



THE ECONOMIC IMPACT OF THE
RECYCLING INDUSTRY
IN TENNESSEE



Prepared for the Southeast Recycling Development Council

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May 31, 2017

Tennessee: The Economic Impact of Recycling

“That recycling is beneficial for the environment is a virtually uncontested proposition. What is becoming increasingly more obvious is that recycling contributes to the economic health of a state's economy.”

- Frank Hefner and Calvin Blackwell, College of Charleston¹



2016 Summary of Results	
Recycling = Jobs Total Economic Impact = 66,555	Recycling = Income Total Economic Impact = \$3.7 Billion
Recycling = Increased Economic Activity Total Economic Impact = \$17.4 Billion	Recycling = Tax Revenues State and Local Taxes = \$497 Million

¹ Hefner, Frank, and Calvin Blackwell. (2007) “The Economic Impact of the Recycling Industry in South Carolina, “*Southern Business Review*, 32 (2), 33-41

Introduction

In order to better understand the economic potential of recycling to the state of Tennessee, the Southeast Recycling Development Council commissioned this study to measure the economic impact of recycling.

This study follows a similar analyses conducted in 2014 in South Carolina sponsored by the S.C. Department of Health and Environmental Control in conjunction with the S.C. Department of Commerce and in 2016 in Alabama for the Southeast Recycling Development Council.

There are a number of methodological issues in analyzing the recycling industry. Unlike industries such as car manufacturing, which have a unique and identifiable designation in the North American Industry Classification System, recycling is not so easily identified. There is no one category that captures the variety of activities that fall under recycling. Researchers have been confronted with similar problems in analyzing other amorphous industries, such as “tourism” and “retirement.” Much like recycling, there is no well-defined category for tourism. The economic activities associated with tourism, like recycling, are diffuse and spread across the entire region.

The most common method to deal with these problems is to combine survey data with an impact model. *This is the method we used in this research.*

Because of the ambiguity in **defining the industry and the usual problems with surveys, comparisons of studies done in other states are not easily made.** For example,

- Alabama in 2012 conducted a study that looked only at municipal solid waste.²
- A study in Connecticut in 2012 found that recycling created 4,860 jobs and contributed \$746 million in economic activity in the state.³
 - The direct impact on jobs was estimated to be 2,785, which implies a multiplier of 1.75 for jobs. The study included public curbside activities as part of the recycling industry.
- The Iowa Department of Natural Resources estimated the impact of recycling in 2005 using a survey.⁴ Approximately 1,365 surveys were mailed with a 15% response rate. It was estimated that 15,684 jobs were directly related to recycling.
 - This generated a total impact of 34,162 jobs in Iowa, which implies a multiplier of 2.18.
- A study done in Illinois included public and private collection of recycling. They identified 958 contacts for a survey, sent 668 surveys, and received 100 returned (15% rate). Municipal residential curbside and drop-off collection amounted to 308 establishments, 665 employees, and \$27,981,000 in payroll. Private residential and commercial collection was 239 establishments, 1,215 employees with a payroll of \$60,859,000. In the Illinois estimate, they also include retail used merchandise sales (595 establishments) such as used furniture stores, Goodwill industries, Play it Again Sports (used sporting equipment), etc.

² *Economic Impact of Recycling in Alabama and Opportunities for Growth*, Alabama Department of Environmental Management, June 2010.

³ *The Economic Impact on Connecticut from Recycling Activity*, prepared by the Connecticut Economic Resource Center, November 2012.

⁴ *Economic Impacts of Recycling in Iowa*, Iowa Department of Natural Resources, December 2007.

The database we used was more in line with an industrial concept.

The Illinois study estimated a direct impact of 40,000 jobs and a total job impact of 111,500. Labor income \$1.5 billion multiplies to \$3.6 billion. Total economic output is \$30.3 billion.⁵

Northeast Recycling Council (NERC) found in 2009 that “Massachusetts is home to over 2000 recycling businesses that employ close to 14,000 people with a payroll approaching \$500 million annually.”⁶ In their 2012 study they surveyed 138 firms. In their 2009 analysis they include municipal residential curbside and drop off collection (so it is private plus public). The study focused primarily on workforce needs in the industry.



⁵ 2010 Recycling Economic Information Study Update for Illinois, Nov. 2010, prepared by DSM Environmental under contract to Illinois Recycling Association.

⁶ Recycling and Jobs in Massachusetts, March 2012.

Results

The Southeast Recycling Development Council identified 281 firms in Tennessee as being in the recycling industry. These firms were contacted and invited to participate in an online survey. Thirty-two surveys were completed.

