted towards highway materials, so Iowa's share of all paved highways nationally was the apportioning factor;
- Organics were apportioned on a per capita basis;
- Tires were apportioned based on the state's share of registered trucks and automobiles; and
- The electronics allocation was based on total personal income shares as an approximation for expected household consumption.

Using the national statistics as our foundation, we can expect 68 jobs and $2.5 million in payroll for C&D activity in the state. Composting would require 316 jobs with $3.1 million in payroll. Electronics demanufacturing would need 38 jobs and $869,000 in payroll, and tire processing would require 58 jobs and $1.3 million in payroll.

Table 4-5
Estimates of C&D, Organics, Used Tires, and Electronics Processing
Using National Shares
(2007 Study)

Industry	Nation[1]	Iowa
Pavement Mix Producers		
Employment	3,460	68
Annual Payroll	$ 135,936,000	$ 2,511,000
Estimated Receipts	$ 831,912,000	$18,742,000
Compost and Miscellaneous Organic Products		
Employment	31,718	316
Annual Payroll	$ 330,679,000	$ 3,079,000
Estimated Receipts	$ 1,905,971,000	$21,641,000
Computer and Electronic Appliance Demanufacturers		
Employment	3,837	38
Annual Payroll	$ 93,312,000	$ 869,000
Estimated Receipts	$ 435,509,000	$ 4,945,000
Tires		
Employment	3,917	58
Annual Payroll	$ 91,456,000	$ 1,274,000
Estimated Receipts	$ 377,434,000	$ 6,411,000

[1] Source: U.S. Recycling Economic Information (REI) Study, by R. W. Beck, Inc. for the National Recycling Coalition (NRC), 2001. The data was updated based on population growth since 2001.

We used the inferences in Table 4-5 as the foundation for estimating the potential economic impact of these industries displayed below in Table 4-6. Overall, C&D processing activities, considering all linkages and induced spending, would be expected to support $25.2 million in total industrial output that was produced by 135 jobs earning $5.8 million in labor income. The organic waste sector would produce $37.9 million in total output using 493 jobs making $18.3 million. Electronics processing would generate $7.8 million in total output from 67 jobs and nearly $2.0 million in labor income, and tire processing would generate $10.2 million in total output from 106 jobs and $2.0 million in labor income.

Table 4-6
Estimated Economic Impacts of Iowa's C&D, Organics, Used Tires, and Electronics Processing Industries
(2007 Study)[1]

Construction & Demolition	Direct	Indirect	Induced	Total[2]	Multiplier
Industrial Output($)	18,742,000	2,864,861	3,600,238	25,207,099	1.34
Value Added($)	4,544,000	1,470,337	2,050,514	8,064,851	1.77
Labor Income($)	3,744,000	984,497	1,089,463	5,817,960	1.55
Jobs	68	27	40	135	1.99
Organic Waste	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	21,641,000	4,617,849	11,676,725	37,935,576	1.75
Value Added($)	13,438,999	2,406,172	6,650,527	22,495,698	1.67
Labor Income($)	13,238,999	1,521,800	3,533,419	18,294,220	1.38
Jobs	316	46	131	493	1.56
Electronics	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	4,945,000	1,615,919	1,216,418	7,777,337	1.57
Value Added($)	1,900,412	844,441	692,808	3,437,661	1.81
Labor Income($)	1,130,841	494,024	368,101	1,992,966	1.76
Jobs	38	15	14	67	1.76
Tires	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Industrial Output($)	6,411,000	1,825,063	1,974,350	10,210,412	1.59
Value Added($)	1,499,181	590,788	715,687	2,805,656	1.87
Labor Income($)	1,274,000	357,720	380,250	2,011,970	1.58
Jobs	58	19	29	106	1.83

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

4.6.3 Combined Recycled Commodity Processing Industry Impacts

The values in Tables 4-4 and 4-6 were combined to provide an estimate of the total size of Iowa's recycled commodity processing industries. These summaries are found below in Table 4-7. We estimate that Iowa's recycled commodity processors were responsible for $232.3 million in direct industrial output, 1,713 jobs, and $49.1 million in labor income. These industries required $55.0 million in production inputs from other Iowa firms, which in turn supported 735 jobs making nearly $19.0 million in labor income. When the direct and the indirect workers converted their salaries and wages to household spending, they induced another $48.3 million in output requiring 649 jobs and $17.1 million in labor income. In total, considering all processed commodities and linkages, recycling processing industries supported $335.6 million in total industrial output, from which $151.6 million in value added was realized, and 3,096 jobs were paid $85.2 million in labor incomes.

