IHS MARKIT ECONOMICS

The Economic Contributions of Recycling to the Pennsylvania Economy

A report of the Pennsylvania Recycling Markets Center

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Pennsylvania Recycling Markets Center
The Keystone of Recycling Markets Development

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For more information about IHS Markit Economics, contact:

Mohsen Bonakdarpour
Managing Director, Applied Economics
IHS Markit (USA) Inc.
1650 Arch Street | Suite 2000
Philadelphia, PA 19103, United States
mohsen.bonakdarpour@ihsmarkit.com

For press information, contact:

Katherine Smith
Manager, Media Relations
IHS Markit (USA) Inc.
24 Hartwell Avenue
Lexington, MA 02421, United States
katherine.smith@ihsmarkit.com

About the Pennsylvania Recycling Markets Center, Inc. (RMC) (www.pennrmc.org)

The Pennsylvania Recycling Markets Center, Inc. (RMC) is a nonprofit corporation with mission to expand and develop markets for recycled materials. Services include one-on-one technical assistance and business growth consultancy, industry outreach and programming, applied research, and ready access to recycling markets development information. RMC collaborates with many environmental, economic development, and technical assistance organizations, resulting in fast-tracking of time to market for processes or products that use Pennsylvania's recycled materials. RMC is headquartered at Penn State Harrisburg with a satellite office near Pittsburgh. The RMC is funded in part by the Pennsylvania Department of Environmental Protection (DEP).

For more information about the Pennsylvania Recycling Markets Center, contact:

Robert J. Bylone Jr., President and Executive Director
Pennsylvania Recycling Markets Center, Inc.
Penn State Harrisburg, Church Hall 3rd Floor, Middletown, PA 17057
717.798.6660
info@pennrmc.org

Contents

IHS Markit™

Project Directors

- Mohsen Bonakdarpour, Managing Director, Consulting, IHS Markit Economics and Country Risk
- Bob Flanagan, Director, Consulting, IHS Markit Economics and Country Risk
- Robert J. Bylone, Jr., President, Executive Director, Pennsylvania Recycling Markets Center, Inc.

IHS Markit Project Team

- Leslie Levesque, Senior Consultant, Consulting, IHS Markit Economics and Country Risk
- Karen Campbell, Senior Consultant, Consulting, IHS Markit Economics and Country Risk
- Karim Jeafarqomi, Senior Consultant, Consulting, IHS Markit Economics and Country Risk
- Ron Whitfield, Vice President, Consulting, IHS Markit Economics and Country Risk
- John Anton, Senior Principal Economist, IHS Markit Economics and Country Risk
- John Mothersole, Research Director, IHS Markit Economics and Country Risk

RMC Project Team

- Robert J. Bylone Jr., President and Executive Director
- Wayne L. Bowen Jr., Senior Recycling Program Manager
- Peter M. Previte, Recycling Markets Development Manager
- Scott V. Marks, Recycling Program Manager
- Melanie K. Morrison, Administrative Support Coordinator
- Kaitlynn J. Hamaty, Research and Information Specialist

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Executive Summary

The Pennsylvania Recycling Markets Center, Inc. (RMC) and IHS Markit are pleased to provide an extensive and in-depth study on the direct, indirect, and induced economic impacts from Pennsylvania's recycling industry, herein called the "Pennsylvania Recycling Marketplace".

Within the boundaries of this study fall three major categories of recycling activity:

- **The Core Recycling Sectors**, which include public and private hauling operations, material recovery facilities, scrap yards, recycled material wholesalers, and compost and mulch operations
- **The Downstream Manufacturing Sectors,** which further process, refine, and convert recycled feedstocks into manufactured goods, which include glass container and beneficiation plants, paper and steel mills and converters, foundries, and plastic interim processors and manufacturers
- **The Re-use and Remanufacturing Sectors,** which repurpose and refurbish goods that still have some utility to other businesses or individuals, which include thrift stores, reclaimers of construction and demolition waste, tire re-treaders, and electronics refurbishers

Based on Pennsylvania Department of Environmental Protection's 2014 reports of compiled data from counties; municipalities; and industrial, commercial, and institutional establishments, the Core Recycling Sector operations collected, processed, and marketed over 17.4 million tons of recycled materials in Pennsylvania. Notwithstanding the significant environmental and social benefits of consistently recycling this quantity of waste, Pennsylvania's Downstream Manufacturing Sectors' supply chains rely on and greatly benefit from these domestically available recycled material feedstocks.

IHS Markit's top-down research approach includes the use of its regional service and market report assets, proprietary databases, US Census data, business directories, and industrial code databases. RMC's bottom-up approach utilizes its knowledge of and access to state-wide and other pertinent databases, a robust verification process, and professional market development field experience. Combining both approaches resulted in the identification of almost 6,400 companies that encompass the Pennsylvania Recycling Marketplace and provided over 66,000 direct jobs in 2015.

The study's analyses utilize the IMPLAN economic modeling software augmented by IHS Markit's economic data as well as data modifiers codeveloped by IHS Markit and RMC, which are unique to Pennsylvania's Recycling Marketplace. Keys metrics assessed in this study include:

- **Employment:** Includes wage, salary, and self-employment jobs
- **Output:** represents the value of industry production as measured by sales transactions
- **Value added (contributions to Pennsylvania's gross state product):** Defined as an industry's or an establishment's total output less the cost of intermediate inputs, further divided into labor income, other property taxes, and indirect business taxes
- **Labor income:** Captures all forms of employment income, including wages and benefits, employer-paid payroll taxes, unemployment taxes, and proprietor income
- **Government revenue**: Includes taxes and other related revenues on federal, state, and local levels

Referring to the results summarized in Tables ES.1 and ES.2, key findings on the economic contributions of the Recycling Marketplace to Pennsylvania's economy for 2015 are as follows:

Employment

- In 2015, the Recycling Marketplace directly employed over 66,000 people, while stimulating almost 110,000 indirect and induced jobs.
- Activity related to the Core Recycling Sector supported over 32,000 direct, indirect and induced jobs. This was matched by over 122,000 Downstream Manufacturing jobs and almost 21,000 Reuse/Remanufacturing jobs.
- For every direct job within the Recycling Marketplace, an additional 1.7 jobs are supported in Pennsylvania.
- For every job associated with the Core Recycling Sectors, an additional 4.4 jobs are supported in Pennsylvania

Output

- Every $1,000 in direct output (sales activity) leads to an additional $700 in indirect and induced sales activity.
- Every $1,000 of output in the Core Recycling Sectors leads to more than $5,000 of output across the Downstream Manufacturing and Reuse/Remanufacturing Sectors.
- Every $1 million in direct output supports six workers throughout the direct, indirect, and induced categories.
- Every $1 million of output related to the Core Recycling Sector supports 21 workers in the Recycling Marketplace.

Value added contribution to GSP

- In 2015, the Recycling Marketplace contributed $22.6 billion to Pennsylvania's gross state product. Every dollar of direct activity was matched by another dollar of combined indirect and induced value added.
- Activity related to the Core Recycling Sectors lead to $3.8 billion of value added contribution to GSP in 2015. The corresponding figures for the Downstream Manufacturing and Reuse/Remanufacturing Sectors were $17.3 and $1.5 billion, respectively.

Labor Income

- The average labor income per direct job within the Recycling Marketplace was almost $73,000 in 2015. The average labor income across the direct, indirect, and induced categories was $64,500, approximately 23% above the state average.

Government Revenues

- IHS Markit estimates the Recycling Marketplace generated $1.7 billion in state and local taxes and $2.7 billion in federal taxes in 2015. Direct economic activity within the Pennsylvania $635 million in state and local taxes and about $1.3 billion in federal taxes during 2015. Activity in the Downstream Manufacturing sector lead to $1.3 billion and $2.0 billion in federal taxes or about three-quarters of both tax categories.

IHS Markit concludes that the Recycling Marketplace makes substantial contributions to Pennsylvania's economy. When combined with the environmental and social benefits, recycling is a strong positive force within the Commonwealth.

Figure ES.1:
Summary of Pennsylvania Recycling Marketplace Economic Contribution Indicators

Economic Indicator	Direct	Indirect	Induced	Total
Employment (workers)	66,041	56,075	53,470	175,586
Value added ($, mil.)	11,271	6,934	4,481	22,685
Labor income ($, mil.)	4,812	3,921	2,587	11,319
Output ($, mil.)	29,971	13,674	7,323	50,968
Labor income/worker ($)	72,860	69,918	48,377	64,465
Value added/worker ($)	170,660	123,651	83,805	129,198
State and local taxes ($, mil.)	635	579	436	1,650
Federal taxes ($, mil.)	1,242	849	560	2,651

Source: IHS Markit

Figure ES.2:
Summary of Recycling Marketplace Key Economic Contributions by Recycling Category

Economic Indicators	Core Recycling	Downstream Manufacturing	Reuse/ Remanufacturing	Total
Employment (workers)	32,196	122,699	20,691	175,586
Value added ($, mil.)	3,846	17,294	1,546	22,685
Labor income ($, mil.)	2,089	8,310	920	11,319
Output ($, mil.)	8,319	40,036	2,613	50,968
Labor income/worker ($)	64,900	67,724	44,460	64,465
Value added/worker ($)	119,447	140,946	74,706	129,198
State and local taxes ($, mil.)	285	1,251	114	1,650
Federal taxes ($, mil.)	478	1,966	207	2,651

Source: IHS Markit

1. Introduction

Recycling is often touted as the environmentally and socially responsible thing to do. Beyond the obvious benefits of a cleaner environment, converting waste into usable commodity-grade materials substantially reduces the mining, energy, and transportation costs required to convert raw commodities into virgin materials. According to the Institute of Scrap Recycling Industries (ISRI), the energy cost savings from using recycled materials range from 34% for glass to 56% for steel and 92% for aluminum[1.] Indeed, based on reports submitted by Pennsylvania counties; municipalities; and industrial, commercial, and institutional establishments, and summarized in the following Figure 1.1, in 2014, over 17.4 million tons of materials were recycled[2,3]. This amount is equivalent to almost 23 Benjamin Franklin Bridges[4] or to 2,731 pounds for every man, woman, and child in the Commonwealth. However, recycling also leads to additional economic contributions that may not be as obvious.

Figure 1.1: Pennsylvania Act 101 and Residual Waste Materials Recycled in 2014 (tons)

	Act 101[2]	Residual Waste[3]	Total by Material	Percent of Grand Total
Construction and demolition, rubber, e-scrap, textiles, misc.	9,449,756	77,292	9,527,048	54.8%
Metals	3,001,783	96,051	3,097,834	17.8%
Paper	1,871,897	17,039	1,888,936	10.9%
Organics	1,391,862	242,236	1,634,098	9.4%
Single stream	905,622	-	905,622	5.2%
Commingled	115,424	-	115,424	0.7%
Plastics	73,857	11,745	85,602	0.5%
Glass	29,274	96,051	125,325	0.7%
Total by activity	**16,839,475**	**540,414**	**17,379,889**	

Source: Pennsylvania Department of Environmental Protection

IHS Markit Economics Consulting (IHS Markit) was retained by the Pennsylvania Recycling Markets Center, Inc. (RMC) to assess the economic contributions of recycling to the Pennsylvania economy. The purpose of this study is to assess the contributions of the recycling industry in terms of employment, value added [contributions to gross state product (GSP)], sales (output), labor income, and taxes within the Pennsylvanian economy and across the state's six Department of Environmental Protection (DEP) regions.

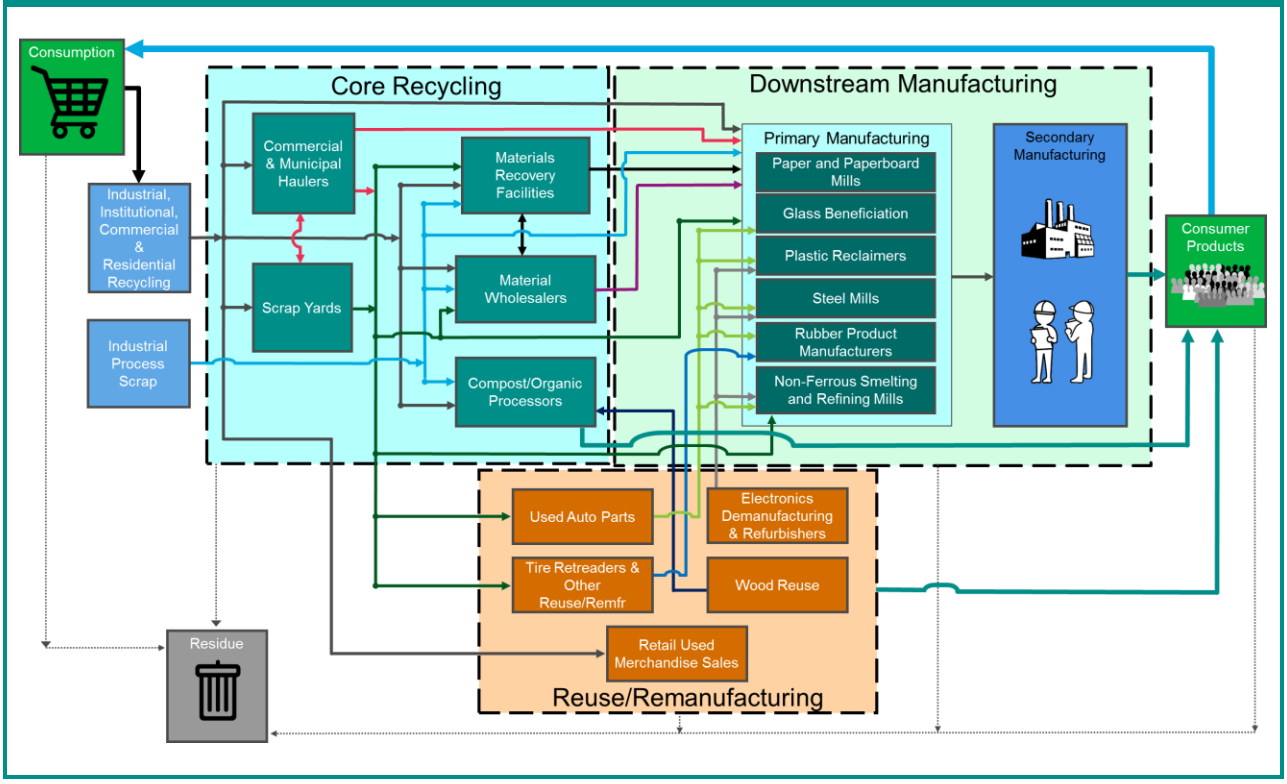
Working together, IHS Markit and RMC identified almost 6,400 companies that form the core of the Pennsylvania Recycling Marketplace. These companies fall into three broad categories:

[1] *Institute of Scrap Recycling Industries, "The ISRI Scrap Yearbook 2015"*
[2] *Pennsylvania DEP 2014 Recycling Report*
[3] *Pennsylvania DEP 2014 Residual Waste Report*
[4] *The Delaware River Port Authority estimates the weight of the Benjamin Franklin Bridge in Philadelphia to be 763,491 tons (http://www.drpa.org/bridges/ben-franklin-bridge.html). Dividing 17,379,889 (tons of recycling) by 763,491 (tons for the bridge) yields 22.8.*

- **Core Recycling Sectors,** which collect, process, and distribute recycled materials, including private and municipal haulers, organics processors and compost producers, materials recovery facilities (MRFs), and scrap yards and recyclables brokers and wholesalers
- **Downstream Manufacturing Sectors** that rely on recycled materials, sometimes as intermediate inputs, such as steel and nonferrous foundries and mills, glass container and product plants, processors and beneficiators, plastics reclaimers, interim processors and product plants, and paper mills and converters. These companies typically have integrated the use of recycled inputs as part of their cost reduction strategies in production processes
- **Reuse/Remanufacturing Sectors**, including companies involved in the reuse, repurposing, or remanufacturing of items such as computers, electronics, used automobile parts, tires, wood, construction materials, clothing, and textiles.

