



The Economic Impacts of
Central Ohio's Recycling,
Reuse and Remanufacturing
Industry

Final Report | June 2018

Prepared by:

DSM ENVIRONMENTAL

THE ECONOMIC IMPACTS OF CENTRAL OHIO'S RECYCLING, REUSE AND REMANUFACTURING INDUSTRY

FINAL REPORT | JUNE 2018

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EXECUTIVE SUMMARY

Introduction

An estimated 2.1 million tons of residential and business waste were generated in SWACO's service region in 2016, of which 46.5 percent were diverted from landfill disposal. Almost 70 percent of the material still landfilled has the potential for diversion. Adding this to the material already diverted through recycling and composting would leave less than 20 percent requiring landfilling.

While achieving additional diversion requires investment in infrastructure and policy changes, as well as the added costs to collect the material, there are clear economic benefits to greater diversion. SWACO contracted with DSM Environmental Services to quantify the economic impacts of the Recycling Industry as it stands today, and project further opportunities for economic growth through expansion of recycling.

Summary of Findings - Direct Economic Impacts

In total, an estimated 372 establishments make up Central Ohio's recycling industries, employing an estimated 5,000 workers with a payroll of \$235 million, producing nearly \$1.3 billion in revenues in 2016.

The **Recycling Industry** includes those firms collecting and processing recyclable materials and organics (**Recycling businesses**); those firms buying recycled materials to produce new products (**Recycling Reliant Industries**); and, those firms which reuse or remanufacture

materials that would otherwise be discarded (**Reuse/Remanufacturing Industry**).

Table ES-1 illustrates how total revenues are distributed among the collection and processing businesses, the recycling reliant industries, and the reuse/remanufacturing sector. It also demonstrates the economic contribution of the larger recycling reliant industries to the total recycling economy of Central Ohio.

TABLE ES-1 –TOTAL ESTIMATED ANNUAL REVENUE, EMPLOYMENT AND PAYROLL FROM THE MAJOR RECYCLING SECTORS (1)

SECTOR	Establishments	Revenue (\$)	Employees	Payroll (\$)
Recycling Collection and Processing	140	\$374,800,000	1,471	\$62,320,000
Recycling Reliant Industries	32	\$802,030,000	2,001	\$130,600,000
Reuse/Remanufacturing	200	\$120,710,000	1,612	\$42,350,000
Total:	372	\$1,297,540,000	5,084	\$235,270,000

(1) For Plastic Reclaimers and all Recycling Reliant industries – the area was expanded to include Ashland, Crawford, Harding, Knox, Muskingham, Marion, and Richland counties broadly referred to as Central Ohio.

In addition to these direct impacts that recycling industries have on the economy, there are indirect and induced economic impacts that occur. Based on input/output analyses completed in neighboring states, it is likely that the indirect and induced impacts of the recycling industries in Central Ohio could double the direct impacts resulting in a total contribution of the recycling industry in Central Ohio of roughly 10,000 jobs, with a payroll close to \$500 million, and gross receipts of over \$2.5 billion.

Economic Growth Through Greater Diversion

It is estimated that by diverting an additional 35 percent of the materials that could be recycled or composted but that are currently disposed at the SWACO landfill, additional direct economic impacts of 400 jobs, \$19 million in new payroll and \$115 million in new gross revenues could occur in the Central Ohio region.

The indirect and induced impacts from this job and revenue growth could potentially double these economic impacts as well.

Growing the Circular Economy

All of the businesses identified in this report are important to the circular economy, and this project is the start of SWACO's ongoing effort to define and connect this economy. This includes continuing to expand the database of recycling, recycling reliant, and reuse and remanufacturing industries created from this project. It also involves identifying and incorporating any missing links in the materials recovery cycle to strengthen Central Ohio's circular economy and reduce materials disposal.

SWACO plays an important role in the circular economy by facilitating transactions between large generators of recyclables and food waste, the recycling and organics processing industries, and the end users of these materials. In addition to documenting the significant impact the recycling industries have on Central Ohio's economy, this report provides an up-to-date database of the existing recycling and recycling reliant industries in Central Ohio. When combined with data on recyclables and organic waste currently being landfilled, this can provide the impetus for expanding employment and revenues from increased diversion.