Table 4-7
Estimated Economic Impacts of All Recycled Commodity Processing in Iowa
(2007 Study)[1]

All Commodities	Direct	Indirect	Induced	Total[2]	Multiplier
Industrial Output($)	232,333,810	54,987,935	48,285,795	335,607,542	1.44
Value Added($)	96,357,096	27,599,139	27,690,970	151,647,205	1.57
Labor Income($)	49,108,400	18,986,942	17,101,120	85,196,464	1.73
Jobs	1,713	735	649	3,096	1.81

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

4.7 Iowa's Recycling Industry End-Users

There are several categories of industries in Iowa that are significant end-users of recycled commodities. Some industries continue to emerge, like plastics and re-manufacturing, while some have a long history in the state, like metals recovery and fabrication. Because these firms are able to purchase recycled commodities that are processed in Iowa, these purchases represent import substitutions and prevent the flow of dollars out of the state. In general, the stronger the linkages that are established between commodity processors and end-users in the state, the stronger the overall economic value of the specific industrial process to the state.

While the total amount of in-state purchases of recycled commodities can only be estimated, we can characterize the overall size and characteristics of these firms in the state. End-user types were constructed to align with the commodity processors: all other paper, old corrugated containers, plastics, all other metals, aluminum, and wood scrap. There were no glass end-users identified in the survey results.

Each of these industries was linked directly to the commodity supply that it purchases to more fully account for the amount and kind of transactions that are expected to occur between supplier and end-user. Each industry's regional purchasing coefficients for their primary inputs were adjusted to reflect the results of the survey regarding the amounts of commodities purchased in-state. Within these estimates, the overall values of the processing industries are subsumed, and they are considered indirect categories as inputs into the end-use production process. Additional secondary data provided by the Iowa Department of Workforce Development were used to determine the employment size of each industry.

Some caution should be used when describing these industries in total. The discrete assessments that we performed exclude measuring the degree to which these industries actually supply manufactured inputs to each other. As a consequence, the totals will reflect a minor amount of "double counting" in the indirect and the induced columns.

Overall, when we sum all of the employment in these firms in Table 4-8 below, we find 10,593 direct manufacturing jobs, $655.7 million in labor income ($61,897 per job), $939.4 million in value added, and $4.1 billion in direct industrial output. All of this direct activity works its way through the economy and supports 25,709 total jobs in the state, $1.15 billion in payments to labor, $1.81 billion in value added, and $5.65 billion in total industrial output.

Table 4-8
Summary of Estimated End-User Manufacturing Economic Values
(2007 Study)[1]

All Manufacturing End-Users	Direct	Indirect	Induced	Total[2]	Multiplier
Output($)	4,064,537,757	882,048,068	701,859,826	5,648,445,770	1.39
Value Added($)	939,365,397	473,222,768	399,795,684	1,812,383,897	1.93
Labor Income($)	655,676,815	281,472,233	212,395,080	1,149,544,119	1.75
Jobs	10,593	7,273	7,843	25,709	2.43

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

Detail for all industries can be found below in Table 4-9. As is the case when conducting similar studies, the metal industry's values are much larger compared to the other commodities. Aluminum and all other metals manufacturing account for large fractions of direct and total jobs and industrial output. The next highest category is "All Other Paper", which accounts for nearly 4,700 jobs and almost $900 million in total output.

Table 4-9
Detailed Manufacturing End-User Estimated Economic Values
(2007 Study)[1]