The following Figure 1.2 depicts the flow of recycled materials into, through, and out of the Pennsylvania Recycling Marketplace. A large version of this graphic is also provided in Appendix D.

Figure 1.2: Materials Flow Diagram of the Pennsylvania Recycling Marketplace



Source: Pennsylvania Recycling Markets Center

Based on the research and analyses conducted in this study, IHS Markit estimates that the three broad classes of the Recycling Marketplace directly employed approximately 66,000 people in 2015. The operation of the direct companies triggers additional activities within their associated supply chains, leading to further "indirect" contributions to the Pennsylvania economy. Finally, the employees of the direct and indirect companies spend a portion of their wages on local goods and services, thereby stimulating "induced" contributions to the economy. The indirect and induced activity supported about 56,100 and 53,500 jobs, respectively, in 2015.

Referring to Figure 1.3, IHS Markit estimates that the Pennsylvania Recycling Marketplace supported almost 176,000 direct, indirect, and induced jobs in Pennsylvania in 2015. This represents 3% of all jobs in Pennsylvania. The average wage for jobs in the Recycling Marketplace in 2015 was $64,500 — 23% higher than the state average. Plus, on average, each of these jobs contributed $129,150 to Pennsylvania's GSP in 2015. Detailed breakouts of the results by Recycling Category and by Pennsylvania DEP Region are presented in the section entitled "The Economic Contributions of the Pennsylvania Recycling Marketplace."

Figure 1.3:
Summary of Pennsylvania Recycling Marketplace Economic Contribution Indicators

Economic Indicator	Direct	Indirect	Induced	Total
Employment (workers)	66,041	56,075	53,470	175,586
Value added ($, mil.)	11,271	6,934	4,481	22,685
Labor income ($, mil.)	4,812	3,921	2,587	11,319
Output ($, mil.)	29,971	13,674	7,323	50,968
Labor income/worker ($)	72,860	69,918	48,377	64,465
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State and local taxes ($, mil.)	635	579	436	1,650
Federal taxes ($, mil.)	1,242	849	560	2,651

Source: IHS Markit

How Economic Contributions Assessments Are Reported

The direct, indirect, and induced results of the economic contributions assessment are reported as four sets of metrics: employment, value added contributions to GSP, labor income, and government revenues. Each metric set is briefly described below.

Employment includes wage, salary, and self-employment jobs within the economy.

Value added (contributions to GSP) is an industry's or an establishment's total output less the cost of intermediate nonlabor inputs.

Labor income is a subcomponent of value added, which captures all forms of employment income, including employee compensation (wages and benefits, employer-paid payroll taxes, unemployment taxes, etc.) and proprietor income (payments received by self-employed individuals and unincorporated business owners).

Output represents the value of industry production. For manufacturers, output is sales +/- change in inventory. For service sectors, output equals sales. For retail and wholesale trade, output equals gross margin.

Government revenue includes taxes and other related revenues on the federal, state, and local levels.

Recycled Materials Included in the Study

IHS Markit assessed the economic contributions to Pennsylvania owing to the recycling of the materials listed below. Much of the demand for recovered materials is met from sources within Pennsylvania, including prompt scrap from manufacturers; the approximately 400 scrap yards; recovered construction and demolition waste; and the metals recycled from residential, commercial, and institutional waste streams.

Iron and Steel

According to the ISRI, steel is the most recycled material in the United States and worldwide. Obsolete ferrous scrap is recovered from automobiles, steel structures, household appliances, railroad tracks, ships, farm equipment, and other sources. In addition, prompt scrap, which is generated from industrial and manufacturing sources, accounts for approximately half of the ferrous scrap supply. Producing iron and steel using ferrous scrap rather than virgin materials reduces carbon dioxide (CO_2) emissions by up to 58%.

According to the US Geological Survey[5], the national recycling rates in 2013–14 for various iron and steel products were:

- Cars: 85% (2013)
- Appliances: 82% (2014)
- Steel cans: 70% (2014)
- Structural steel: 98% (2014)

Both obsolete and prompt scraps are processed by the recycling industry into commodity-grade materials that are used to produce more than 60% of total raw steel produced in the United States, predominantly at electric arc furnaces. IHS Markit estimates that Pennsylvania mills with electric arc furnaces have a combined annual production capacity of below 7.68 million metric tons (MMt). The utilization rate of these furnaces in recent years has been slightly over 70%. Furthermore, IHS Markit assumes that 1.1 tons of scrap are required to produce 1.0 ton of steel. Combining these factors, IHS Markit estimates the practical annual maximum demand for steel scrap by electric arc furnaces in Pennsylvania as follows:

7.68 MMt of capacity (70%) 1.1 tons of scrap/ton of new steel
= 5.91 MMt of scrap demand per year

Blast furnace mills, on the other hand, primarily use iron ore rather than scrap. However, a blast furnace mill will almost always use a minimum of 3% scrap for metallurgical reasons and can use up to 25% scrap if ore is expensive, and scrap is relatively cheap. The normal range is 5–10% and is most often at the lower end of the range.

Pennsylvania operates one large blast furnace with a rated annual capacity of about 2.35 MMt per year. Assuming a 7% scrap input, IHS Markit estimates a maximum scrap usage of 2.35 MMt (7%) scrap usage = 0.16 MMt of scrap demand per year.

In total, the practical annual demand for scrap iron and steel from Pennsylvania steel mills is about 6.07 MMt. According to the Pennsylvania DEP's 2014 Recycling and Residual Waste Report, approximately

[5] *U.S. Geological Survey Mineral Commodity Summary, January 2017*

1.3 million (short) tons of ferrous metals were recycled in Pennsylvania. This figure does not include the ferrous metals reported in the single stream and commingled recycling categories.

Aluminum, Copper, and Other Nonferrous Metals

Nonferrous metals, including aluminum, copper, lead, nickel, tin, and zinc do not degrade or lose their chemical or physical properties during the recycling process. As a result, nonferrous metals can theoretically be recycled for an infinite number of times. While ISRI estimates that nonferrous scrap makes up only 7% of the volume of materials recycled in the United States, it accounts for more than half of the total US scrap recycling industry earnings. Based on the Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report, almost 1.5 million (short) tons of nonferrous metals were recycled in Pennsylvania. This figure does not include the nonferrous metals (aluminum cans) in the single stream and commingled recycling streams. Nonferrous scrap is consumed by secondary smelters, refiners, ingot makers, fabricators, foundries, and other industrial consumers. Some typical uses for recycled nonferrous metals include:

- Aluminum: Soft drink cans, aluminum siding, car radiators
- Copper: Wire and electronic device circuitry
- Lead: Car batteries

The national recycling rate for aluminum cans stands at about 67%[6]. Recycling one ton of aluminum cans conserves more than 152 million Btu, the equivalent of 1,024 gallons of gasoline.[7]

Plastics

Recycled postconsumer plastic resin competes head-to-head with virgin materials and is often integrated into the supply chain based on relative price and technical factors such as variations in the melt index and color. Recycled polyethylene terephthalate (rPET) is typically used for fiber applications such as polyester fiberfill for pillows, jackets, sleeping bags, carpet yarns, and geotextiles. The largest use for recycled high-density polyethylene (rHDPE) is nonfood application bottles (e.g., detergent, motor oil, household cleaners), plastic lumber, and composite plastic lumber. Recycled composite lumber consists of wood (sawdust), fiberglass, rHDPE, low-density polyethylene (LDPE), and linear low-density polyethylene (LLDPE) resins. The Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report indicated that over 97,000 (short) tons of plastics were recycled in Pennsylvania. This figure does not include the plastics in the single stream and commingled recycling streams.

From an environmental perspective, recycled plastic can provide enormous benefits over the use of its virgin counterparts. According to the US Environmental Protection Agency (EPA), producing new plastic from recycled materials uses only two-thirds of the energy required to manufacture it from raw materials[8].

[6] *Recycling Quick Read", The Aluminum Association website, "http://www.aluminum.org/industries/production/recycling*

[7] *"Advancing Sustainable Materials Management: 2014 Fact Sheet', EPA website, www.epa.gov/sites/production/files/2016-11/documents/2014_smmfactsheet_508.pdf*

[8] *"Environmental Factoids", EPA website, https://archive.epa.gov/epawaste/conserve/smm/wastewise/web/html/factoid.html*

Glass

According to the Glass Packaging Institute, glass is made from readily available domestic materials, such as sand, soda ash, limestone, and "cullet", the industry term for furnace-ready recycled glass. Manufacturers benefit from using cullet as it results in a reduction of emissions and consumption of raw materials (up to 95%). Its use also extends the life of plant equipment, such as furnaces. In addition, according to ISRI, up to 34% energy savings are realized by using cullet. ISRI estimates that every ton of glass recycled saves 1,300 lbs. of sand, 410 lbs. of soda ash, 380 lbs. of limestone, and 160 lbs. of feldspar, while requiring 34% less energy. ISRI estimates that in 2013, the national recycling rate for glass containers was close to 34%, broken down as follows:

- Beer and soft drink bottles: 41.3%
- Wine and liquor bottles: 34.5%
- Food jars: almost 15%

Noncontainer uses of recycled glass include fiberglass, sandblast abrasive, construction aggregate, filtration media, decorative landscaping and countertops, and concrete products.

According to the Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report, which includes estimated quantities of glass from single stream and commingled materials, an estimated 375,000 tons of postconsumer and postindustrial glass were recycled in Pennsylvania.

Paper

With a recovery rate exceeding 65% nationally, paper and cardboard are among the most widely recycled materials. ISRI estimates that Americans have recycled almost 1.1 billion tons of recovered fiber since 1990. Cardboard and various grades of paper enter the recycling process through single-stream, commingled or source-separated collection programs. In 2014, it is estimated that 1.8 million tons of paper and cardboard were recycled in Pennsylvania. The Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report estimated that almost 1.9 million tons of paper were recycled in Pennsylvania.

The recovered fiber from recycled paper and cardboard is sorted and baled by various specification grades for shipment to paper mills both within and outside Pennsylvania to produce new packaging, paper, tissue, and newsprint. Other uses of recycled paper include cellulose insulation, ceiling tiles, plant containers, packing material, and soil amendments. ISRI estimated that 76% of paper mills rely on recovered fiber to make some or all of their products. Producing paper and cardboard from recovered fiber can result in cost and energy savings of up to 68%.

Other Recycled Materials

Electronics: Electronics recyclers repair, refurbish, and resell functioning electronics equipment as used products in domestic and international markets. Many companies also provide a number of logistical services, such as collection, storage, and transportation as well as scrubbing hard drives of sensitive personal and commercial data. The industry is driven by equipment collected from businesses and commercial interests, comprising up to 75% of the market on a volume basis. In Pennsylvania, there are 31 facilities operating under the Pennsylvania DEP General Permit WMGR081, which authorizes the processing and beneficial use of electronic equipment and components by sorting, disassembling, or mechanical processing. The Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report indicated that almost 26,000 tons of electronic wastes were recycled.

Textiles: EPA estimated that the textile segment of the recycling industry processes billions of pounds of cotton, wool, synthetic, and synthetic-blend products each year. Textiles recovered from individuals (postconsumer) and manufacturers (preconsumer) are recycled as new raw materials for the automotive, furniture, mattress, coarse yarn, home furnishings, paper, and other industries. The Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report indicated that over 13,500 tons of textile wastes were recycled.

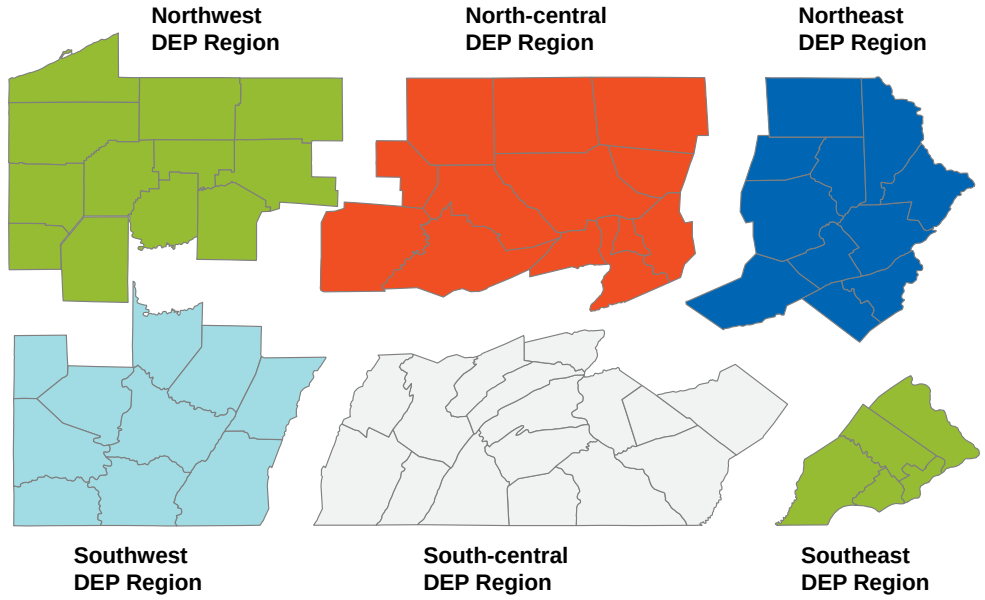
Tires: According to ISRI, in 2014, 103 million tires were processed by the US recycling industry. Scrap tire rubber is used in the manufacture of products such as new tires, playground surfaces and mulches, equestrian mats, and asphalt modifiers. According to The Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report, over 47,000 tons of rubber tires were recycled.

Organics: Act 101 requires mandated municipalities to collect leaves. Waste vehicle loads comprised primarily of leaves are banned from disposal in Pennsylvania landfills and incinerators. In addition to the increase of food scrap and other organics diversion programs, these two factors have fostered a vibrant composting industry in Pennsylvania. According to the Pennsylvania DEP's 2014 Annual Recycling and Residual Waste Report, almost 1.4 million tons of leaf and yard wastes, woody wastes, and source-separated food scraps were recycled by 479 DEP–authorized private and municipal compost sites.

Geographic Coverage

The Pennsylvania DEP aggregates the 67 counties in the Commonwealth of Pennsylvania into six regions. Because the compiled list of companies in the Pennsylvania Recycling Marketplace includes physical addresses, IHS Markit was able to assign each company to its corresponding Pennsylvania DEP region. IHS Markit developed individual models for each Pennsylvania DEP region, enabling the ability to assess the economic contributions of recycling within each region. Pennsylvania DEP regions and their associated counties are shown in the following Figure 1.4.

Figure 1.4: Pennsylvania Department of Environmental Protection Regions



DEP Region	Counties in DEP Region
North West	Butler, Clarion, Crawford, Elk, Erie, Forest, Jefferson, Lawrence, McKean, Mercer, Venango, Warren
North Central	Bradford, Cameron, Centre, Clearfield, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga, Union
North East	Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northampton, Pike, Schuylkill, Susquehanna, Wayne, Wyoming
South West	Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington, Westmoreland
South Central	Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry, York
South East	Bucks, Chester, Delaware, Montgomery, Philadelphia

Source: Pennsylvania Department of Environmental Protection

The Economic Context

Over the last few years, Pennsylvania's economic growth has been sluggish mainly because of ongoing trends in labor force demographics. While Pennsylvania continues to be the sixth most populous state in the union, its population growth has been very low (but positive) for several years, although it slipped slightly below zero from mid-2015 to mid-2016. Similar to other northeastern states, this is driven by high levels of outmigration to other states, likely because of the climate preferences and relatively high cost of living. Exacerbating the situation is a decline of white-collar jobs and related services, which cuts both ways as employers shun expanding in or relocating to areas where they fear current or future labor shortages.