One of the features of recycling is the wide range of industries engaged in recycling activities. The following table details the range found in our survey.

Distribution of Industries Engaged in Recycling in Tennessee
Waste Remediation
Material Recovery
Janitorial Services
Home Furnishings
Recycling Wholesaler
Miscellaneous Manufacturer
Upholstered Household Furniture Manufacturer
Nonferrous Metal Smelting and Refining
Rolled Steel Manufacturer
Plastics Plumbing Fixture Manufacturer
Petrochemical Manufacturer
Paperboard Mill
Tobacco Manufacturer

Facility Type	Per Cent
Hauler	15.6%
Manufacturer	25%
Broker	15.6%
Processor	59.4%
Remanufacturer	25%
Reuse	6.3%

➤ *One of the characteristics of this industry is that firms are often multi-activity firms. A firm could be both a hauler and a manufacturer.*

➤ *Thus, the total adds to more than 100%. 21.9% of the firms engaged in multiple activities*

Material	Per Cent
Bio-mass	12.5%
Metals	56.3%
Petroleum	6.3%
Glass	15.6%
Electronics	15.6%
Organics	9.4%
Rubber	6.3%
Paper	53.1%
Construction – Demolition	6.3%
Textiles	12.5%
Miscellaneous	
Plastics	56.3%

➤ *Paper and metals dominate the recycled materials. Since some firms recycle more than one type material, the percentages add to more than 100%. 62.5% report they process more than one material*

The survey also asked “What percent of your feedstock is from out of state?”

Out of State Range	Per Cent
1-25%	40.6%
26-50%	6.3%
51-75%	12.5%
76-100%	15.6%
Unsure	12.5%

Employment

A number of firms engage in recycling but recycling is only a part of their business activities. The survey asked “Percentage of your business engaged in recycling.” Respondents were given ranges: 1-25%; 26-50%; 51-75%; 76-100% and “unsure.” Unsure responses were re-categorized based on consistency with other responses. For example, a firm that indicated “unsure” but also indicated a high level of recycling, such as being a manufacturer of recycling equipment, was reclassified into the 76-100% category. Also, where firm names were available, a search of company websites guided our reclassification.

Consistent with the diverse nature of the recycling industry, firm size ranged from 8,000 to 2.5 employees. The average was 413. The median was 24.5. The average salary was reported as \$36,539.

62% of the business activity in the surveyed firms was attributable to recycling. In terms of measuring impact to the state, we will attribute 62% of the total impact of these firms to recycling.



Outlook

In response to the question, “**How many more employees engaged in recycling do you plan to hire in 2017?**”

- 44% indicated they would hire an additional 1-50 employees in 2017.
- 31% indicated they would not increase and
- 25% were unsure.

Consistent with employment outlook, **40.6% indicated that they planned to invest in more plant capacity, equipment, or land in the next five years for recycling.** However, 28% said they were not expanding plant and/or equipment while 31% were unsure. The expansion plans ranged from \$500,000 to a reported range of \$1 million to \$5 million.

Of the firms surveyed, 62.5% are optimistic regarding the potential of recycling responding that they believe that the industry is a growing one. 15.6% were more pessimistic while 21.9% were unsure. **However, 75% of the respondents believe the industry will grow between 1% - 25% annually.**



Multiplier Concept

The survey results provide information on what is termed a “**direct impact.**” The direct impact is the initial spending or job generated by the firm engaged in recycling activities. In order to understand the complete economic impact of the recycling industry, we must also consider what are called “ripple effects.” Ripple effects comprise indirect and induced impacts. The concept is fairly straight forward and often analysts refer to the idea of dropping a stone in a pond. The initial splash is the direct impact. The accompanying ripples are the “multiplier effects.”

Consider a recycling facility. The plant hires workers and pays a payroll. The operations of the plant are the direct expenditures. In the process of its operations the firm may purchase goods and services from other companies. Those purchases are termed the “**indirect impacts.**”

For example, a recyclable materials processor purchases machinery from machinery manufacturers who in turn purchase raw materials, parts, and services from other industries. Further, the recyclable materials processor provides processed feedstock to other manufacturers who then sell their product. The employees in turn spend their paychecks, which in turn generates additional impacts. These impacts are termed “**induced impacts.**”

Multiplier Effects Example

As an example, consider a firm in Tennessee that is in the Waste Management and Remediation Services Sector and employs 100 workers.