PART 1: BACKGROUND AND METHODOLOGY

Introduction

The Solid Waste Authority of Central Ohio (SWACO) recognizes that materials recycling and reuse are not only important steps in minimizing solid waste disposal, but that they provide economic value to the region. To capture this value, they contracted with DSM Environmental Services, Inc. (DSM) to quantify the economic impacts of the Recycling Industry¹ as it stands today, and project further opportunities for economic growth through expansion of recycling. DSM's scope of work included:

- Identifying entities currently working in the Recycling Industry, and estimate the economic impact of their activities in the region;
- Provide stakeholders, policymakers, as well as local and regional economic development practitioners, with a comprehensive analysis of the identified Recycling Industry's current and potential economic impact, including jobs, payroll and revenues contributed to the region's economy; and,
- Provide SWACO with a database of these industries and their major activities to enable the opportunity to link generators of recycled materials with end users.

The newly adopted mission of SWACO, home to 1.26 million residents and a vibrant business community, is to improve the community's solid waste stream through effective reduction, recycling, and disposal. They are guided by their adopted principles to:

- "Collaborate with our public and private partners;
- Operate with transparency, efficiency, innovation and fiscal responsibility;
- Leverage the waste stream for economic benefit;
- Contribute to a safe and healthy community; and,
- Engage the community through education and outreach".

In 2016, an estimated 1.8 million tons of municipal solid waste (MSW) were generated by residents and businesses in SWACO's region, of which 800 thousand tons were diverted for recycling or composting with the balance landfilled.² In addition, another 223 thousand tons of industrial waste were generated of which 71 percent were diverted, for a total diversion rate of 46.5 percent. Reuse is not included in this calculation but plays an important role in materials diversion.

¹ The Recycling Industry includes: businesses that operate to reuse materials (e.g., Salvation Army); businesses that collect and process recyclable materials; and, businesses that buy recycled materials, referred to as Recycling Reliant industries, to produce new materials (e.g., a paper mill or glass plant).

² Disposal, Recycling and Generation Summary for 2016. Solid Waste Authority of Central Ohio (Franklin County SWMD).

DSM researched the contribution of the recycling, recycling reliant and reuse/remanufacturing industries (collectively called the Recycling Industry) to the economy in Central Ohio³ beginning in the spring of 2017. They are defined as:

- **Recycling Industries** are those organizations who collect, process, and market (broker or wholesale) recyclable materials and organics;
- **Recycling Reliant Industries** are firms buying recycled materials to produce new products; and,
- **Reuse and Remanufacturing Industries** are those firms which reuse materials that would otherwise be discarded, including those that remanufacture or repurpose materials for reuse (such as pallet rebuilders).

DSM tracked and estimated the *direct* economic impacts for each recycling industry sector following a similar methodology used in the original *2001 EPA report*⁴ and the subsequent Northeast Recycling Council Report⁵. A key difference between this report and others following the EPA methodology was that DSM attempted to identify all of the individual recycling and reuse businesses operating in Franklin County, and the surrounding counties (collectively referred to as Central Ohio), instead of relying primarily on state-wide US Census and other economic data. This provides SWACO with an expanded database of recycling industries to track future diversion activities.

In the end, data were compiled on the number of establishments, and total employment, payroll, and gross receipts for each recycling industry sector; and, for sectors where data were available, throughput was also estimated. These terms are defined as:

- **Establishment** is a single location where a recycling, recycling reliant or reuse entity operates.
- **Employment** includes all employees (jobs) in the recycling, recycling reliant, and reuse industries (allocated by use of recycled versus virgin materials processed or otherwise used), from the factory worker to the administrator, and are reported as full time equivalent jobs.
- **Payroll** represents total taxable wages for each employee counted.
- **Gross receipts** represent total sales revenue for each recycling industry sector.
- **Throughput** represents estimated tons of recovered or recycled material handled, processed or otherwise used by the recycling or recycling reliant industries. It is important to note that throughput is not readily available for many sectors.