Pennsylvania's slow population growth also stems from a relatively low birth rate coupled with an aging population. At 17%, the proportion of residents aged 65 or older exceeds the US average of 14.9%. The state's natural increase in population, i.e., the number of births less the number of deaths, is lower compared with the national average and is actually negative in many parts of the state.

Pennsylvania's payrolls continued to be flat during the latter part of 2016, with very little overall growth since March. The job market began 2016 with solid gains, but payrolls leveled off by midyear. One sector that has shown solid growth is professional, scientific, and technical services, all of which are occupational areas within the Recycling Marketplace. This is a promising development for the state's economy, as it tends to feature higher wages and can engender indirect job gains. Many other sectors, such as leisure, hospitality, and retail, continue to remain flat. However, these sectors rely heavily on recycling and waste management services.

Payrolls in the natural resources and mining sector continue to decline, although IHS Markit anticipates the numbers to at least level off soon. Job losses began in the beginning of 2015 in the natural gas sector, with closures of coal mines piling on later in the year and into 2016. Natural gas drilling activity is gradually increasing in the state, thanks to a moderate increase in gas prices and the expectation of added pipeline capacity by late 2017. Jobs in iconic manufacturing sectors, such as iron and steel, are expected to continue their steady decline. Retail and wholesale jobs will also continue their downward trend.

Against this backdrop of slow growth and negative demographics, any economic activity that helps Pennsylvania maintain or expand its economy is desirable. One such area is sustainable waste materials management and by extension, the recycling industry. However, in a slow economy, lower waste generation rates typically occur and subsequently fewer materials become available for recycling. In addition, shifting consumer preferences and new packaging designs are causing a significant change in the composition of materials processed. Material recovery facilities need to constantly play a game of equipment modification and technology catch-up to deal with the "evolving ton", where valuable commodities, such as aluminum, paper, and plastics are being recovered in lower quantities owing to lightweighting of packaging materials. For example, today, when compared with 1980, a baled ton of recycled PET and aluminum takes 10,460 more 16 oz plastic bottles and 12,100 more 12 oz aluminum cans, respectively[9]. However, despite these challenges, the following report sections will show that the Recycling Marketplace makes substantial contributions to the Commonwealth.

[9] Anderson, R. (19 July 2016). The Perfect Storm—Economic Impact of Changes in the Recycling Industry [Webinar]. National Recycling Coalition/ PA Recycling Markets Center Sustainable Management Webinar Series

The Impact of Act 101 of 1988—Pennsylvania's Recycling Law[10]

In the 1980's, approximately 1,000 community- and privately owned "dumps" in Pennsylvania were faced with a mandate to comply with new federal and state design and operation standards; otherwise, they would need to cease operations. Because many of these dumps were closed and replaced with highly technologically advanced municipal solid waste landfills, their numbers dwindled to below 50 locations, resulting in many areas experiencing disposal capacity issues that were at or near crisis stage. Citing the need for a comprehensive plan for the Commonwealth to properly manage its municipal waste, the Pennsylvania Legislature enacted the Municipal Waste Planning, Recycling, and Waste Reduction Act (Act 101) of 1988.

The main provisions of Act 101 include:

- A requirement for each of the 67 counties to develop and submit approved plans to the Pennsylvania Department of Environmental Protection to manage their municipal waste and assure a minimum of 10 years of disposal capacity.
- A requirement for counties to report annually municipal waste generation and recycling data to the DEP for use in compiling a statewide analysis of recycling and its benefits.
- A goal for Pennsylvania to recycle at least 25%of all municipal waste by 1997. After meeting this goal, the target became 35% by 2003, which was also met.
- A mandate for municipalities with populations greater than 5,000 and population densities greater than 300 per square mile to collect and recycle a minimum of three items. Based on the 2010 US Census, currently 475 municipalities, which comprise almost 68% of the state's population, are mandated to recycle. At least 91% of the population has access to 1,061 curbsides and/or 814 drop-off recycling programs in Pennsylvania.
- The establishment of grants for the development of county waste plans, municipal recycling collection programs, public education, materials processing and composting facilities, equipment, technical training, household hazardous waste and waste tire collection, and county recycling coordinators. Past grant offerings have included funding for recycling processing and manufacturing equipment for private-sector operations.
- The establishment of a $2-per-ton fee on all wastes disposed at municipal waste landfills and waste-to-energy facilities. To date, over $1.2 billion has been disbursed to support the aforementioned grant programs. This figure includes transfers to the Commonwealth's general fund, but not financial seeding of the Growing Greener Program.

Over a billion-dollar worth of investment into Pennsylvania's waste management and recycling infrastructure has certainly played a significant role in making a positive impact to on the environment and economy. In many cases, public-private partnerships exist. For instance, there are hundreds of communities using the grant program to purchase recycling roll carts, which are then serviced by a contractor to the community. In the lesser-developed areas of Pennsylvania, drop-off and curbside programs have been grant-funded, leading to additional materials available for material recovery facilities and manufacturing operations across Pennsylvania. Consider this: 16.84 million tons of recycled

[10] Sources:

- http://pawasteindustries.org/waste-industry/history/
- Primer—Recycling Fund. Joe Markosek (D), PA House Appropriations Committee Chairman, 2016
- http://www.dep.pa.gov/Business/Land/Waste/Recycling/Pages/default.aspx
- Public Hearing Testimony on Act 101 of 1988, The Municipal Waste Planning, Recycling & Waste Reduction Act. PA Joint Legistlative Air and Water Pollution Control Committee. R Bylone. June, 2017

materials in 2014 translate to more than 15.88 million tons of CO_2 emissions removed from the air, the amount of electricity saved in 2.18 million American homes per year, or 3.34 million passenger vehicles taken off the road for one year.

Recycling materials handling, processing, and manufacturing equipment have dramatically evolved during the 29 years of Act 101's existence. The advent of automated mixed recyclable material processing technologies, commonly known as "single stream", has been engineered to separate recycled materials. Private multimillion-dollar investments (as much as $20 million) have been made in several single-stream projects in Pennsylvania. These technologies can enhance efficiency and streamline other business costs, which is especially important in a variable and sometimes volatile commodity market.

When compared with many other states, Pennsylvania has demonstrated prominence as a leader in recycling and responsible solid waste management. Given the challenges of a commodity marketplace, supporting both the Recycling Marketplace and material supply infrastructure enables Pennsylvanians to engage in recycling.

2. Approach and Methodology

Defining the Pennsylvania Recycling Marketplace

After review of many previous recycling economic studies, IHSM and RMC set the established a new basis for the analysis conducted in this study. Significant modifications and discoveries were made based on RMC's deep understanding of the inner workings of the Pennsylvania recycling industry.

The framework of previous studies assigned industries based on North American Industry Code System (NAICS) to each subcategory. Therefore, this methodology tends to be a top-down approach, starting with an initial list of candidate establishments that match a set of industry-specific criteria, followed by a desk research or survey work to validate that list. This study, on the other hand, took a bottom-up approach, drawing extensively on the RMC's knowledge of the recycling industry in Pennsylvania. By combining data from other sources such as the Pennsylvania DEP's registry of recycling firms and IHS Markit's proprietary Business Market Insights (BMI[11]) database with RMC's deep knowledge of the Pennsylvania recycling markets, a verified list of almost 6,400 business establishments that define the recycling industry in Pennsylvania was compiled to include in the assessment.

During the process of compiling the list, many establishments with NAICS codes not included in previous study frameworks were included in this analysis. While previous study frameworks specified up to approximately 40 NAICS codes, this study encompasses analysis of companies from over 150 NAICS codes and over 95% of Pennsylvania municipalities involved with recycling. Conversely, not every company within a specific NAICS code was automatically included in the analysis. Rather, the RMC verified the candidates to include in the assessment, after which IHS Markit assigned the NAICS code. Focusing on the functional roles companies play in the Recycling Marketplace, rather than just their related NAICS codes, has resulted in a more comprehensive and accurate mapping of the Pennsylvania Recycling Marketplace.

As sales data were not available for all companies on the verified list, IHS Markit used BMI as well as external sources such as Hoovers to collect employment figures and industry assignments for each company by location. Different locations of a given company may have different industry assignments related to the core business functions conducted at each location. In addition, by working at the location level, the IHS Markit and RMC team was able to assign each establishment to the appropriate Pennsylvania DEP region. Thus, focusing on location-specific data refined by RMC has helped IHS Markit develop a more comprehensive data set from which to assess the Pennsylvania Recycling Marketplace.

The entity data were aggregated by NAICS code and geography (i.e., Pennsylvania DEP regions) and used as primary inputs to IHS Markit's economic impact models. IHS Markit constructed custom models for each Pennsylvania DEP region and for the Commonwealth of Pennsylvania.

[11] Additional Information on BMI is provided at the end of this report section.

Core Recycling Sectors

This Recycling Marketplace category includes the operations that many people typically associate with recycling: the collection and transportation of recyclable materials; composting activities; material processing; and the resale of recycled materials (typically in baled format) to downstream sectors for use, in many cases, as intermediate inputs.

For both private- and public-sector operations, collection of recycled materials typically occurs in conjunction with the collection of materials destined for disposal. Since this study addresses economic activity related only to recycling, the RMC has made a concerted effort to determine how much of a particular collection operation should be counted toward recycling. To that end, the RMC developed conservative methodologies and multipliers to estimate recycling activities for private and public collection operations. They are described as follows:

Public Collection Operations: Many Pennsylvania counties, cities, boroughs, townships, and municipal authorities provide waste management services. Employees that do this work are typically assigned to the public works department. However, an employee can hold many functions and duties, some of which are neither attributable nor related to recycling (i.e., one day curbside-collecting recyclables or trash, the next day cleaning storm drains, and the next day installing playground equipment). Based on survey responses from several hundred Pennsylvania municipalities, full-time equivalent (FTE) employee figures for recycling-related tasks and activities were obtained, analyzed, and detailed by RMC, then utilized as input data for the IHS Markit economic model(s).

Private Collection Companies—Small to Medium Operations: Through RMC's data collection efforts, a total of 238 Pennsylvania-based private hauling operations that provide recycling services were identified. Economic model input data for these operations included multiple tiered modifiers based on estimated percentage of recycling related activity in a given DEP region. As one would anticipate, the modifier figures were found to be lower in Pennsylvania DEP regions where there are lower percentages of populations served by curbside recycling programs.

Publically Traded Collection Companies: There are four publically traded collection companies that provide recycling-related services in Pennsylvania. Using data from revenue tables found in each of the company's annual reports, the percentage of recycling-related business for each company was estimated.

Figure 2.1: Core Recycling (CR) Sectors

CR-Sector ID	CR Sector Name	Description
CR 1	Public Collection	Recyclables collected from residential, commercial, institutional, and industrial sources using government employees
CR 2	Private Collection	Recyclables collected from residential, commercial, institutional, and industrial sources using private firms
CR 3	Compost, Mulch and Miscellaneous Organic Products Producers	Establishments that process organic materials such as leaves, yard waste, agricultural manures and residues, and biosolids into compost, mulch, or soil amendment products
CR 4	Materials Recovery Facilities (MRFs)	Establishments that process single-stream, commingled, or source-separated materials from residential, commercial, institutional, and industrial sources
CR 5	Scrap Yards and Recyclable Material Wholesalers	Paper stock dealers, scrap metal processors, and other establishments that sort, remove contaminants, and densify recovered materials, including wholesalers of recovered electronics, textiles, and plastics

Downstream Manufacturing sectors

The Downstream Manufacturing Sectors represent manufacturing operations that utilize recycled materials to various degrees. The decision to incorporate recycled content feedstocks may depend on a number of factors, including but not limited to the following:

- Marketing or sales strategies that are based on consumer demand for recycled content products as well as corporate sustainability or "green" initiatives that are supported by recycled content manufacturing production
- Ease or cost of material acquisition, which influences decisions to use recycled feedstocks as a safeguard against virgin commodity supply and price fluctuations. In addition, some manufacturers purposely site their operations near or adjacent to their recycled content suppliers to ensure a reliable supply chain where transportation cost containment can be realized.
- Certain manufacturing processes require utilization of recycled content feedstocks to meet certain chemical or metallurgical requirements. A good example is an electric arc furnace, which is designed to utilize a high percentage of recycled scrap in its production.

For this study, IHS Markit considered Downstream Manufacturing in a manner somewhat different from previous studies. Previous studies estimated the percentage of a manufacturing sector's intermediate inputs that is typically spent on recycled materials. This same percentage was then applied to sector-level employment and revenues and classified as the portion of the sector's business that was reliant on recycling. This study assumed that the use of recycled inputs is already factored into a company's or sector's cost structure. Thus, the full employment and revenues of downstream companies were reported in this study, and rationale for the same is described in this section. This is not meant to claim that all employment of a company is dependent upon recycling simply because it uses recycled inputs. Instead, it was intended to highlight the depths to which recycling permeates the manufacturing sector in Pennsylvania.

Figure 2.2: Downstream Manufacturing (DM) Sectors Industries Category

Sector ID	DM Sector Name	Description
DM 1	Glass Container Manufacturing Plants and Glass Product Producers	Producers of finished glass, container glass, and products other than containers, such as aggregate, reflective materials, fiberglass, and abrasives
DM 2	Nonferrous Secondary Smelting and Refining Mills, Foundries, and Product Producers	Recycling and alloying of nonferrous metals into primary shapes, including billets, ingots, and other basic shapes; producers of nonferrous primary products through extrusion, rolling, or drawing processes; and production of castings from nonferrous metals
DM 3	Paper and Paperboard Mills/Deinked Market, Pulp Producers, and Paper-Based Product Converters and Manufacturers	Producers of paper and paperboard products from recovered paper or market pulp and/or deink-recovered paper and cellulose-based products from recovered paper or paperboard (e.g., cellulose insulation, hydroseeding, molded fiber trays)
DM 4	Plastics Reclaimers, Interim Processors, Compounders, and Product Manufacturers	Transformers of recovered plastics into raw materials such as flake or pellet ready for remanufacture and into intermediate or end products (e.g., plastic lumber)
DM 5	Rubber Product Manufacturers	Producers that use crumb rubber or cut rubber shapes and stampings as feedstock
DM 6	Steel Mills and Iron and Steel Foundries	Producers of iron and steel slabs, billets, bar, plate, and sheet from scrap and/or raw materials, including upstream preparation and downstream stamping and cutting; and production of cast iron or steel products
DM 7	Other Recycling Processors/Manufacturers	Processors and manufacturers not elsewhere classified, using ash, sludge, asphalt, engineering application of tires, or other recyclable materials

Reuse/Remanufacturing Sectors

Not all recycled materials are melted down or processed into secondary materials. Computers and electronics can be refurbished and resold. Valuable parts can be extracted from automobiles for resale before scrap yards process the cars for their steel. Goodwill and other charitable organizations run thrift shops where used furniture and clothing can be purchased. The Reuse Sectors include those companies that repurpose, refurbish, and redeploy goods that still have some utility to other businesses or individuals.

When conducting research on the Reuse sectors, it was recognized that automotive parts can typically be purchased through two channels. The first includes the wholesalers, whose businesses are built primarily around the reselling of used automotive parts. These wholesalers were fully included in the analysis. The second channel includes retail establishments (such as Advance Auto Parts or Pep Boys), which primarily sell new automotive parts, with a minimal amount of their business coming from used or rebuilt systems. A small portion of their business activity (5%) was included in the analysis.