Economic Impact of Typical Firm Waste Management and Remediation Services 100 Employees in Tennessee (2016)

Impact Type	Employment	Labor Income	Output
Direct Effect	100	\$6,773,867	\$21,182,220
Indirect Effect	56.8	\$3,159,342	\$8,599,173
Induced Effect	64.7	\$3,124,126	\$8,900,073
Total Effect	221.5	\$13,057,334	\$38,681,466

For every 100 employees working in the Waste Management and Remediation Sector, an additional 121.5 jobs are generated through the indirect and the induced effects, resulting in a total of 221.5 jobs. Labor income paid total \$13,057,334. The total economic activity resulting from the direct output and all of the ripple effects amounts to \$38,681,466.

Other sectors that IMPLAN identifies as being impacted by this firm include food services and drinking places, employment services, real estate, physicians, dentists, and wholesale and retail trade. This is what is meant by the “ripple effect.”

In our sample, a total of 32 firms were identified by the NAICS code. Each firm engaged in recycling in some form. The NAICS codes were matched to IMPLAN for proper input into the model.



The 32 firms employed a total of 2,782 employees in recycling activities. This represents their direct impact. The total impact of in Tennessee of these identified firms as a result of recycling is 7,574.3 jobs, which includes the indirect and induced effects. Total labor income is estimated to be \$425,108,686. Total economic activity in the state is \$1,986,639,918. Total state and local taxes collected as a result of this economic activity are estimated to be \$56,608,774.

Total Economic Impact of Recycling of 32 Firms in Sample

Impact Type	Employment	Labor Income	Output
Direct Effect	2,782.2	171,060,942.8	1,244,924,972.3
Indirect Effect	2,684.2	152,309,959.5	451,855,615.3
Induced Effect	2,107.9	101,737,783.9	289,859,330.3
Total Effect	7,574.3	\$425,108,686	\$1,986,639,918

Total Economic Impact of Recycling Activity in Tennessee

The average number of jobs per firm attributable to recycling activities was estimated to be 87. In order to capture the impact of recycling efforts in Tennessee, the jobs attributable to recycling was used rather than the total number of jobs generated by the firms. With 281 firms identified in this study and an average of 87 jobs per firm, the implication is a direct impact of 24,447 jobs. Using the estimate of the average employment in firms associated with recycling we estimate the following total impacts in Tennessee. This assumes that the industry is characterized by the same mix of firms with similar characteristics as the sample.

Estimated Total Impact of Recycling in Tennessee

Impact Type	Employment	Labor Income	Output	State and Local Taxes
Total	66,555	\$3,735,400,779	\$17,456,468,284	\$497,438,204

APPENDIX A

THE INPUT - OUTPUT MODEL

This section presents a brief description of how regional input-output models are used to estimate economic impacts. Much of the material included is found in a more complete exposition written by Hefner (1997).⁷

The basis for impact analysis is the input-output (I-O) table. The table is constructed with data on detailed inter-industry flows throughout an economy and information on both final demands and total output. An I-O table is fundamentally an accounting relationship for an entire economy (national, state, or sub-state), with each industry represented as both a column and a row in a matrix. In simple terms, it is a set of recipes for production in a given economy. The table provides data on industry demands and supplies to all industries. The multipliers that are used in measuring economic impacts are calculated from the I-O table.

A simple numerical example containing hypothetical data of a two sector economy input-output table is presented in Figure 1.

Figure 1.

<u>Hypothetical Input - Output Table</u>				
	Con	Manu	Final Demand	Total Output
Con	200	100	700	1,000
Manu	400	500	1,100	2,000

⁷Hefner, Frank (1997). "Using Input-Output Models to Measure Local Economic Impacts." *International Journal of Public Administration*, 20 (8&9): 1469-1487.

In this example, the manufacturing sector delivers to final demand \$1,100 worth of goods. Final demand is the finished product that is used by a consumer. In addition, this sector provided \$400 of output to the construction sector and \$500 to itself. The total output of manufacturing is the row total, or \$2,000. From the column of manufacturing data, it is apparent that to produce the \$1,100 of final goods, the manufacturing sector used \$500 worth of its own output and \$100 of output from the construction sector. These demands for goods to be used in the production of goods delivered to final demand are termed intermediate demands.