Economic activities included in the recycling and reuse industries were broadly grouped as follows:

³ Central Ohio includes the counties adjacent to Franklin County (SWACO) and when identifying Recycling Reliant Industries (who use recycled feedstock) also includes Ashland, Crawford, Harding, Knox, Muskingham, Marion, and Richland counties.

⁴ *The US Recycling Economic Information (REI) Study* was an unprecedented national study that demonstrates the importance of recycling and reuse to the US economy. The study was commissioned by the US EPA and numerous states through a cooperative agreement with the National Recycling Coalition. As part of this original effort, a report was completed for the State of Ohio.

⁵ *Recycling Economic Information Study Update: Delaware, Maine, Massachusetts, New York, and Pennsylvania*, Northeast Recycling Council, DSM Environmental Services, Inc. and MSW Solid Waste Consultants, March 2009.

- **Collection, processing, and wholesaling** of recyclable materials including paper, metals, glass, plastics, textiles, and electronics;
- **Processing/composting and sale of organic materials**, including leaf and yard waste, brush and tree trunks, food waste, and biosolids;
- **Reclamation of processed materials** to prepare them for end use (e.g. cleaning and granulating plastics by resin type, cleaning and color sorting glass cullet);
- **Manufacturing first stage products from recycled scrap** including, but not limited to paper rolls, metal ingots, billet or rods, metal castings, plastic lumber, sheet or shapes, and glass containers;
- **Wholesale reuse businesses**, such as materials exchange services and used motor vehicle parts sales; and,
- **Retail reuse businesses**, such as used clothing, furniture, electronics, and building supply stores.

Table 1 lists each sector within the broad classifications.

TABLE 1 – RECYCLING, RECYCLING RELIANT AND REUSE INDUSTRIES

RECYCLING INDUSTRIES (Supply Side)
Residential Curbside Recycling Collection
Commercial Recyclables Collection
Compost/Organics Processors
Materials Recovery Facilities
Recyclables Material Wholesalers
Plastics Reclaimers
Other Recycling Processors/Manufacturers
RECYCLING RELIANT INDUSTRIES (Demand Side)
Glass Container Manufacturing Plants
Glass Product Producers
Nonferrous Secondary Smelting and Refining mills
Nonferrous Product Producers
Nonferrous Foundries
Paper and Paperboard Mills/Deinked Market Pulp Producers
Paper-based Product Manufacturers
Pavement Mix Producers (asphalt and aggregate)
Plastics Converters and End Users
Rubber Product Manufacturers
Steel Mills
Iron and Steel Foundries
REUSE AND REMANUFACTURING
Computer and Electronic Appliance Demanufacturers
Used Motor Vehicle Parts Retailers and Wholesalers
Retail Used Merchandise Sales
Tire Retreaders
Wood Reuse
Material Exchanges and Other Reuse

Research and Survey Methodology

DSM attempted to compile, and accurately classify, recycling activity in each of the sectors listed in Table 1, including or counting only known recycling establishments. For purposes of this study, “Central Ohio” is assumed to include all counties contiguous to Franklin County. However, for recycling reliant industries, it was necessary to go outside of these seven counties to identify important manufacturing plants that rely on recycled materials, including materials generated and processed in Franklin County and the contiguous counties.⁶

The data development and survey approach included the following steps.

First, DSM sought to develop a comprehensive database of recycling businesses, by sector. DSM collected and merged contact lists from a myriad of sources, including recycling market listings and databases, trade organization member lists, and published and purchased (D&B Hoovers and Plastic News subscription) directories. DSM then carefully reviewed the listings for duplication and performed significant internet research to both correctly code each listing as well as identify additional establishments in each recycling sector. The goal of this extensive research was to create a single database of recycling businesses for Central Ohio coded by sector.