Figure 2.3: Reuse/Remanufacturing (RR) Category

Sector ID	RR Sector Name	Description
RR 1	Computer and Electronic Appliance De-manufacturers	Sort, grade, dismantle, and/or refurbish used electronic devices and peripherals
RR 2	Motor Vehicle Parts (used)	Clean, sort, inspect, remanufacture, wholesale, and retail used automobile parts
RR 3	Retail Used Merchandise Sales	Retail thrift stores, antique shops, reuse centers, and other shops dedicated to selling used merchandise, including building materials
RR 4	Wood Reuse	Process or repurpose used wood for reuse (e.g., pallet rebuilders, construction materials)
RR 5	Other Reuse	Other reuse or remanufacturing, not elsewhere classified

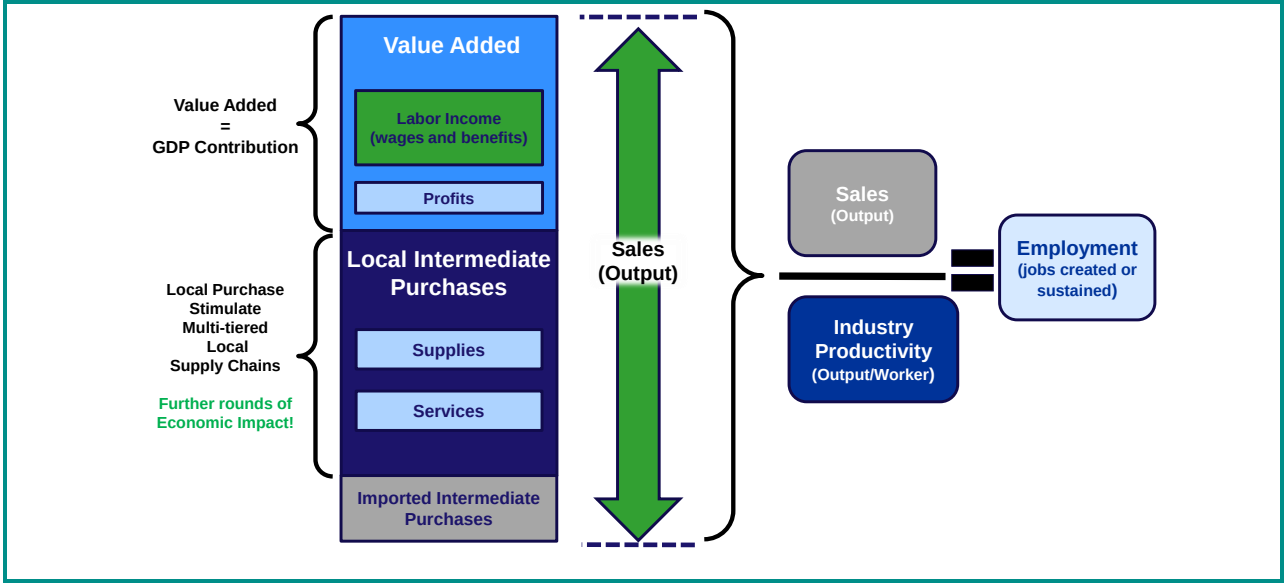
Measuring the Contribution of the Pennsylvania Recycling Industry

Business transactions with local suppliers and service providers serve as catalysts that trigger a flurry of further economic activity. For example, when a supplier sells a product or service to a producer of an end-use good or service, that supplier needs to hire employees (e.g., labor) to transform inputs (raw materials, energy, intellectual capital) into the final product or service. The inflation-adjusted ratio of sales to employees—which economists call output per employee—is a measure of productivity that can be used to translate sales levels into requisite employment needs.

The models IHS Markit developed to assess the Pennsylvania recycling industry contain productivity statistics for 440 industry sectors. As described at the end of this section, the IHS Markit Business Markets Insight (BMI) data provided one means to translate and aggregate the compiled list into a composite of the Pennsylvania Recycling Marketplace. This data enabled an accurate assignment of the employment in each establishment to the appropriate industry sector and regional model. Industry-specific productivity data was then applied to quantify the level of output supported by the business transactions within each industry sector by Pennsylvania DEP region. These contributions were classified as direct impacts.

Sourcing from a supplier chain invokes additional rounds of economic impact. Referring to the left side of the following graphic, when a company places an order, the supplier must then purchase the inputs (supplies and services) needed to produce the final product. Some of these purchases will be imported from outside Pennsylvania and, therefore, were not included in the analysis. The remaining purchases, which represent sales for local businesses, remain within the Pennsylvania economy. Each supplier must, in turn, hire employees and source additional inputs from its suppliers. This effect occurs over and over again throughout the extended local supply chain. Because they are the result of transactions between vendors and their supplier networks (interindustry), these activities are classified as indirect impacts.

Figure 2.4: Economic Impact Metrics



Source: IHS Markit

The difference between the value of a sale and the cost of its required nonlabor inputs is known as value added. As its name suggests, this represents how much more valuable a final product or service is relative to its inputs. The sum of all of the value added by all industries within an economy is equivalent to gross domestic product (GDP) on the national level or GSP on the state level. Assessing value added safeguards against the double counting that may occur when compiling output or sales revenue data by industry.

GDP or GSP is generally considered the broadest measure of an economy's health. The models developed by IHS Markit for this study included value added statistics for each of 440 industries, allowing IHS Markit to assess the contributions of the recycling industry to Pennsylvania's GSP. A company draws from its value added to pay its employees, pay taxes, and retain profits.

Finally, the direct and indirect employees spend a portion of their salaries in the local economy on consumer goods and services. This stimulates yet another round of economic activity, which results in "induced" impacts on employment and value added, among others.

The analysis determined industry-specific income, employment, and value added data for Pennsylvania and each of the Pennsylvania DEP regions. IHS Markit maintains broad industry-level data by state for employment and GSP contributions through its US Regional Economics group. Contributions to federal and state tax were also determined as part of the economic impact analysis.

IHS Markit Business Market Insights (BMI)

BMI is a robust database that provides market-leading forecast views of business employment and output at the state, metropolitan statistical area (MSA), and county level. Using advanced modeling techniques and a rich dataset from the United States Census Bureau, IHS Markit teams of economists and business specialists leverage the IHS Markit's internationally recognized US macroeconomic, industry, and regional forecasts to generate business activity indicators by county and detailed four-digit NAICS code. Private companies, financial institutions, and government agencies use this one-of-a-kind database to get a deep look at the US markets. It enables users to estimate the size and growth potential of a specific industry in a particular geography even when regional data are limited. The database is designed to allow users to easily aggregate our historical data and forecasts by market area or industry.

Database coverage:

- Employment
- Number of establishments
- Sales (output) in current and constant dollars
- Four-digit NAICS code
- US states, MSAs, counties, and census regions
- 25-year forecast, 15+ years history, annual data

IMPLAN Model

IHS Markit Global Insight sourced data from IMPLAN to construct the seven models (Commonwealth of Pennsylvania state plus six Pennsylvania DEP regions) used in this study to quantify the economic contributions of the Pennsylvania recycling industry. The IMPLAN model closely follows the accounting conventions such those used in the US Bureau of Economic Analysis' study—Input-Output Study of the US Economy—and is flexible enough to evaluate changes via the value of output or employment from the source industry. Using data from the World Industry Services, World Economic Services, and other IHS Markit proprietary data assets, we customized and refined the modeling environment.

The direct, indirect, and induced job estimates in this report were quantified through input-output modeling and social accounting matrices using the customized IMPLAN model. Input-output accounting describes commodity flows from producers to intermediates and final consumers. The total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced.

The notion of a multiplier rests upon the difference between the initial effect of a change in final demand and the total effects of that change. Total effects can be calculated either as direct and indirect effects; or as direct, indirect, and induced effects. Direct effects are production changes associated with the immediate effects or final demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries (for example, additional purchases to produce additional output). Induced effects are the changes in regional household spending patterns caused by changes in household income generated from the direct and indirect effects.

Type I multipliers

A Type I multiplier is the direct effect produced by a change in final demand plus the indirect effect, divided by the direct effect. Increased demand is assumed to lead to increased employment and population, with the average income level remaining constant. The Leontief inverse (Type I multipliers matrix) is derived by inverting the direct coefficients matrix. The result is a matrix of total requirement coefficients, the amount each industry must produce for the purchasing industry to deliver one dollar's worth of output to final demand.

Type SAM multipliers

Type SAM multipliers incorporate “induced” effects resulting from the household expenditures from new labor income. The linear relationship between labor income and household expenditure can be customized in the IMPLAN software. The default relationship is PCE and total household expenditure. Each dollar of workplace-based income is spent based on the SAM relationship generated by IMPLAN.

3. The Economic Contributions of the Pennsylvania Recycling Marketplace

The primary goal of this study is to conduct a comprehensive assessment of the economic contributions of recycling to the Commonwealth of Pennsylvania. Earlier assessments were completed before the Great Recession of 2009. Therefore, those assessments are based on an outdated structure of the Pennsylvania economy. For example, IHS Markit and RMC identified many more second-hand stores in Pennsylvania in 2015 than found in previous studies. This could potentially be an indicator of changes in consumer shopping patterns coming out of the Great Recession.

Another differentiator is this study was conducted using a bottom-up approach. Working together, IHS Markit and RMC identified almost 6,400 companies that form the Pennsylvania Recycling Marketplace. This included many companies that are active participants in the Recycling Marketplace that may have been overlooked in more top-down approaches. The IHSM/RMC approach captured companies based on their functional participation in the recycling, not just their designated industry codes.

The companies in the Recycling Marketplace fall into three broad categories (see below). Additional details regarding the subcomponents of each category are provided in the Approach and Methodology section.

- **Core Recycling Sectors,** which collect, process, and distribute recycled materials, including private and municipal haulers, organics processors and compost producers, and MRFs, and scrap yards and recyclables brokers and wholesalers

- **Downstream Manufacturing Sectors** that rely on recycled materials, sometimes as intermediate inputs, such as steel and nonferrous foundries and mills, glass container and product plants, processors and beneficiators, plastics reclaimers, interim processors and product plants, and paper mills and converters. These companies typically have integrated the use of recycled inputs as part of their cost reduction strategies to production processes.

- ***Reuse/Remanufacturing Sectors***, including companies involved in the reuse, repurposing, or remanufacturing of items such as computers, electronics, used automobile parts, tires, wood, construction materials, clothing, and textiles.

IHS Markit assessed the recycling industry's contributions in terms of employment, value added (contributions to GSP), sales (output), labor income, and taxes within the Pennsylvania economy and across the state's six DEP regions.

Based on the research and analyses conducted in this study, IHS Markit estimates that the three broad classes of the Recycling Marketplace directly employed over 66,000 people in 2015. Figure 3.1 presents the distribution of recycling establishments and employment by both category and Pennsylvania DEP region. The Pennsylvania DEP regions in the southern part of Pennsylvania account for 65% of the recycling establishments and 66% of the direct employment. This is not surprising, given the population and industrial centers of Pittsburgh and Philadelphia are in the South West and South East Pennsylvania DEP regions, respectively. As previously noted, the reuse sectors, which are dominated by second-hand shops and used automotive parts stores, make up a significant portion of the Recycling Marketplace, accounting for 62% of establishments and 21% of employment. The large disparity between the reuse sector's percentage of establishments (62%) and employment (21%) reflects the fact that although there are many establishments, they tend to employ relatively few workers.

Figure 3.1: Recycling Marketplace Establishments and Employment by DEP Region

Number of Establishments	North East	North Central	North West	South East	South Central	South West	PA
Core Recycling Sectors	433	155	173	296	437	343	1,837
Downstream Manufacturing Sectors	84	38	67	98	151	141	579
Reuse/Remanufacturing Sectors	562	280	410	959	908	838	3,957
Total	1,079	473	650	1,353	1,496	1,322	6,373
Distribution							
Core Recycling Sectors	6.8%	2.4%	2.7%	4.6%	6.9%	5.4%	28.8%
Downstream Manufacturing Sectors	1.3%	0.6%	1.1%	1.5%	2.4%	2.2%	9.1%
Reuse/Remanufacturing Sectors	8.8%	4.4%	6.4%	15.0%	14.2%	13.1%	62.1%
Total	16.9%	7.4%	10.2%	21.2%	23.5%	20.7%	100.0%

Employment	North East	North Central	North West	South East	South Central	South West	PA
Core Recycling Sectors	2,060	875	1,475	2,702	2,553	3,033	12,698
Downstream Manufacturing Sectors	6,208	2,364	5,183	3,841	10,946	11,257	39,799
Reuse/Remanufacturing Sectors	1,868	982	1,397	3,137	3,216	2,944	13,544
Total	10,136	4,221	8,055	9,680	16,715	17,234	66,041
Distribution							
Core Recycling Sectors	3.1%	1.3%	2.2%	4.1%	3.9%	4.6%	19.2%
Downstream Manufacturing Sectors	9.4%	3.6%	7.8%	5.8%	16.6%	17.0%	60.3%
Reuse/Remanufacturing Sectors	2.8%	1.5%	2.1%	4.8%	4.9%	4.5%	20.5%
Total	15.3%	6.4%	12.2%	14.7%	25.3%	26.1%	100.0%

Source: IHS Markit

The operation of the direct companies stimulates additional activities within their associated supply chains, leading to further "indirect" contributions to the Pennsylvania economy. Finally, the employees of the direct and indirect companies spend a portion of their wages on local goods and services, thereby stimulating "induced" contributions to the economy. IHS Markit estimates that the Pennsylvania Recycling Marketplace supported approximately 176,000 direct, indirect, and induced jobs across Pennsylvania in 2015. This represents 3% of the jobs in Pennsylvania. The average labor income for jobs in the Recycling Marketplace in 2015 was $64,500. Plus, on average, each of these jobs contributed $129,150 to Pennsylvania's GSP in 2015. In addition, IHS Markit estimates the economic activity stimulated by the Pennsylvania Recycling Marketplace generated almost $1.7 billion in state and local taxes and $2.7 billion in federal taxes during 2015.

Figure 3.2 shows the key economic contributions of the Recycling Marketplace by recycling category. This clearly shows that downstream manufacturing firms drive the bulk of the economic contributions. For example, downstream manufacturing drives approximately 123,000 out of the 176,000 jobs (70%) in the Recycling Marketplace.

Figure 3.2: Recycling Marketplace Key Economic Contributions by Recycling Category

Economic Indicators	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Employment (workers)	**32,196**	**122,699**	**20,691**	**175,586**
Direct	12,698	39,799	13,544	66,041
Indirect	9,681	43,562	2,831	56,075
Induced	9,816	39,338	4,316	53,470
Value added ($, mil.)	**3,846**	**17,294**	**1,546**	**22,685**
Direct	1,929	8,435	907	11,271
Indirect	1,094	5,562	278	6,934
Induced	823	3,297	361	4,481
Labor income ($, mil.)	**2,089**	**8,310**	**920**	**11,319**
Direct	962	3,312	537	4,812
Indirect	652	3,094	174	3,921
Induced	475	1,903	209	2,587
Output ($, mil.)	**8,319**	**40,036**	**2,613**	**50,968**
Direct	4,718	23,703	1,550	29,971
Indirect	2,257	10,945	473	13,674
Induced	1,344	5,388	591	7,323
Value added/worker ($)	**119,447**	**140,946**	**74,706**	**129,198**
Direct	151,916	211,938	66,939	170,660
Indirect	113,010	127,679	98,058	123,651
Induced	83,795	83,813	83,763	83,805
Labor income/worker ($)	**64,900**	**67,724**	**44,460**	**64,465**
Direct	75,799	83,220	39,662	72,860
Indirect	67,362	71,035	61,465	69,918
Induced	48,373	48,379	48,362	48,377
Output/worker ($)	**258,382**	**326,297**	**126,288**	**290,275**
Direct	371,548	595,575	114,422	453,823
Indirect	233,090	251,251	166,882	243,855
Induced	136,942	136,967	136,895	136,957

Source: IHS Markit

Figure 3.3 shows the key economic contributions of the Recycling Marketplace by Pennsylvania DEP region. Given the concentration of downstream manufacturing firms located in the South Central and South West regions, more than half of any of the economic contributions accrue in these two regions.