Wassily Leontief, 1973 Nobel Prize winner in economics, developed the mathematical technique to calculate what is now called the Leontief Inverse, which posits that changes in one economic sector cause a ripple effect into other sectors of the economy. The inverse allows researchers to determine the total effects of a change in final demand. For example, in our simple model above the manufacturing sector utilizes inputs from both its own sector and construction. Construction, in turn, to meet this increase in demand, uses inputs from manufacturing. The Leontief inverse is a mathematical tool that calculates the total round by round changes in demands. The direct impact is the initial change in final demand. The total intermediate demands (the supplier chain) are the indirect impacts. By adding to this simple model a row for payments to labor by the firm (wages) and a column of expenditure patterns (the marginal propensity to consume each type of product), the multipliers derived from the Leontief inverse will incorporate the direct, indirect, and induced impacts. The induced impacts are additional expenditures resulting from increased earnings by local residents as a result of the increase in final demand.

Economic Impact Analysis – Terminology

Term	Definition
Economic activity	Sales of firms within the region.
Jobs	The number of jobs in the region supported by the economic activity associated with the economic activity. IMPLAN jobs include all full-time, part time, and temporary positions. Job estimates are not full time equivalents, but include part time positions. Seasonal jobs are adjusted to annual equivalents, thus 1 job lasting 12 months = 2 jobs lasting 6 months each = 3 jobs lasting 4 months each.
Income	Labor income, including wages and salaries, payroll benefits and incomes of sole proprietors.
Direct effects	Direct effects are the initial changes in sales, income and jobs in those businesses or agencies that directly receive the spending directly. This is the initial impact.
Indirect effects	The impact of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy.
Induced effects	Changes in economic activity in the region resulting from household spending of income earned through a direct or indirect effect. For example, employees in a recycling facility live in the region and spend their incomes on housing, groceries, education, clothing and other goods and services.
Total Output	Sum of direct, indirect and induced effects. <ul style="list-style-type: none"> ▪ Direct effects accrue largely to recycling-related businesses in the area ▪ Indirect effects accrue to a broader set of businesses that serve these firms. ▪ Induced effects are distributed widely across a variety of local businesses that provide goods and services to households in the region.
Multipliers	Multipliers capture the size of the total effects relative to the direct effects.

APPENDIX B

IMPLAN

In the mid-1970s, the USDA Forest Service developed IMPLAN (Impact Analysis for Planning) for community impact analysis. IMPLAN is a regional economic impact model. The current IMPLAN input-output database and model is maintained and sold by MIG, Inc. (Minnesota IMPLAN Group).

All economic impact models use data developed by the U.S. Department of Commerce and follow the methodology described above. According to the USDA, Natural Resources Conservation Service, over 1,500 clients across the country use the IMPLAN model making the results acceptable in inter-agency analysis within the government.⁸ IMPLAN users range from federal, state, and local governments, universities, and private companies.

In Tennessee for example, the model has been used by university researchers at The University of Tennessee's Center for Business and Economic Research and the Institute of Agriculture and at Middle Tennessee State University.

In 2013, MIG was purchased by IMPLAN Group LLC and relocated from Minnesota to Huntersville, N.C., just north of Charlotte.

IMPLAN Group LLC, IMPLAN System (data and software), 16905 Northcross Dr., Suite 120, Huntersville, NC 28078 www.IMPLAN.com

⁸ <http://www.economics.nrcs.usda.gov/technical/implan/implanmodel.html>, August 21, 2009.

APPENDIX C

AUTHOR

Frank Hefner, Ph. D., is a Professor of Economics and director of the Office of Economic Analysis at the College of Charleston. He received his B.A. Degree in Economics from Rutgers College and his M.A. and Ph.D. Degrees from the University of Kansas. He taught at Washburn University in Topeka while he was a research assistant in the Institute for Policy and Social Research at the University of Kansas and at the University of South Carolina where he served as a research economist in the Division of Research. Dr. Hefner's research interests include regional economic development and forecasting. He participates in the Regional Advisory Committee of the S.C. Board of Economic Advisors. He is a past president of the Southern Regional Science Association. He has been quoted frequently in the press and has commented on economic conditions on local television and radio stations and before a number of organizations.

Economic Impact Resume (Selected Works)

Hefner, Frank, Brumby McLeod, and John Crotts. (2014) "Research Note: An Analysis of Cruise Ship Impact on Local Hotel Demand – An Event Study in Charleston, SC," *Tourism Economics*, 20 (5), 1145-1153

Hefner, Frank, and Calvin Blackwell. (2007) "The Economic Impact of the Recycling Industry in South Carolina," *Southern Business Review*, 32 (2), 33-41.

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Hefner, Frank L. (1997) "Using Input-Output Models to Measure Local Economic Impacts," *International Journal of Public Administration*, (20) 8 & 9, pp. 1469-1487.