Second, DSM reviewed and compiled available government economic and throughput data on each sector. Government economic data used for the study included:

- **The United States Economic Census** is conducted every five years in the years ending with ‘2 and ‘7, with the most recent data available from 2012 and available at the State level.
- **County Business Patterns (CBP)** is a supplemental set of economic data on employment and wages available at the County level, with in most cases the most recent year available as 2015.
- **The Annual Survey of Manufacturers (ASM)** is an annual survey undertaken by the U.S. Census Bureau of a subset of manufacturers and available at the State level, with the most recent year available 2015.⁷
- **The Bureau of Labor Statistics (BLS)** provides quarterly and annual employment statistics by state and occupation, which can be used to supplement suppressed data from the economic census and/or to research average wages in a state or specific occupation, and available at the County level with the most recent year available 2016.
- **The United States Geological Survey Metals Yearbook** provides an annual review of the mineral and material industries of the United States and foreign countries and contains statistical data on materials and minerals including economic and technical trends and development. While some data are available at the state level, no data are available at the County level.

Table 2, on the next page, lists the recycling, recycling reliant, and reuse and remanufacturing sectors covered in this report and the North American Industry Classification System (NAICS) codes that each sector may be classified under. Note that in some cases there are more than one NAICS code that may

⁶ For Plastic Reclaimers and all Recycling Reliant industries the search area was expanded to include Ashland, Crawford, Harding, Knox, Muskingham, Marion, and Richland counties broadly referred to as Central Ohio.

⁷ For some sectors in some states, ASM data is only available at the national level.

apply to a particular sector (or company). In other cases, the NAICS code may be specific to manufacturing, wholesaling, retailing or other business activities and not to a recycling related activity. And in other cases, there is no code that adequately defines that type of recycling business.

Therefore, Table 2 should be viewed as a reference table only, with the knowledge that DSM used other data sources to refine the number of establishments engaged in recycling activities.

The NAICS code assignment was primarily used to apply CBP, BLS, Economic Census and ASM data on payroll and employment to identify the average wage (per employee) in that sector since payroll information is typically not available from other sources. It was also used in cases where no revenue data were available to estimate annual revenues based on employment.

Third, DSM contacted several active trade organizations representing recycling industries in Ohio and the United States. A list of contacts made to trade organizations and to other government experts, and that provided input ultimately used for this study are shown in Table 3. This includes a list of organizations with data and information contained on their websites that were used as resources for this research.

Fourth, DSM relied heavily on a purchased database compiled by Dun and Bradstreet known as D&B Hoovers which provided much of the employment and revenue data for each identified business. Background on this database is discussed below.

Fifth, for sectors where existing data were unavailable or insufficient, DSM surveyed specific establishments. Survey data were used to: confirm the business location and that the facility was still operating; better understand those activities related to recycling; collect and/or verify employment data or other economic activity for that sector; and, in some cases, provide data to complement existing economic census information where data were suppressed on a statewide basis.

Finally, DSM gathered data necessary to model the public and private recycling collection industries in Central Ohio.

A summary of the methodology used for each sector is outlined in Table 4.