Figure 3.3: Recycling Marketplace Key Economic Contributions by Pennsylvania DEP Region

Economic Indicators	North East	North Central	North West	South East	South Central	South West	PA
Employment (workers)	**29,716**	**8,544**	**17,571**	**22,077**	**42,140**	**55,538**	**175,586**
Direct	10,136	4,221	8,055	9,680	16,715	17,234	66,041
Indirect	10,532	2,296	5,032	5,856	12,927	19,431	56,075
Induced	8,966	1,944	4,581	6,524	12,427	19,027	53,470
Value added ($, mil.)	**3,879**	**982**	**2,240**	**2,849**	**5,325**	**7,411**	**22,685**
Direct	1,907	592	1,369	1,356	2,894	3,152	11,271
Indirect	1,226	238	545	829	1,447	2,648	6,934
Induced	722	145	324	661	984	1,646	4,481
Labor income ($, mil.)	**1,832**	**456**	**1,008**	**1,627**	**2,549**	**3,846**	**11,319**
Direct	780	255	547	691	1,189	1,351	4,812
Indirect	653	120	283	532	812	1,521	3,921
Induced	394	77	178	402	548	988	2,587
Output ($, mil.)	**8,970**	**2,350**	**5,617**	**5,867**	**11,797**	**16,367**	**50,968**
Direct	5,511	1,605	3,623	3,146	7,366	8,720	29,971
Indirect	2,201	478	1,402	1,662	2,828	5,103	13,674
Induced	1,169	243	583	1,059	1,620	2,649	7,323
Value added/worker ($)	**130,525**	**114,953**	**127,505**	**129,029**	**126,360**	**133,436**	**129,198**
Direct	188,113	140,369	169,986	140,124	173,129	182,887	170,660
Indirect	116,413	103,606	108,389	141,634	111,899	136,293	123,651
Induced	80,469	74,398	70,616	101,304	79,192	86,527	83,805
Labor income/worker ($)	**61,660**	**53,330**	**57,353**	**73,716**	**60,501**	**69,258**	**64,465**
Direct	76,945	60,331	67,858	71,425	71,112	78,366	72,860
Indirect	61,965	52,361	56,276	90,778	62,816	78,274	69,918
Induced	43,905	39,393	38,788	61,689	44,125	51,923	48,377
Output/worker ($)	**301,848**	**275,077**	**319,650**	**265,759**	**279,952**	**294,706**	**290,275**
Direct	543,695	380,131	449,810	324,992	440,702	505,978	453,823
Indirect	208,960	208,330	278,589	283,867	218,772	262,602	243,855
Induced	130,329	125,035	127,342	162,390	130,354	139,206	136,957

Source: IHS Markit

Appendices A and B provide more detailed breakouts of the economic contributions by Recycling Marketplace category, DEP region, and industry.

Conclusion

Working together, IHS Markit and RMC used a bottom-up approach to identify almost 6,400 companies that encompass the Pennsylvania Recycling Marketplace. IHS Markit segmented the Recycling Marketplace into three broad categories: core recycling sectors, downstream manufacturing sectors, and reuse/remanufacturing sectors, IHS Markit estimates that the 6,400 companies in the Pennsylvania Recycling Marketplace directly employed over 66,000 people in 2015.

The operation of the direct companies stimulates additional activities within their associated supply chains, leading to further "indirect" contributions to the Pennsylvania economy. Finally, the employees of the direct and indirect companies spend some of their wages on local goods and services, thereby stimulating "induced" contributions to the economy. The indirect and induced activities supported about 56,000 and over 53,500 jobs, respectively, in 2015. Key findings of this study include:

Employment

- In 2015, the Recycling Marketplace directly employed over 66,000 people, while stimulating almost 110,000 indirect and induced jobs.
- Activity related to the Core Recycling Sector supported over 32,000 direct, indirect and induced jobs. This was matched by over 122,000 Downstream Manufacturing jobs and almost 21,000 Reuse/Remanufacturing jobs.
- For every direct job within the Recycling Marketplace, an additional 1.7 jobs are supported in Pennsylvania.
- For every job associated with the Core Recycling Sectors, an additional 4.4 jobs are supported in Pennsylvania

Output

- Every $1,000 in direct output (sales activity) leads to an additional $700 in indirect and induced sales activity.
- Every $1,000 of output in the Core Recycling Sectors leads to more than $5,000 of output across the Downstream Manufacturing and Reuse/Remanufacturing Sectors.
- Every $1 million in direct output supports six workers throughout the direct, indirect, and induced categories.
- Every $1 million of output related to the Core Recycling Sector supports 21 workers in the Recycling Marketplace.

Value added contribution to GSP

- In 2015, the Recycling Marketplace contributed $22.6 billion to Pennsylvania's gross state product. Every dollar of direct activity was matched by another dollar of combined indirect and induced value added.
- Activity related to the Core Recycling Sectors lead to $3.8 billion of value added contribution to GSP in 2015. The corresponding figures for the Downstream Manufacturing and Reuse/Remanufacturing Sectors were $17.3 and $1.5 billion, respectively.

Labor Income

- The average labor income per direct job within the Recycling Marketplace was almost $73,000 in 2015. The average labor income across the direct, indirect, and induced categories was $64,500, approximately 23% above the state average.

Government Revenues

- IHS Markit estimates the Recycling Marketplace generated $1.7 billion in state and local taxes and $2.7 billion in federal taxes in 2015. Direct economic activity within the Pennsylvania $635 million in state and local taxes and about $1.3 billion in federal taxes during 2015. Activity in the Downstream Manufacturing sector lead to $1.3 billion and $2.0 billion in federal taxes or about three-quarters of both tax categories.

IHS Markit concludes that the Recycling Marketplace makes substantial contributions to the Commonwealth of Pennsylvania's economy. When combined with the environmental and social benefits, recycling is a strong positive force within the Commonwealth.

Appendix A:
Economic Contributions by PA DEP Region

Summary of Recycling's Economic Contributions by PA DEP Region

Recycling Marketplace's Economic Contributions by Pennsylvania DEP Region

Economic Indicators	North East	North Central	North West	South East	South Central	South West	PA
Employment (workers)	**29,716**	**8,544**	**17,571**	**22,077**	**42,140**	**55,538**	**175,586**
Direct	10,136	4,221	8,055	9,680	16,715	17,234	66,041
Indirect	10,532	2,296	5,032	5,856	12,927	19,431	56,075
Induced	8,966	1,944	4,581	6,524	12,427	19,027	53,470
Value Added Contribution to GSP ($, mil.)	**3,879**	**982**	**2,240**	**2,849**	**5,325**	**7,411**	**22,685**
Direct	1,907	592	1,369	1,356	2,894	3,152	11,271
Indirect	1,226	238	545	829	1,447	2,648	6,934
Induced	722	145	324	661	984	1,646	4,481
Labor Income ($, mil.)	**1,832**	**456**	**1,008**	**1,627**	**2,549**	**3,846**	**11,319**
Direct	780	255	547	691	1,189	1,351	4,812
Indirect	653	120	283	532	812	1,521	3,921
Induced	394	77	178	402	548	988	2,587
Output ($, mil.)	**8,970**	**2,350**	**5,617**	**5,867**	**11,797**	**16,367**	**50,968**
Direct	5,511	1,605	3,623	3,146	7,366	8,720	29,971
Indirect	2,201	478	1,402	1,662	2,828	5,103	13,674
Induced	1,169	243	583	1,059	1,620	2,649	7,323
Value Added per Worker ($)	**130,525**	**114,953**	**127,505**	**129,029**	**126,360**	**133,436**	**129,198**
Direct	188,113	140,369	169,986	140,124	173,129	182,887	170,660
Indirect	116,413	103,606	108,389	141,634	111,899	136,293	123,651
Induced	80,469	74,398	70,616	101,304	79,192	86,527	83,805
Labor Income per Worker ($)	**61,660**	**53,330**	**57,353**	**73,716**	**60,501**	**69,258**	**64,465**
Direct	76,945	60,331	67,858	71,425	71,112	78,366	72,860
Indirect	61,965	52,361	56,276	90,778	62,816	78,274	69,918
Induced	43,905	39,393	38,788	61,689	44,125	51,923	48,377
Output per Worker ($)	**301,848**	**275,077**	**319,650**	**265,759**	**279,952**	**294,706**	**290,275**
Direct	543,695	380,131	449,810	324,992	440,702	505,978	453,823
Indirect	208,960	208,330	278,589	283,867	218,772	262,602	243,855
Induced	130,329	125,035	127,342	162,390	130,354	139,206	136,957

Source: IHS Economics

Core Recycling Sectors' Economic Contributions by Pennsylvania DEP Region

Economic Indicators	North East	North Central	North West	South East	South Central	South West	PA
Employment (workers)	**4,922**	**2,037**	**2,963**	**7,079**	**6,749**	**8,446**	**32,196**
Direct	2,060	875	1,475	2,702	2,553	3,033	12,698
Indirect	1,488	600	776	2,034	2,304	2,479	9,681
Induced	1,336	548	816	2,330	1,866	2,921	9,816
Value Added Contribution to GSP ($, mil.)	**508**	**227**	**402**	**967**	**744**	**997**	**3,846**
Direct	257	125	271	464	361	452	1,929
Indirect	144	62	76	271	241	300	1,094
Induced	105	40	56	230	145	246	823
Labor Income ($, mil.)	**267**	**125**	**170**	**573**	**381**	**574**	**2,089**
Direct	127	71	99	256	165	244	962
Indirect	83	33	40	176	137	183	652
Induced	57	21	31	140	80	146	475
Output ($, mil.)	**1,117**	**533**	**851**	**1,970**	**1,828**	**2,020**	**8,319**
Direct	677	328	599	1,032	1,046	1,036	4,718
Indirect	259	136	154	568	551	587	2,257
Induced	171	68	100	366	240	399	1,344
Value Added per Worker ($)	**103,132**	**111,430**	**135,806**	**136,615**	**110,280**	**118,083**	**119,447**
Direct	124,712	142,722	183,517	171,907	141,225	148,869	151,916
Indirect	96,972	103,686	98,023	133,119	104,532	120,960	113,010
Induced	78,511	73,136	69,177	98,734	77,529	84,384	83,795
Labor Income per Worker ($)	**54,242**	**61,415**	**57,315**	**80,904**	**56,475**	**67,930**	**64,900**
Direct	61,671	81,484	67,103	94,925	64,523	80,436	75,799
Indirect	55,618	54,791	52,155	86,361	59,470	73,952	67,362
Induced	42,615	38,507	37,726	59,968	42,913	50,075	48,373
Output per Worker ($)	**226,878**	**261,712**	**287,294**	**278,275**	**270,882**	**239,134**	**258,382**
Direct	328,421	374,689	406,378	382,021	409,630	341,609	371,548
Indirect	174,373	227,275	198,483	279,358	239,303	236,825	233,090
Induced	127,971	123,283	122,854	157,282	128,755	136,553	136,942

Source: IHS Economics

Summary of Recycling's Economic Contributions by PA DEP Region (cont.)

Downstream Manufacturing Sectors' Economic Contributions by Pennsylvania DEP Region

Economic Indicators	North East	North Central	North West	South East	South Central	South West	PA
Employment (workers)	**21,921**	**5,177**	**12,657**	**10,103**	**30,347**	**42,494**	**122,699**
Direct	6,208	2,364	5,183	3,841	10,946	11,257	39,799
Indirect	8,635	1,536	4,033	3,171	9,832	16,355	43,562
Induced	7,036	1,212	3,437	3,088	9,522	15,043	39,338
Value Added Contribution to GSP ($, mil.)	**3,166**	**685**	**1,714**	**1,464**	**4,185**	**6,080**	**17,294**
Direct	1,528	423	1,015	660	2,292	2,517	8,435
Indirect	1,046	164	452	482	1,131	2,287	5,562
Induced	570	91	244	322	759	1,310	3,297
Labor Income ($, mil.)	**1,446**	**289**	**767**	**783**	**1,959**	**3,065**	**8,310**
Direct	581	157	400	282	902	991	3,312
Indirect	548	80	232	305	631	1,298	3,094
Induced	311	48	135	196	424	788	1,903
Output ($, mil.)	**7,505**	**1,692**	**4,551**	**3,244**	**9,245**	**13,800**	**40,036**
Direct	4,624	1,197	2,885	1,756	5,861	7,381	23,703
Indirect	1,880	319	1,214	973	2,144	4,415	10,945
Induced	922	153	443	519	1,247	2,105	5,388
Value Added per Worker ($)	**144,440**	**132,364**	**135,414**	**144,873**	**137,893**	**143,083**	**140,946**
Direct	246,079	178,911	195,757	171,944	209,377	223,633	211,938
Indirect	121,102	106,743	112,146	151,923	115,050	139,838	127,679
Induced	81,018	75,163	71,105	104,279	79,729	87,103	83,813
Labor Income per Worker ($)	**65,984**	**55,922**	**60,590**	**77,506**	**64,547**	**72,127**	**67,724**
Direct	93,554	66,277	77,101	73,315	82,419	88,055	83,220
Indirect	63,502	52,154	57,577	96,021	64,197	79,371	71,035
Induced	44,261	39,931	39,150	63,624	44,509	52,414	48,379
Output per Worker ($)	**342,369**	**326,809**	**359,610**	**321,055**	**304,628**	**324,744**	**326,297**
Direct	744,785	506,520	556,569	457,125	535,445	655,659	595,575
Indirect	217,735	207,723	301,003	306,702	218,103	269,941	251,251
Induced	130,980	126,068	128,890	168,217	130,929	139,899	136,967

Source: IHS Economics

Reuse/Remanufacturing Sectors' Economic Contributions by Pennsylvania DEP Region

Economic Indicators	North East	North Central	North West	South East	South Central	South West	PA
Employment (workers)	**2,873**	**1,331**	**1,951**	**4,895**	**5,044**	**4,598**	**20,691**
Direct	1,868	982	1,397	3,137	3,216	2,944	13,544
Indirect	409	160	223	650	791	597	2,831
Induced	595	184	328	1,106	1,039	1,063	4,316
Value Added Contribution to GSP ($, mil.)	**205**	**70**	**124**	**418**	**396**	**333**	**1,546**
Direct	122	45	84	231	241	183	907
Indirect	36	12	17	77	75	61	278
Induced	47	13	23	109	80	90	361
Labor Income ($, mil.)	**119**	**41**	**71**	**272**	**210**	**208**	**920**
Direct	72	27	48	153	122	115	537
Indirect	22	7	11	51	44	40	174
Induced	25	7	12	66	44	53	209
Output ($, mil.)	**348**	**125**	**214**	**654**	**724**	**548**	**2,613**
Direct	211	79	139	358	460	303	1,550
Indirect	61	23	34	121	132	101	473
Induced	76	23	40	174	133	145	591
Value Added per Worker ($)	**71,293**	**52,601**	**63,576**	**85,355**	**78,482**	**72,481**	**74,706**
Direct	65,393	45,489	60,085	73,788	75,082	62,133	66,939
Indirect	88,155	73,230	76,580	118,086	94,203	102,854	98,058
Induced	78,378	73,122	69,062	98,412	77,256	84,271	83,763
Labor Income per Worker ($)	**41,386**	**30,867**	**36,404**	**55,497**	**41,544**	**45,181**	**44,460**
Direct	38,592	27,169	34,361	48,870	37,857	39,181	39,662
Indirect	52,611	45,255	47,105	79,021	55,411	66,168	61,465
Induced	42,579	38,490	37,644	59,910	42,788	50,046	48,362
Output per Worker ($)	**121,142**	**94,257**	**109,531**	**133,521**	**143,615**	**119,176**	**126,288**
Direct	112,805	80,720	99,583	114,085	142,899	102,982	114,422
Indirect	149,580	143,233	152,176	186,561	167,304	168,606	166,882
Induced	127,928	123,457	122,302	156,881	127,951	136,687	136,895