Old Corrugated Containers	Direct	Indirect	Induced	Total[2]	Multiplier
Output ($)	135,444,992	58,262,500	24,854,918	218,562,416	1.61
Value Added ($)	29,196,480	27,191,770	14,158,061	70,546,312	2.42
Labor Income ($)	17,587,762	15,467,390	7,521,443	40,576,596	2.31
Jobs	265	410	278	952	3.59
All Other Paper	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output ($)	641,472,256	121,904,000	130,463,592	893,839,872	1.39
Value Added ($)	153,648,624	65,504,112	74,316,480	293,469,216	1.91
Labor Income ($)	134,795,520	39,905,128	39,479,616	214,180,256	1.59
Jobs	2,250	989	1,458	4,697	2.09
Plastics	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output ($)	253,376,416	66,147,388	58,955,692	378,479,488	1.49
Value Added ($)	101,657,600	32,526,342	33,583,116	167,767,056	1.65
Labor Income ($)	60,052,632	19,218,358	17,840,636	97,111,624	1.62
Jobs	1,431	478	659	2,568	1.79
Aluminum	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output ($)	2,390,555,136	444,905,568	293,148,480	3,128,609,280	1.31
Value Added ($)	386,617,440	246,503,536	166,981,840	800,102,848	2.07
Labor Income ($)	245,414,992	144,690,384	88,713,512	478,818,880	1.95
Jobs	3,067	3,695	3,276	10,038	3.27
All Other Metal	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output ($)	566,559,680	174,408,048	171,872,016	912,839,744	1.61
Value Added ($)	221,803,760	93,463,008	97,902,336	413,169,120	1.86
Labor Income ($)	172,233,280	57,576,056	52,011,424	281,820,768	1.64
Jobs	3,093	1,577	1,921	6,591	2.13
Wood	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output ($)	77,129,277	16,420,564	22,565,128	116,114,970	1.51
Value Added ($)	46,441,493	8,034,000	12,853,851	67,329,345	1.45
Labor Income ($)	25,592,629	4,614,917	6,828,449	37,035,995	1.45
Jobs	487	124	252	863	1.77

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

4.8 Iowa's Remanufacturing and Reuse Sectors

Table 4-10 below lists the economic values for all remanufacturing and reuse industries in Iowa. These businesses repair and re-sell used commodities or re-usable items. The industries assessed include wood reuse, computer and peripheral repair, motor vehicle parts, tire retreading, and used goods retail. All of these industries accounted for $272.5 million in direct output requiring 2,855 jobs earning $68.4 million in labor income. These industries also linked very strongly with the Iowa economy by requiring $88.7 million in indirect inputs, which required 723 jobs and $25.1 million in labor income. When the direct and the indirect workers converted their wages and salaries into household incomes, they induced $70.2 million in additional sales in the state, 785 more jobs, and $21.3 million in labor income. All together, remanufacturing and reuse accounted for $431.5 million in output, $187.8 million in value added, 114.8 million total labor incomes, and 4,363 jobs.

Table 4-10
Estimated Economic Impacts of Remanufacturing and Reuse Industries
(2007 Study)[1]

Wood Reuse	Direct	Indirect	Induced	Total[2]	Multiplier
Output($)	129,128,904	58,818,828	27,481,570	215,429,296	1.67
Value Added($)	27,855,066	25,717,046	15,652,061	69,224,176	2.49
Labor Income($)	21,777,810	14,922,062	8,316,222	45,016,096	2.07
Jobs	851	417	307	1,576	1.85
Tire Retreading	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output($)	34,189,901	7,330,716	6,526,961	48,047,578	1.41
Value Added($)	8,697,182	3,798,919	3,717,974	16,214,074	1.86
Labor Income($)	6,341,102	2,328,881	1,975,131	10,645,115	1.68
Jobs	143	58	73	274	1.92
Used Motor Vehicle Parts	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output($)	42,152,266	11,231,362	13,128,743	66,512,371	1.58
Value Added($)	24,868,338	6,393,140	7,478,576	38,740,054	1.56
Labor Income($)	13,672,634	4,044,689	3,972,890	21,690,214	1.59
Jobs	409	126	147	681	1.67
Retail Used Goods	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output($)	29,723,733	5,038,951	12,489,492	47,252,176	1.59
Value Added($)	21,911,555	2,874,114	7,114,460	31,900,129	1.46
Labor Income($)	14,727,365	1,738,743	3,779,421	20,245,529	1.37
Jobs	1,160	55	140	1,354	1.17
Computer and Peripheral Reuse and Repair	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output($)	37,308,816	6,292,643	10,621,908	54,223,368	1.45
Value Added($)	22,332,910	3,345,156	6,049,700	31,727,764	1.42
Labor Income($)	11,884,570	2,110,659	3,214,286	17,209,516	1.45
Jobs	292	67	119	478	1.64
Total Reuse and Remanufacturing	**Direct**	**Indirect**	**Induced**	**Total[2]**	**Multiplier**
Output($)	272,503,619	88,712,500	70,248,674	431,464,789	1.58
Value Added($)	105,665,050	42,128,375	40,012,771	187,806,197	1.78
Labor Income($)	68,403,481	25,145,034	21,257,951	114,806,469	1.68
Jobs	2,855	723	785	4,363	1.53

[1] All data is for calendar year 2005. Source of data: Iowa Department of Workforce Development and the U.S. Census Bureau. R. W. Beck quantified the economic activity of remanufacturing and reuse industries by combining existing economic data with data from the U.S. Census Bureau's economic census of U.S. businesses.
[2] Totals may not sum due to rounding.