TABLE 2 – POTENTIAL NAICS CODE ASSIGNMENT FOR RECYCLING, RECYCLING RELIANT AND REUSE INDUSTRIES

		Potential NAICS	
Sector		Code	NAICS Code Description
Recycling Collection	Residential Curbside Recycling Collection	562111	Public entities engaged in solid waste collection (without disposal) at the curb and at drop-off facilities.
	Commercial Recyclables Collection	562111	Establishments primarily engaged in operating nonhazardous solid waste transfer stations; and collecting and/or hauling mixed recyclable materials within a local area from both residents and businesses.
Recycling Processing	Compost/Organics Processors	325311, 325314	Nitrogenous Fertilizer Mixing; Fertilizers (Mixing Only) Manufacturing
	Materials Recovery Facilities	56292	Materials Recovery Facilities
	Recyclables Material Wholesalers	42393	Recyclables Material Wholesalers
	Plastics Reclaimers	325991	Custom Compounding of Purchased Resins
	Other Recycling Processors	N/A	This includes construction and demolition debris recyclers, textile recyclers and universal waste recyclers
Recycling Reliant Industries	Glass Container Manufacturing Plants	327213	Glass Container Manufacturing
	Glass Product Producers	327211, 327212, 327993	Flat Glass Manufacturing; Other Pressed and Blown Glass and Glassware Manufacturing; Mineral Wood Manufacturing
	Nonferrous Secondary Smelting and Refining Mills	331314, 331420, 331492	Secondary smelting and alloying of aluminum; Copper Rolling, Drawing, Extruding and Alloying; Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)
	Nonferrous Product Producers	331315, 331318, 331420, 331491	Aluminum Sheet, Plate, and Foil Manufacturing; Other Aluminum Rolling, Drawing, and Extruding; Copper Rolling, Drawing, Extruding, and Alloying; Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding
	Nonferrous Foundries	33152	Nonferrous Metal Foundries
	Paper and Paperboard Mills/Deinked Market Pulp Producers	3221	Pulp, paper and paperboard mills
	Paper-based Product Manufacturers	322299, 322219	All Other Converted Paper Product Manufacturing; Other paperboard container manufacturing
	Pavement Mix Producers (asphalt and aggregate)	324121	Asphalt Paving Mixture and Block Manufacturing
	Plastics Converters and End Users	32611, 32612, 326160, 32619	Plastics Packaging Materials and Unlaminated Film and Sheet Manufacturing; Plastic Pipe, Pipe Fitting and Unlaminated Profile Shape Manufacturing; Plastic Bottle Manufacturing; Other Plastics Product Manufacturing
	Rubber Product Manufacturers	326299	Other Rubber Products Manufacturing,
	Steel Mills	33111	Iron and Steel Mills
	Iron and Steel Foundries	33151	Ferrous Metal Foundries
Reuse and Remanufacturing	Computer and Electronic Appliance Demanufacturers	N/A	Not available for this sector.
	Motor Vehicle Parts (used)	423140	Establishments primarily engaged in the merchant wholesale distribution of used motor vehicle parts (except used tires and tubes) and establishments primarily engaged in dismantling motor vehicles for the purpose of selling the parts
	Retail Used Merchandise Sales	453310	Establishments primarily engaged in retailing used merchandise, antiques, and secondhand goods (except motor vehicles, such as automobiles, RVs, motorcycles, and boats; motor vehicle parts; tires; and mobile homes)
	Tire Retreaders	326212	Establishments primarily engaged in retreading or rebuilding tires.
	Wood Reuse	321920, 321219	Wood Container and Pallet Manufacturing, Reconstituted Wood Product Manufacturing
	Material Exchange Services and Other Reuse	N/A	Not available for this sector.