Source: IHS Economics

Economic Contribution of the Recycling Marketplace to Pennsylvania by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	698	1,567	158	2,423
Financial Services	118	4,712	5,524	10,354
Information & Professional Services	6,719	21,543	20,093	48,355
Leisure & Other Services	169	5,739	12,309	18,216
Manufacturing	40,433	5,206	838	46,477
Natural Resources	262	2,085	435	2,782
Transportation & Utilities	82	7,985	1,716	9,783
Wholesale & Retail Trade	17,475	6,774	11,982	36,231
Government	85	465	414	964
Total	**66,041**	**56,075**	**53,470**	**175,586**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	183.2	420.0	53.1	656.2
Financial Services	24.0	679.3	1,412.1	2,115.5
Information & Professional Services	809.0	1,935.7	1,449.4	4,194.0
Leisure & Other Services	10.8	259.3	430.1	700.2
Manufacturing	8,692.5	1,107.0	151.1	9,950.6
Natural Resources	38.2	200.1	21.1	259.5
Transportation & Utilities	5.0	1,313.1	219.2	1,537.3
Wholesale & Retail Trade	1,497.3	982.1	728.3	3,207.6
Government	10.5	37.1	16.8	64.5
Total	**11,270.6**	**6,933.7**	**4,481.0**	**22,685.3**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	43.6	97.0	12.2	152.8
Financial Services	15.1	256.9	279.0	550.9
Information & Professional Services	441.2	1,517.4	1,243.6	3,202.2
Leisure & Other Services	11.1	230.7	358.1	599.9
Manufacturing	3,373.6	436.0	58.5	3,868.1
Natural Resources	14.1	137.4	17.0	168.6
Transportation & Utilities	4.5	644.0	118.1	766.6
Wholesale & Retail Trade	899.3	558.5	468.7	1,926.5
Government	9.2	42.7	31.5	83.5
Total	**4,811.7**	**3,920.6**	**2,586.7**	**11,319.1**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	228.8	503.3	62.6	794.7
Financial Services	39.2	1,052.8	2,077.0	3,169.0
Information & Professional Services	1,448.9	2,975.2	2,290.9	6,715.1
Leisure & Other Services	17.7	437.7	780.7	1,236.2
Manufacturing	25,965.7	4,248.6	544.8	30,759.2
Natural Resources	67.6	495.9	57.5	621.0
Transportation & Utilities	10.0	2,417.2	366.6	2,793.8
Wholesale & Retail Trade	2,167.7	1,439.1	1,077.0	4,683.7
Government	25.2	104.5	65.9	195.5
Total	**29,970.9**	**13,674.2**	**7,323.0**	**50,968.2**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Recycling Marketplace to PA DEP North East Region
by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	13	325	28	366
Financial Services	0	623	799	1,422
Information & Professional Services	1,379	4,349	3,470	9,198
Leisure & Other Services	19	1,114	2,050	3,183
Manufacturing	6,369	790	146	7,306
Natural Resources	0	332	41	373
Transportation & Utilities	13	1,588	290	1,892
Wholesale & Retail Trade	2,340	1,319	2,064	5,723
Government	3	100	77	181
Total	**10,136**	**10,540**	**8,966**	**29,642**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	3.2	83.0	8.9	95.1
Financial Services	0.0	94.2	220.8	315.0
Information & Professional Services	161.0	330.0	229.9	720.9
Leisure & Other Services	1.3	48.0	69.2	118.5
Manufacturing	1,551.5	173.4	28.6	1,753.5
Natural Resources	0.0	33.7	1.8	35.5
Transportation & Utilities	0.9	274.2	38.8	313.9
Wholesale & Retail Trade	186.5	181.7	118.6	486.8
Government	0.4	8.9	3.3	12.5
Total	**1,904.8**	**1,227.0**	**719.8**	**3,851.7**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	0.6	15.8	1.6	18.0
Financial Services	0.0	28.7	29.0	57.8
Information & Professional Services	83.6	247.3	193.4	524.3
Leisure & Other Services	1.1	42.3	57.0	100.4
Manufacturing	586.1	66.7	9.7	662.5
Natural Resources	0.0	18.3	1.6	20.0
Transportation & Utilities	0.7	125.3	19.8	145.9
Wholesale & Retail Trade	105.9	98.1	74.6	278.6
Government	0.4	9.6	5.9	15.8
Total	**778.3**	**652.2**	**392.7**	**1,823.2**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	3.9	100.3	10.5	114.7
Financial Services	0.0	141.5	314.8	456.3
Information & Professional Services	293.8	532.0	375.9	1,201.8
Leisure & Other Services	2.0	83.1	128.9	213.9
Manufacturing	4,929.9	475.2	77.7	5,482.8
Natural Resources	0.0	83.2	4.5	87.7
Transportation & Utilities	1.9	492.6	63.2	557.6
Wholesale & Retail Trade	276.6	271.5	178.0	726.1
Government	0.9	24.4	12.7	38.0
Total	**5,509.0**	**2,203.7**	**1,166.3**	**8,879.0**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Recycling Marketplace to PA DEP North Central Region by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	400	77	7	484
Financial Services	0	160	118	277
Information & Professional Services	561	851	700	2,112
Leisure & Other Services	3	286	488	776
Manufacturing	2,124	186	30	2,339
Natural Resources	0	98	22	121
Transportation & Utilities	3	355	65	423
Wholesale & Retail Trade	1,055	253	496	1,804
Government	75	25	14	114
Total	**4,221**	**2,290**	**1,939**	**8,451**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	98.5	19.4	2.1	120.0
Financial Services	0.0	21.8	44.2	66.0
Information & Professional Services	64.3	62.5	44.2	171.0
Leisure & Other Services	0.2	10.2	14.1	24.5
Manufacturing	359.8	30.2	4.4	394.4
Natural Resources	0.0	8.2	1.1	9.3
Transportation & Utilities	0.0	52.8	8.4	61.2
Wholesale & Retail Trade	60.4	29.8	25.4	115.6
Government	9.1	2.1	0.6	11.8
Total	**592.4**	**236.9**	**144.6**	**973.9**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	22.8	3.4	0.4	26.6
Financial Services	0.0	6.2	4.1	10.3
Information & Professional Services	33.4	43.4	37.7	114.4
Leisure & Other Services	0.1	9.1	11.7	21.0
Manufacturing	158.2	14.2	1.6	174.0
Natural Resources	0.0	5.8	0.8	6.7
Transportation & Utilities	0.0	21.2	3.5	24.8
Wholesale & Retail Trade	32.1	14.3	15.4	61.9
Government	8.0	2.3	1.3	11.6
Total	**254.6**	**119.9**	**76.6**	**451.2**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	126.4	23.5	2.5	152.4
Financial Services	0.0	35.8	65.3	101.0
Information & Professional Services	118.4	110.8	73.0	302.2
Leisure & Other Services	0.3	19.2	28.1	47.6
Manufacturing	1,244.2	110.0	14.7	1,368.9
Natural Resources	0.0	21.7	2.8	24.6
Transportation & Utilities	0.2	101.8	14.3	116.3
Wholesale & Retail Trade	92.8	46.4	39.1	178.4
Government	22.1	6.4	3.1	31.6
Total	**1,604.4**	**475.6**	**242.8**	**2,322.9**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Recycling Marketplace to PA DEP North West Region
by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	0	172	13	186
Financial Services	0	236	232	468
Information & Professional Services	572	1,861	1,778	4,212
Leisure & Other Services	1	613	1,166	1,780
Manufacturing	5,638	566	47	6,251
Natural Resources	0	315	51	366
Transportation & Utilities	1	594	124	718
Wholesale & Retail Trade	1,843	635	1,130	3,608
Government	0	43	39	83
Total	**8,055**	**5,036**	**4,580**	**17,671**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	0.0	43.4	4.4	47.8
Financial Services	0.0	39.3	101.1	140.4
Information & Professional Services	63.3	132.1	100.1	295.5
Leisure & Other Services	0.0	22.8	32.7	55.5
Manufacturing	1,175.1	113.0	8.1	1,296.1
Natural Resources	0.0	19.8	2.2	22.0
Transportation & Utilities	0.1	91.1	13.0	104.2
Wholesale & Retail Trade	131.2	80.7	60.0	272.0
Government	0.0	3.3	1.5	4.7
Total	**1,369.7**	**545.5**	**323.0**	**2,238.2**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	0.0	7.7	0.8	8.5
Financial Services	0.0	12.4	11.7	24.1
Information & Professional Services	32.4	95.9	85.6	213.9
Leisure & Other Services	0.0	20.6	27.3	47.9
Manufacturing	441.7	42.9	3.0	487.7
Natural Resources	0.0	16.8	1.8	18.6
Transportation & Utilities	0.1	42.6	7.1	49.7
Wholesale & Retail Trade	72.6	40.5	37.1	150.1
Government	0.0	3.8	2.9	6.8
Total	**546.8**	**283.3**	**177.4**	**1,007.5**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	0.0	52.5	5.2	57.8
Financial Services	0.0	60.4	144.7	205.1
Information & Professional Services	116.6	223.2	171.1	510.8
Leisure & Other Services	0.1	42.1	65.7	107.9
Manufacturing	3,308.0	656.8	67.1	4,031.9
Natural Resources	0.0	56.1	5.9	62.0
Transportation & Utilities	0.1	180.1	23.0	203.2
Wholesale & Retail Trade	198.9	123.9	91.4	414.1
Government	0.0	9.9	6.5	16.3
Total	**3,623.7**	**1,405.0**	**580.5**	**5,609.1**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Recycling Marketplace to PA DEP South East Region by Industry, 2015

Employment

Industry Sector	Direct	Indirect	Induced	Total
Construction	72	126	18	216
Financial Services	3	750	960	1,713
Information & Professional Services	1,234	2,527	2,497	6,258
Leisure & Other Services	58	587	1,394	2,039
Manufacturing	4,153	459	128	4,740
Natural Resources	24	39	18	81
Transportation & Utilities	54	727	183	964
Wholesale & Retail Trade	4,082	599	1,288	5,970
Government	0	53	46	100
Total	**9,680**	**5,868**	**6,533**	**22,081**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	26.2	37.6	6.6	70.3
Financial Services	0.2	119.6	214.9	334.7
Information & Professional Services	168.5	312.3	223.3	704.1
Leisure & Other Services	2.3	31.5	60.6	94.4
Manufacturing	735.9	106.6	40.4	883.0
Natural Resources	3.3	2.9	0.8	7.0
Transportation & Utilities	3.8	114.6	27.0	145.3
Wholesale & Retail Trade	417.9	104.2	92.7	614.8
Government	0.0	5.3	2.5	7.8
Total	**1,358.1**	**834.5**	**668.9**	**2,861.4**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	7.1	11.7	2.0	20.9
Financial Services	0.1	54.9	63.5	118.6
Information & Professional Services	99.9	256.7	193.7	550.3
Leisure & Other Services	3.6	28.2	51.9	83.6
Manufacturing	302.7	47.3	13.3	363.3
Natural Resources	1.3	2.4	1.0	4.7
Transportation & Utilities	3.5	62.1	14.9	80.5
Wholesale & Retail Trade	274.4	67.4	63.9	405.7
Government	0.0	6.0	4.2	10.2
Total	**692.6**	**536.9**	**408.2**	**1,637.7**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	30.6	44.3	7.7	82.5
Financial Services	0.4	173.7	313.7	487.8
Information & Professional Services	287.9	442.2	331.2	1,061.2
Leisure & Other Services	4.9	49.3	99.7	153.9
Manufacturing	2,233.8	603.6	136.7	2,974.1
Natural Resources	5.9	6.6	1.7	14.2
Transportation & Utilities	6.9	188.4	42.9	238.2
Wholesale & Retail Trade	577.3	144.3	131.6	853.1
Government	0.0	13.3	8.0	21.3
Total	**3,147.6**	**1,665.6**	**1,073.2**	**5,886.3**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding

Economic Contribution of the Recycling Marketplace to PA DEP South Central Region by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	197	333	35	565
Financial Services	90	874	1,084	2,047
Information & Professional Services	1,637	4,947	4,530	11,114
Leisure & Other Services	8	1,379	2,924	4,310
Manufacturing	10,481	1,361	280	12,122
Natural Resources	223	357	106	686
Transportation & Utilities	1	1,992	413	2,406
Wholesale & Retail Trade	4,075	1,556	2,967	8,598
Government	3	107	95	205
Total	**16,715**	**12,906**	**12,432**	**42,053**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	50.9	88.0	11.6	150.6
Financial Services	17.9	131.6	306.2	455.7
Information & Professional Services	192.0	403.0	305.2	900.2
Leisure & Other Services	1.1	58.8	96.1	156.0
Manufacturing	2,281.7	245.9	40.8	2,568.4
Natural Resources	34.0	15.9	5.3	55.1
Transportation & Utilities	0.1	288.1	47.0	335.1
Wholesale & Retail Trade	313.3	204.1	167.5	684.9
Government	0.4	8.1	3.3	11.8
Total	**2,891.3**	**1,443.5**	**983.0**	**5,317.8**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	11.9	19.3	2.5	33.7
Financial Services	10.8	41.3	44.4	96.5
Information & Professional Services	101.0	306.8	261.7	669.5
Leisure & Other Services	0.9	52.1	79.5	132.4
Manufacturing	874.1	103.6	17.1	994.9
Natural Resources	12.1	16.8	4.1	33.0
Transportation & Utilities	0.1	154.4	27.5	181.9
Wholesale & Retail Trade	175.1	106.2	103.8	385.1
Government	0.4	9.8	7.1	17.2
Total	**1,186.4**	**810.3**	**547.6**	**2,544.3**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	62.6	105.7	13.7	182.1
Financial Services	29.6	199.2	440.3	669.1
Information & Professional Services	350.3	644.3	490.7	1,485.3
Leisure & Other Services	1.5	101.7	178.0	281.2
Manufacturing	6,389.7	852.1	134.2	7,376.0
Natural Resources	59.5	44.7	15.1	119.3
Transportation & Utilities	0.1	539.9	78.5	618.5
Wholesale & Retail Trade	469.5	309.2	252.8	1,031.5
Government	0.9	24.1	14.9	39.9
Total	**7,363.7**	**2,820.9**	**1,618.3**	**11,803.0**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Recycling Marketplace to PA DEP South West Region by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	16	534	58	607
Financial Services	25	2,070	2,331	4,426
Information & Professional Services	1,367	7,008	7,118	15,492
Leisure & Other Services	80	1,760	4,288	6,128
Manufacturing	11,595	1,844	207	13,646
Natural Resources	15	944	197	1,155
Transportation & Utilities	10	2,729	641	3,380
Wholesale & Retail Trade	4,122	2,412	4,038	10,572
Government	4	135	142	281
Total	**17,234**	**19,434**	**19,019**	**55,687**