4.9 Export Sales of Collected Recyclable Materials

Iowa's collectors of recycled commodities had export sales that were valued at $20.5 million. Sales to exports constitute the allocation of a commodity to final demand and can be considered an economic impact. Those sales were run through the I-O model used for this exercise. The findings are contained below in Table 4-11. The economic impacts of exports were not characterized in the previous studies.

Collection export sales required 76 jobs earning $2.26 million in labor income. In so doing, Iowa's collectors required $3.2 million in inputs further stimulating 31 jobs and $.983 million in labor income. When workers in the direct and the indirect industries converted their wages and salaries into household consumption, they induced another $2.4 million in output requiring 27 jobs and $.732 million in labor income. In all, the economic impact of exported collections yielded $26.1 million in industrial output, $6.85 million in state value added, $3.97 million in labor income, and 133 jobs.

Table 4-11
Estimated Collection Export Sales Economic Impacts
(2007 Study)[1]

Collection Export Sales	Direct	Indirect	Induced	Total[2]	Multiplier
Output($)	20,483,107	3,216,447	2,421,622	26,121,177	1.28
Value Added($)	3,790,716	1,681,672	1,379,438	6,851,826	1.81
Labor Income($)	2,255,666	983,499	732,807	3,971,973	1.76
Jobs	76	31	27	133	1.76

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

4.10 Recycling Equipment Manufacturers Economic Values

Recycling equipment manufacturers in Iowa were also surveyed, however because the number of completed surveys returned was limited, economic data for manufacturers of recycling equipment compiled by the Iowa Department of Natural Resources were used as a surrogate for the analysis. These data were summarized by industrial code and the estimated employment in these firms was entered into the I-O model to determine the production characteristics of this component of Iowa's recycling industrial matrix.

Recycling equipment includes the containers, processing equipment, and the vehicles necessary to collect or process recyclable products. As shown in Table 4-12, we estimated that Iowa firms that manufacture these types of goods directly employed 523 workers, paid $27.1 million in labor income, and produced $106.6 million in industrial output. As those activities worked their way through the Iowa economy, we estimated that 994 total jobs were sustained by this sector, $42.2 million in labor

incomes were supported, and total industrial output was $154.7 million. While a portion of the demand for recycling equipment sales originate within the state, a large fraction of the total demand likely comes from out-of-state. Consequently, these firms generate sales for export and are thus considered a part of Iowa's industrial base.

Table 4-12
Estimated Recycling Equipment Manufacturers Economic Values
(2007 Study)[1]

Totals	Direct	Indirect	Induced	Total[2]	Multiplier
Industrial Output($)	106,577,805	22,418,962	25,667,610	154,664,377	1.45
Value Added($)	35,904,400	11,922,702	14,618,915	62,446,017	1.74
Labor Income($)	27,094,544	7,328,191	7,767,316	42,190,051	1.56
Jobs	523	184	287	994	1.90

[1] All data is for calendar year 2005.
[2] Totals may not sum due to rounding.

4.11 Summary

Overall, in 2005, the Iowa recycling industry economic values reflected the following:

- More than $159 million in commodity gross receipts;
- 1,713 direct processing jobs and 3,096 in total recycling-related processing jobs (including C&D, organics, used tires, and electronics);
- 10,593 in direct end-use recycling industry jobs and more than $4 billion in direct industrial output;
- The remanufacturing and reuse industry, in itself, provides more than $431 million in total output and 4,363 jobs;
- The recycling equipment industry, provides more than $154 million in total industrial output and 994 total jobs;
- For every 100 jobs created in the recycling processing industry, 81 additional jobs are sustained in the Iowa economy; and
- For every dollar in labor income created in the recycling processing industry, $0.73 of additional income is sustained in the Iowa economy.

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