THE ECONOMIC IMPACTS OF CENTRAL OHIO'S RECYCLING, REUSE AND REMANUFACTURING INDUSTRY

TABLE 3 – LIST OF GOVERNMENT, INDUSTRY AND OTHER ORGANIZATION RESOURCES USED

TRADE ORGANIZATIONS AND OTHER RESOURCES	WEBSITE
American Forest and Paper Association	http://www.afandpa.org/
American Foundry Society	http://www.afsinc.org/
American Iron and Steel Institute (Steel Recycling Institute)	http://www.steel.org/about-aisi.aspx
Association of Plastic Recyclers (formerly Association of Postconsumer Plastic Recyclers)	https://www.plasticsrecycling.org/
Association of Responsible Recyclers	http://www.noranews.org/
Automotive Recyclers Association	http://a-r-a.org/
Car-Part	http://car-part.com/
Cellulose Insulation Manufacturers Association – Paper products	https://cellulose.org/index.php
Columbus 2020	http://columbusregion.com/columbus-2020/
Columbus Economic Development	https://www.columbus.gov/development/Economic-Development/
Construction Materials Recycling Association	https://cdrecycling.org/
DKMM Solid Waste District Recycling and Waste Business Guide	https://www.dkmm.org/business-recycling-waste-and-disposal-service-guide
Flexible Film Recycling Group (FFRG) of the American Chemistry Council.	http://www.PlasticFilmRecycling.org
Flexible Pavements of Ohio	http://www.flexiblepavements.org/
Franklin County Economic Development	https://development.franklincountyohio.gov/
Glass Packaging Institute	http://www.gpi.org/recycling
Institute of Scrap Recycling Industries	http://www.isri.org/
National Asphalt Pavement Association	http://www.asphaltpavement.org/
National Wooden Pallet and Container Association	http://www.palletcentral.com/
Nonferrous Founders Society	http://www.nffs.org/
North American Wood Reuse & Recycling Directory	http://reusewood.org/organizations/organization_65
Ohio Auto and Truck Recyclers	https://oatra.net/
Ohio Cast Metals Association	http://ohiocastmetals.org/
Ohio EPA Recyclers and Environmental Services Providers	https://ebiz.epa.ohio.gov/Recyclers/jsp/search.jsp
Ohio EPA Composting - Composting Report	http://epa.ohio.gov/dmwm/home/Composting.aspx
Ohio EPA Materials Marketplace	https://ohio.materialsmarketplace.org/
Ohio Polymer Association	https://polymerohio.org/
Ohio Recycling Association	https://www.ohiorecycles.org/
Ohio Steel Council	http://www.ohiosteel.org/
Plastics Industry Association - Recycling and Sustainability	http://plasticsindustry.org/supply-chain/recycling-sustainability
Plastics News - Recyclers Ranking 2017	Subscription
Retread Tire Association	http://www.retreadtire.org/
Shingle Recycling	http://www.ShingleRecycling.Org

TABLE 4 – METHOD USED TO DEVELOP ECONOMIC DATA FOR EACH SECTOR

SECTOR	Primary Methodology	Secondary Data	
Recycling Collection	Residential Curbside Recycling Collection	Modeled costs using SWACO tonnage data on municipal curbside recycling and yard waste collection, and on drop offs, collection frequency and program type and households served.	DSM cost data on per truck collection and labor costs supplemented by CBP on payroll per collection worker. Some contract and per program data.
	Commercial Recyclables Collection	Modeled revenues based on SWACO maintained data on tons collected (by material type for ICI recycling) and estimated per ton (by material type) collection costs (price) and assumed volume per stop and stops per hour	DSM cost data on collection costs (per ton) and CBP on average payroll per collection worker.
Recycling Processing	Compost/organics Processors	SWACO/State data on tons managed/permitted per composting facility. Hoovers. DSM data on cost, employees and pay per ton managed.	Survey local facilities to confirm some data and fill in gaps
	Materials Recovery Facilities and Recyclable Material Wholesalers	Hoovers, SWACO tonnage reports, CBP and Economic Census	Survey data on specific facilities. CBP data
	Plastics Reclaimers	Hoovers, then trade organizations to identify potential companies	CBP data, Research and survey on % recycled resins
	Other Recycling Processors/Manufacturers	SWACO and State Data, DSM research and DSM data for employment and total revenues	Survey for missing data
Recycling Reliant Industries	Glass Container Manufacturing Plants and Glass Product Producers	CBP and Hoovers, DSM Glass Study	Research on Recycled Content and Economic Census and CBP data
	Nonferrous secondary smelting and refining mills and product producers	CBP and Census data with research and industry input for recycled content	
	Nonferrous and Iron and Steel Foundries	CBP and Census data with industry input	Ohio Steel Council Report, CBP
	Paper and Pulp Mills and Paper-based Product Manufacturers	Hoovers and CBP, with survey information	Research on Recycled Content
	Pavement Mix Producers (asphalt and aggregate)	Census and industry data for standard recycled input	Research on Recycled Content
	Plastics Converters and End Users	Hoovers, then trade organizations to identify potential companies	Research on Recycled Content
	Rubber Product Manufacturers	Hoovers, then trade organizations to identify potential companies	Surveys on Recycled Content
	Steel Mills	Census and Industry data	Ohio Steel Council Report, CBP
Reuse and Remanufacturing	Computer and Electronic Appliance Demanufacturers	SWACO and State Data on tonnages, DSM data for employment and payroll, model revenues	Survey for missing data
	Motor Vehicle Parts (used)	Economic Census, CBP, BLS	DSM research to verify data
	Retail Used Merchandise Sales	Hoovers, CBP, and Economic Census	DSM research to verify data
	Tire Retreaders	Industry data supplemented by Census, CBP	Survey for missing data
	Wood Reuse	SWACO and State Data, DSM data for employment and total revenues	Survey for missing data
Material Exchange Services and Other Reuse	SWACO and State Data for tonnages, DSM data for employment and total revenues		