Source: IHS Markit

Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	4.4	148.6	19.5	172.5
Financial Services	6.0	272.7	524.9	803.6
Information & Professional Services	159.9	695.7	546.5	1,402.2
Leisure & Other Services	5.9	87.9	157.4	251.2
Manufacturing	2,588.5	437.9	28.8	3,055.2
Natural Resources	1.0	119.8	9.9	130.7
Transportation & Utilities	0.2	492.4	84.9	577.5
Wholesale & Retail Trade	388.0	381.6	264.1	1,033.6
Government	0.6	9.5	5.7	15.8
Total	**3,154.3**	**2,646.2**	**1,641.7**	**7,442.3**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	1.2	39.0	4.9	45.2
Financial Services	4.1	113.3	126.1	243.5
Information & Professional Services	90.9	567.2	471.6	1,129.7
Leisure & Other Services	5.4	78.5	130.7	214.5
Manufacturing	1,010.8	161.2	13.8	1,185.8
Natural Resources	0.7	77.2	7.7	85.6
Transportation & Utilities	0.2	238.4	45.3	283.9
Wholesale & Retail Trade	239.2	232.0	173.9	645.1
Government	0.5	11.2	10.2	21.9
Total	**1,353.1**	**1,518.1**	**984.1**	**3,855.3**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	5.3	177.0	22.9	205.2
Financial Services	9.2	442.2	798.2	1,249.7
Information & Professional Services	282.0	1,022.7	849.0	2,153.7
Leisure & Other Services	8.9	142.4	280.4	431.7
Manufacturing	7,860.3	1,550.8	114.4	9,525.4
Natural Resources	2.2	283.6	27.3	313.2
Transportation & Utilities	0.7	914.5	144.7	1,059.9
Wholesale & Retail Trade	552.6	543.8	384.2	1,480.5
Government	1.3	26.4	20.8	48.4
Total	**8,722.4**	**5,103.4**	**2,642.0**	**16,467.8**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Appendix B:
Economic Contribution by Recycling Category

Summary of Recycling's Economic Contributions by Recycling Category

Recycling Marketplace Key Economic Indicators by Recycling Category

Economic Indicators	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Employment (workers)	**32,196**	**122,699**	**20,691**	**175,586**
Direct	12,698	39,799	13,544	66,041
Indirect	9,681	43,562	2,831	56,075
Induced	9,816	39,338	4,316	53,470
Value Added Contribution to GSP ($, mil.)	**3,846**	**17,294**	**1,546**	**22,685**
Direct	1,929	8,435	907	11,271
Indirect	1,094	5,562	278	6,934
Induced	823	3,297	361	4,481
Labor Income ($, mil.)	**2,089**	**8,310**	**920**	**11,319**
Direct	962	3,312	537	4,812
Indirect	652	3,094	174	3,921
Induced	475	1,903	209	2,587
Output ($, mil.)	**8,319**	**40,036**	**2,613**	**50,968**
Direct	4,718	23,703	1,550	29,971
Indirect	2,257	10,945	473	13,674
Induced	1,344	5,388	591	7,323
Value Added per Worker ($)	**119,447**	**140,946**	**74,706**	**129,198**
Direct	151,916	211,938	66,939	170,660
Indirect	113,010	127,679	98,058	123,651
Induced	83,795	83,813	83,763	83,805
Labor Income per Worker ($)	**64,900**	**67,724**	**44,460**	**64,465**
Direct	75,799	83,220	39,662	72,860
Indirect	67,362	71,035	61,465	69,918
Induced	48,373	48,379	48,362	48,377
Output per Worker ($)	**258,382**	**326,297**	**126,288**	**290,275**
Direct	371,548	595,575	114,422	453,823
Indirect	233,090	251,251	166,882	243,855
Induced	136,942	136,967	136,895	136,957

Source: IHS Economics

Economic Contribution of the Recycling Categories to Pennsylvania by Industry, 2015

Employment (workers)

Industry Sector	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Construction	254	2,088	82	2,423
Financial Services	1,879	7,669	806	10,354
Information & Professional Services	13,736	31,593	3,027	48,355
Leisure & Other Services	3,393	13,409	1,414	18,216
Manufacturing	2,673	42,314	1,491	46,477
Natural Resources	258	2,350	173	2,782
Transportation & Utilities	2,070	7,087	627	9,783
Wholesale & Retail Trade	7,669	15,542	13,021	36,231
Government	265	648	51	964
Total	**32,196**	**122,699**	**20,691**	**175,586**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Construction	70.1	558.0	28.2	656.2
Financial Services	397.4	1,551.6	166.5	2,115.5
Information & Professional Services	1,362.2	2,579.0	252.8	4,194.0
Leisure & Other Services	129.5	517.8	52.9	700.2
Manufacturing	664.6	9,097.2	188.7	9,950.6
Natural Resources	20.8	230.7	8.0	259.5
Transportation & Utilities	259.3	1,216.2	61.7	1,537.3
Wholesale & Retail Trade	919.1	1,504.1	784.5	3,207.6
Government	22.6	39.3	2.5	64.5
Total	**3,845.7**	**17,293.9**	**1,545.8**	**22,685.3**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Construction	16.2	130.2	6.5	152.8
Financial Services	100.1	411.4	39.3	550.9
Information & Professional Services	908.3	2,094.8	199.0	3,202.2
Leisure & Other Services	110.3	442.7	46.9	599.9
Manufacturing	229.7	3,556.5	81.9	3,868.1
Natural Resources	15.5	144.6	8.5	168.6
Transportation & Utilities	148.6	578.5	39.6	766.6
Wholesale & Retail Trade	535.7	896.5	494.2	1,926.5
Government	25.1	54.3	4.0	83.5
Total	**2,089.5**	**8,309.6**	**919.9**	**11,319.1**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Core Recycling	Downstream Manufacturing	Reuse / Remanufacturing	Total
Construction	83.8	677.6	33.2	794.7
Financial Services	590.5	2,333.8	244.8	3,169.0
Information & Professional Services	2,298.3	4,016.6	400.2	6,715.1
Leisure & Other Services	229.1	911.8	95.3	1,236.2
Manufacturing	3,138.1	27,039.5	581.6	30,759.2
Natural Resources	58.3	541.3	21.4	621.0
Transportation & Utilities	510.7	2,179.8	103.4	2,793.8
Wholesale & Retail Trade	1,347.8	2,211.4	1,124.5	4,683.7
Government	62.3	124.4	8.8	195.5
Total	**8,318.8**	**40,036.3**	**2,613.0**	**50,968.2**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Core Recycling Category to Pennsylvania by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	30	195	29	254
Financial Services	0	865	1,014	1,879
Information & Professional Services	5,751	4,296	3,689	13,736
Leisure & Other Services	53	1,080	2,260	3,393
Manufacturing	1,919	600	154	2,673
Natural Resources	0	178	80	258
Transportation & Utilities	21	1,734	315	2,070
Wholesale & Retail Trade	4,840	629	2,200	7,669
Government	84	105	76	265
Total	**12,698**	**9,681**	**9,816**	**32,196**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	8.0	52.31	9.74	70.1
Financial Services	0.0	138.2	259.2	397.4
Information & Professional Services	693.2	403.0	266.0	1,362.2
Leisure & Other Services	4.8	45.8	79.0	129.5
Manufacturing	514.7	122.2	27.7	664.6
Natural Resources	0.0	16.9	3.9	20.8
Transportation & Utilities	1.5	217.6	40.2	259.3
Wholesale & Retail Trade	696.4	89.0	133.7	919.1
Government	10.4	9.1	3.1	22.6
Total	**1,929.0**	**1,094.1**	**822.6**	**3,845.7**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	1.9	12.08	2.24	16.2
Financial Services	0.0	48.9	51.2	100.1
Information & Professional Services	377.1	302.9	228.3	908.3
Leisure & Other Services	3.9	40.6	65.8	110.3
Manufacturing	170.3	48.6	10.7	229.7
Natural Resources	0.0	12.4	3.1	15.5
Transportation & Utilities	1.2	125.7	21.7	148.6
Wholesale & Retail Trade	398.9	50.8	86.0	535.7
Government	9.1	10.2	5.8	25.1
Total	**962.5**	**652.1**	**474.9**	**2,089.5**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	9.6	62.67	11.49	83.8
Financial Services	0.0	209.2	381.3	590.5
Information & Professional Services	1,243.8	634.0	420.5	2,298.3
Leisure & Other Services	6.8	78.9	143.4	229.1
Manufacturing	2,410.1	628.0	100.0	3,138.1
Natural Resources	0.0	47.8	10.5	58.3
Transportation & Utilities	3.1	440.3	67.3	510.7
Wholesale & Retail Trade	1,019.6	130.5	197.7	1,347.8
Government	24.9	25.3	12.1	62.3
Total	**4,717.9**	**2,256.6**	**1,344.3**	**8,318.8**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Downstream Manufacturing Category to Pennsylvania by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	636	1,335	116	2,088
Financial Services	118	3,486	4,065	7,669
Information & Professional Services	735	16,075	14,782	31,593
Leisure & Other Services	0	4,354	9,055	13,409
Manufacturing	37,248	4,449	617	42,314
Natural Resources	261	1,769	320	2,350
Transportation & Utilities	2	5,822	1,262	7,087
Wholesale & Retail Trade	798	5,929	8,815	15,542
Government	1	342	305	648
Total	**39,799**	**43,562**	**39,338**	**122,699**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	161.1	357.79	39.05	558.0
Financial Services	24.0	488.6	1,039.0	1,551.6
Information & Professional Services	87.4	1,425.2	1,066.4	2,579.0
Leisure & Other Services	0.0	201.4	316.4	517.8
Manufacturing	8,020.0	966.1	111.2	9,097.2
Natural Resources	38.2	176.9	15.5	230.7
Transportation & Utilities	0.2	1,054.8	161.3	1,216.2
Wholesale & Retail Trade	104.0	864.2	535.8	1,504.1
Government	0.1	26.9	12.4	39.3
Total	**8,434.9**	**5,562.0**	**3,297.0**	**17,293.9**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	38.5	82.66	8.98	130.2
Financial Services	15.1	191.2	205.2	411.4
Information & Professional Services	48.0	1,131.9	915.0	2,094.8
Leisure & Other Services	0.0	179.3	263.4	442.7
Manufacturing	3,135.7	377.7	43.1	3,556.5
Natural Resources	14.1	118.0	12.5	144.6
Transportation & Utilities	0.1	491.5	86.9	578.5
Wholesale & Retail Trade	60.5	491.2	344.9	896.5
Government	0.1	31.0	23.2	54.3
Total	**3,312.1**	**3,094.5**	**1,903.1**	**8,309.6**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	202.8	428.75	46.06	677.6
Financial Services	39.2	766.5	1,528.1	2,333.8
Information & Professional Services	155.5	2,175.4	1,685.6	4,016.6
Leisure & Other Services	0.0	337.4	574.3	911.8
Manufacturing	23,085.1	3,553.5	400.9	27,039.5
Natural Resources	67.5	431.5	42.3	541.3
Transportation & Utilities	0.3	1,909.8	269.7	2,179.8
Wholesale & Retail Trade	152.6	1,266.4	792.4	2,211.4
Government	0.3	75.7	48.5	124.4
Total	**23,703.3**	**10,945.1**	**5,388.0**	**40,036.3**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Economic Contribution of the Reuse/Remanufacturing Category to Pennsylvania by Industry, 2015

Employment (workers)

Industry Sector	Direct	Indirect	Induced	Total
Construction	32	37	13	82
Financial Services	0	361	445	806
Information & Professional Services	233	1,172	1,622	3,027
Leisure & Other Services	116	304	994	1,414
Manufacturing	1,266	157	68	1,491
Natural Resources	1	137	35	173
Transportation & Utilities	59	429	139	627
Wholesale & Retail Trade	11,837	217	967	13,021
Government	0	18	33	51
Total	**13,544**	**2,831**	**4,316**	**20,691**

Source: IHS Markit

Value Added Contribution to Gross State Product ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	14.0	9.89	4.28	28.2
Financial Services	0.0	52.5	113.9	166.5
Information & Professional Services	28.5	107.4	116.9	252.8
Leisure & Other Services	6.0	12.1	34.7	52.9
Manufacturing	157.8	18.8	12.2	188.7
Natural Resources	0.1	6.3	1.7	8.0
Transportation & Utilities	3.3	40.7	17.7	61.7
Wholesale & Retail Trade	697.0	28.8	58.7	784.5
Government	0.0	1.2	1.3	2.5
Total	**906.6**	**277.6**	**361.5**	**1,545.8**

Source: IHS Markit

Labor Income Contribution ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	3.2	2.29	0.98	6.5
Financial Services	0.0	16.8	22.5	39.3
Information & Professional Services	16.2	82.6	100.3	199.0
Leisure & Other Services	7.2	10.8	28.9	46.9
Manufacturing	67.5	9.7	4.7	81.9
Natural Resources	0.1	7.0	1.4	8.5
Transportation & Utilities	3.1	26.9	9.5	39.6
Wholesale & Retail Trade	439.9	16.5	37.8	494.2
Government	0.0	1.5	2.5	4.0
Total	**537.2**	**174.0**	**208.7**	**919.9**

Source: IHS Markit

Output ($, mil.)

Industry Sector	Direct	Indirect	Induced	Total
Construction	16.3	11.85	5.05	33.2
Financial Services	0.0	77.1	167.6	244.8
Information & Professional Services	49.6	165.8	184.8	400.2
Leisure & Other Services	10.9	21.3	63.0	95.3
Manufacturing	470.6	67.1	43.9	581.6
Natural Resources	0.2	16.6	4.6	21.4
Transportation & Utilities	6.6	67.2	29.6	103.4
Wholesale & Retail Trade	995.5	42.1	86.9	1,124.5
Government	0.0	3.4	5.3	8.8
Total	**1,549.7**	**472.5**	**590.8**	**2,613.0**

Source: IHS Markit

Note: The sums presented in this industry table may differ from those on the main report owing to rounding.

Appendix C: Glossary

Technical terms used throughout this report

Recycling Terms

Term	Definition
Blast furnace mills	a large vertical furnace for smelting iron from ore, using coke as fuel; designed so as to direct a continuous blast of air through the fuel in order to obtain a high rate of combustion. (Dictionary.com)
Biosolids	nutrient-rich organic materials obtained from wastewater treatment and used beneficially, as for fertilizer. (Dictionary.com)
Commingled	to combine into a common fund or stock. (Merriam-Webster)
Commodity	an economic good that is subject to ready exchange or exploitation within the market. (Merriam-Webster) In regards to recycling, individual items, or products, are sorted, bundled, baled, and sold to other manufacturers or businesses. The finished baled product of recycled goods is a commodity, while the individual recycled goods prior to being baled are not. (RMC)
Compost	a mixture that consists largely of decayed organic matter and is used for a soil amendment and conditioning land. (Merriam-Webster, RMC)
Core recycling sectors	category that includes facilities or businesses that collect, process, and redistribute recycled materials, including private and municipal haulers, organics/compost processors, materials recovery facilities (MRFs), recyclable wholesalers, and plastics reclaimers. (IHS/RMC) – (REI Study)
Crumb or cut rubber	any material derived by reducing scrap tires or other rubber into uniform granules with the inherent reinforcing materials such as steel and fiber removed along with any other type of inert contaminants such as dust, glass, or rock. (Scrap Tire News)
Cullet	furnace-ready scrap glass. (REI Study)
Deink-recovered paper	printed discarded paper that has been collected and removed of ink, filler, and other nonfibrous material. (*The McGraw-Hill Recycling Handbook*) (RMC)
Domestic materials	items or resources that are bought and sold within a country, in reference to Pennsylvania recycling, recycled materials bought or sold within the United States. (RMC)
Downstream manufacturing sectors	category that includes facilities or businesses that rely on recycled materials as intermediate inputs, such as steel mills, glass plants, and paper mills. (IHS/RMC) – (REI Study)
Drop-off collection	method of gathering recyclable or compostable materials in which the materials are taken by individuals to sites, or centers, and deposited into designated containers or at a designated pile, as in compostables. (*The McGraw-Hill Recycling Handbook and RMC*)
Electric arc furnaces	a high-temperature furnace that uses high-voltage electric arcs to make steel. (Hunker.com) A furnace for scrap-base steelmaking that uses graphite electrodes to create intense heat that melts the scrap. (ArcelorMittal.com)
End-use good or service	the use or uses of diverted material or product which has been returned to the economic mainstream, whether or not this return is through sale of the material or product. (*The McGraw-Hill Recycling Handbook*)

Evolving ton	recycling term referring to the changing type and quantity of recyclable goods needed to create a metric ton of commodity product. Over the past two decades, there has been a change in the type of products in the recycling stream, i.e., decline in paper, lighter plastic, thinner cans, etc., which changes the processing requirements of recycled goods and quantity associated per unit weight. (RMC)
Fabricators	businesses or facilities that take previously recycled products and transform them into new end products. For example, a business may take recycled scrap metal, originally from a car, and produce a knife or metal sculpture. (RMC)
Feldspar	any group of crystalline minerals that consists of aluminum silicates with either potassium, sodium, calcium, or barium and that are an essential constituent of nearly all crystalline rocks. (Merriam-Webster)
Ferrous metals	any iron or steel scrap that has an iron content sufficient for magnetic separation. (*The McGraw-Hill Recycling Handbook*)
Fiber	a strand that is a slender and greatly elongated, typically derived from cellulose, typically capable of being reconstituted from pulp, dried and rolled into paper, wafer board, or cardboard. (RMC)
Flake	chopped, shredded, or ground plastic items, typically rigid packaging, with maximum dimension of less than 1 inch or 2.5 cm. (The Association of Plastic Recyclers)
Foundries	an establishment where the act, process, or art of casting metals is carried out. (Merriam-Webster)
Glass plants	manufacturing facility where typically sand, soda ash, lime and other resources are combined to create a finished product, soda-lime glass, which is then molded into containers. (RMC)
Geotextile(s)	a strong synthetic fabric; often used in civil engineering construction projects, which stabilizes loose soil and prevents erosion. (Merriam-Webster)
Grades	a position in a scale of ranks or qualities. (Merriam-Webster) For recycled goods, there are specific grades of product accepted. (RMC)
Ingot makers	a manufacturing tool used to cast a mass of metal into a convenient shape for storage or transportation to be later processed. (Merriam-Webster/RMC)
Institute of Scrap Recycling Industries (ISRI)	a Washington D.C.–based trade association that represents more than 1,700 for-profit companies ranging from small, family-owned businesses to large, multi-national corporations; operating at more than 6,000 facilities in the United States and 30 countries worldwide. (ISRI website)
Iron ore	a native compound of iron from which the metal may be profitably extracted. (Merriam-Webster)
Large national haulers	publically traded corporations responsible under contract, for the collection and transportation of solid waste within the geographic boundaries of the contract community(s) to the recycling or disposal facility as allowed in a given County Plan.
Limestone	a rock that is formed chiefly by accumulation of organic remains. (Merriam-Webster)

Market pulp	a moist mixture of fibers, from which paper is made, that is ready to be sold as a feedstock to a secondary manufacturer. (The McGraw-Hill Recycling Handbook/RMC)
Materials Recovery Facility	specialized facility that receives, separates, and prepares recycled materials for end-market users and manufacturers, imparting quality through isolation of similar material types which are typically compacted and bailed with exception of glass. (RMC)
Metallurgical	the science of obtaining metals from their ores and preparing them for use. (Merriam-Webster)
Metric ton	a unit of mass equal to 1,000 kilograms. (Meriam-Webster)
Melt index	a measure for the ease of flow of melted plastics, often used in the plastic industry for quality control of thermoplastics. (Polymer Properties Database)
Municipal hauler	a government entity that provides collection and transportation of solid waste from a community to a transfer station, material recovery facility, or disposal facility for a fee determined and billed at the municipality's discretion. (RMC)
Natural gas sector	an industry founded on the collection of a flammable gas mixture from below the earth's surface that is used especially as a fuel. (Merriam-Webster/RMC)
Nonferrous metals	materials relating to metals other than iron that are also not magnetic. (Merriam-Webster/RMC)
Obsolete scrap	an end of life, or recycled, metal product which is made up of iron and steel and often recovered from automobiles, steel structures, household appliances, railroad tracks, ships, and farm equipment. (ISRI/RMC)
Paper mill	a facility where paper, or thin sheets produced from pulp from wood or other fibrous materials, is manufactured. (Oxforddictionaries.com/RMC)
Plastic reclaimers	a commercial entity that accepts aggregated postconsumer and/or postindustrial materials and performs a series of operations to allow the materials to return to commerce as useful raw materials or be used by the reclaimer to convert the materials to new finished items of commerce. (The Association of Plastic Recyclers)
Postconsumer plastic resin	the reuse of the chemical components of plastic generated from residential and commercial waste. (The McGraw-Hill Recycling Handbook) – (combined two definitions)
Private hauler	privately owned, and not publically traded, independent waste collection business that services a local area with collection and removal of household waste and recycling. (RMC)
Prompt scrap	iron and steel metal generated from a manufacturing process. (ISRI/RMC)
Purity	free of dirt or impurities. (Merriam-Webster)
Raw commodities	substances still in their natural or original state, before processing or manufacturing. (The McGraw-Hill Recycling Handbook)
Raw steel	steel in the first solid state after melting, suitable for further processing or for sale. (ArcelorMittal.com)

Recovery rate	percentage of usable recycled materials that have been removed from the total amount of municipal solid waste generated in a specific area or by a specific business. (https://ofmpub.epa.gov)
Recycled HDPE (rHDPE or recycled high-density polyethylene)	a recyclable plastic, used for items such as milk containers, detergent containers, and base cups of plastic soft drink bottles. (The McGraw-Hill Recycling Handbook)
Recycled LDPE (recycled low-density polyethylene)	a plastic resin used to make various containers and dispensing bottles. (RMC)
Recycled LLDPE (recycled linear low-density polyethylene)	a plastic resin used to make plastic bags and sheets, plastic wrap, stretch wrap, and flexible tubing. (RMC)
Recycled PET (rPET or recycled polyethylene terephthalate)	a plastic resin used to make packaging, particularly soft drink bottles. (The McGraw-Hill Recycling Handbook)
Recycle	to pass again through a series of changes or treatments as to process in order to regain material for human use. (Merriam-Webster)
Recycling streams	the flow of materials from the point of collecting through sorting, baling, reselling, and transforming into new products and back again. (RMC)
Refining mills	facilities that process metals by removing any remaining leftover or nondesirable materials which if left in the composition would reduce the purity of the metal. (EnviroBlend/RMC)
Refurbish	to repair or make improvements to a product so that all or most functionality is preserved. (Merriam-Webster/RMC)
Reuse sectors	category that includes facilities and businesses which are involved in the reuse, repurposing or remanufacturing of computers, electronic equipment, used automobile parts, retreaded tires and so on. (IHS/RMC) – (REI Study)
Rubberized asphalt	a product that combines ground-up scrap tires and asphalt; it is primary used in highway, runway, and street projects as a stress-absorbing membrane interlayer. (The McGraw-Hill Recycling Handbook)
Resin	plastic that has been purified from recycled plastic of various types or numbers and is typically extruded and chopped into plastic pellets which can then be melted and manufactured into a new product
Thrift store (also referred to as second-hand shops or reuse stores)	a business or store that sells used goods and especially used clothes and that is often run by charity. (Merriam-Webster)
Secondary smelters	a process that involves separating metal from ore using heat and reducing or purifying agents such as coke and charcoal. (EnviroBlend)
Sell pulp	a moist mixture of fibers, from which paper is made. (The McGraw-Hill Recycling Handbook)
Single stream	system in which all products including paper, plastic, metal, glass, and so on at deposited into the same bin, or container, in order for them to be disposed of. (RMC)

Soda ash	commercial anhydrous sodium carbonate. (Merriam-Webster) This is a white powered or granule material used in the production of glass, detergent chemicals, and other industrial products. (ANSAC)
Specification	a description of materials to be used exactly and clearly. (Merriam-Webster) In regards to commodities, there are different parameters or guidelines that are followed when baling and selling recycled goods, i.e. moisture level with paper. (RMC)
Steel and nonferrous foundries and mills	manufacturing operation whereby iron is alloyed with carbon in the presence of heat to form a solid metallic substance that has properties such as increased strength over the ingredients and improved corrosion resistance.
Sustainable	of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged. (Merriam-Webster)
Virgin materials	raw materials as yet unused and as removed from the earth; for example, virgin aluminum that has not yet been fabricated into cans. (The McGraw-Hill Recycling Handbook)
Waste management	practice of using an integration of regulated scientific and engineered systems to manage reuse, recycle, or dispose of specific components of unwanted or undesirable materials a consumer no longer wants or deems of value. (RMC)
Wholesaler	a person or company that sells goods to business and not to individuals. (Merriam-Webster)

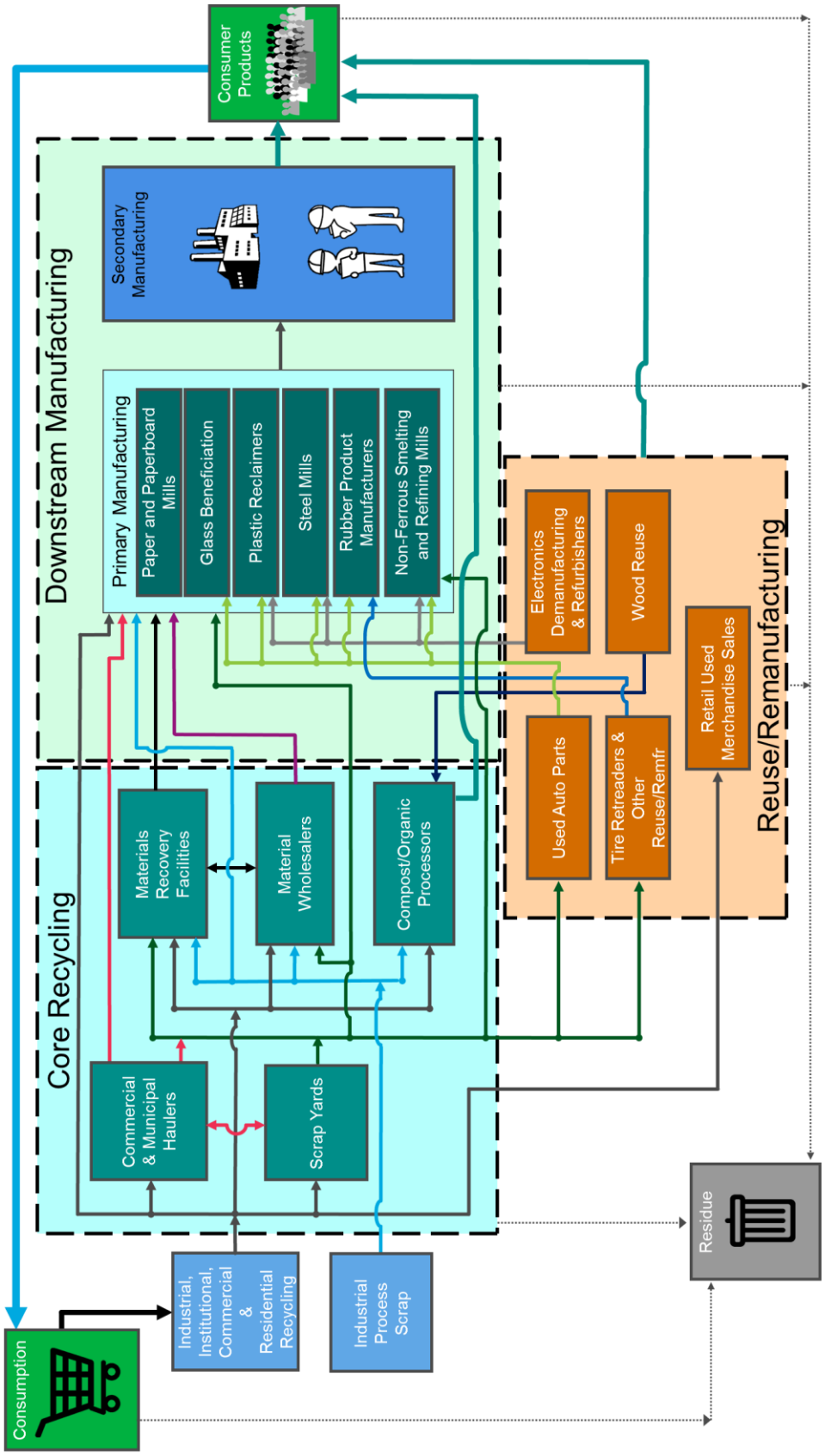
Economic Terms

Term	Definition
Capital Expenditure (CAPEX)	this includes the investments made by establishments operating in a particular sector during a certain year, net of fixed assets sold.
Commodity	a commodity is a basic good used as input in the production of other goods or services.
Corporate Income Tax	the tax levied on a corporation's income.
Domestic markets	a specific region within which the economic activity is being measured or analyzed. In this study the domestic markets that were analyzed included the Commonwealth of Pennsylvania and the six DEP regions.
Direct Impacts	the first-order responses throughout the economy due to spending with or operations of the core recycling, downstream manufacturing or reuse firms.
Economic Impact Analysis	a study that examines the direct, indirect and induced impacts of operations and capital spending by estimating the level of related economic activity and capturing the supplier linkages and multipliers associated with expenditures and investments.
Economic Indicators	parameters that are used to gauge the response of an economy to stimuli. The economic indicators considered in this study included: employment, output, value added, labor income and government revenues.
Employment	this includes wages, salaries and self-employment jobs within the economy.
Extended supply chain	the network of suppliers who provide goods and services to Tier 1 suppliers. This is covered under the indirect effects of the company's economic contributions to Indonesia.
Fiscal Analysis	the estimation of the impacts of tax and nontax contributions of an entity to the government in which it is currently operating.
Full-time equivalent (FTE)	the ratio of the total number of paid hours during a period (part time, full time, contracted) by the number of working hours in that period.
Government revenues	the streams of revenues paid to the government, including taxes and other related revenues at the federal, state & local levels.
Gross Domestic Product (GDP)	the sum of value added across all products and services produced within a national economy.
Gross State Product (GSP)	the sum of value added across all products and services produced within a state economy.
IMPLAN model	an industry-standard Input-Output model used for conducting economic impact analysis.
Indirect impacts	the contributions to the economy owing to economic activity in the extended supply chain.
Induced impacts	the response of the economy to marginal changes in consumer spending from employees of the direct and indirect businesses.

Input-Output Analysis	analysis utilizing input-output tables that depict the flows of related economic transactions which take place within an economy. It also shows the economic interconnections that exist between different components of the economic system, i.e. production activities, the government and supplier enterprises.
Labor Income	labor income includes employee compensation.
NAICS Code	the North American Industry Classification System (NAICS) classifies business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. economy. The NAICS industry codes define establishments based on the activities in which they are primarily engaged.
Operating Expenditures (OPEX)	this captures purchases of inputs and suppliers.
Output	the total value of all goods and services produced within an economy.
Personal Income Tax	the tax levied on an individual's income.
SAM Multipliers	similar to the Type 1 multiplier, the SAM multipliers incorporate "induced" effects resulting from the household expenditures from new labor income. The SAM multipliers are the sum of direct + indirect + induced effects divided by direct effects.
Supply Chain	the combination of the Tier-1 Suppliers and the Extended Supply Chain.
Tier-1 Suppliers	the suppliers with whom customers directly spend their capital expenditure and operating expenditure funds. In the context of this study, Tier 1 suppliers include the core recycling, downstream manufacturing and reuse firms.
Type 1 Multipliers	a Type I multiplier is the direct effect produced by a change in final demand plus the indirect effect, divided by the direct effect.
Value added	the difference between the revenue received for a product or service and its nonlabor input costs.

Appendix D: Pennsylvania Recycling Marketplace & Material Flow Diagram

Materials Flow Diagram of the Pennsylvania Recycling Marketplace



Source: Pennsylvania Recycling Markets Center

IHS Markit Customer Care:

Americas: +1 800 IHS CARE (+1 800 447 2273); CustomerCare@ihs.com
Europe, Middle East, and Africa: +44 (0) 1344 328 300; Customer.Support@ihs.com
Asia and the Pacific Rim: +604 291 3600; SupportAPAC@ihs.com