Hoovers Data

DSM subscribed to the Dun and Bradstreet (D&B) Hoovers (previously known as OneSource) online database to obtain economic information for this project. Subscriptions allows the user to access what is said to be “the largest commercial database available with information on over 285 million companies and listing 85 million specific companies, 100 million professionals, and 1,000 industry segments.”

The database allowed DSM to not only identify additional companies in the region but to obtain and check information on recycling industries already in DSM's database. Additionally, this database served as the main source of employment counts and revenues for many of the businesses identified. For each company DSM obtained the following information: number of employees; location(s); physical address and website; NAICS code; and, actual annual sales.

The benefit of the D&B Hoovers database is that it gave DSM access to employment counts and annual revenues at each identified recycling and recycling reliant business that had been operating for several years. However, businesses newly opened or those closed and then opened under different names are not always updated in the database. In addition, some closed businesses were still listed in the database. Finally, in many cases total sales (annual revenues) data were not listed and therefore DSM had to estimate revenue for that location based on employment or another data point.

Surveys

DSM used telephone and e-mail correspondence to contact individual facilities to confirm information as well as gather additional data. A letter provided by SWACO was used to validate the study (See Appendix B) and in some cases, accompanied by written survey questions.

The type of data collected included:

- Verifying the business was still located at the address identified and qualified as a recycling business;
- Determining what percentage of operations were recycling related as opposed to performing other functions that generated revenue (for example compost or mulch producers that also sold garden or nursery products, or Construction & Demolition (C&D) processors that recycle some percentage of material managed);
- Verifying or obtaining an employee count or estimate for that location;
- Verifying Hoover's data on gross revenues for that location; and,
- Determining how they may fit into Central Ohio's recycling economy.

Survey respondents were offered confidentiality when supplying information and all data collected were aggregated with other businesses in that sector.

Use of Other Data to Develop Estimates

In the absence of Hoovers data and survey participation, DSM made facility specific cost estimates based on other data points. These included:

- Annual revenues based on average per ton costs to manage yard, and in some cases, food wastes and on annual throughput at the composting facility;
- Annual revenues for some specific facilities based on employment and their NAICS code classification and related Economic Census data;
- Annual revenues for some Recyclable Material Wholesalers based on annual tonnage and material type(s) handled; and,
- In the absence of data other than employment, annual revenues were assumed to be equal to or great than estimated annual payroll.

Modeling Collection Costs

Economic data on recycling collection are not available separate from the solid waste collection industry. Therefore, DSM modeled estimated revenues and labor requirements for recycling collection in Franklin County.

For curbside residential recycling and yard waste collection, DSM received detailed data on households served and tons collected in each municipality in 2016. Using these data by municipality, as well as collection frequency, DSM estimated the number of recycling trucks used and drivers/collectors as well as the cost to operate each truck.

DSM used data reported under CBP (2015) for the NAICS Code 562111, Solid Waste Collection, to determine the average pay for recycling collection workers and to estimate total payroll based on the modeled labor requirements in Franklin County. For drop-off recycling, DSM obtained data on SWACO's program and estimated for other municipal recycling based on industry standard costs.

For municipal yard waste collection, DSM followed the same methodology as for estimating municipal curbside recycling costs, adjusting for a slightly shorter collection season, a crew count of two per truck, and 75 percent of CBP wages for solid waste collection workers.

Annualized truck costs were assumed to be \$250,000 for each recycling truck use and \$180,000 for each yard waste truck. It was also assumed that an average of 1.3 driver/collectors were on each recycling truck and 2.25 drivers/collectors for each yard waste collection truck.

However, for the City of Columbus, the collection contract price was used instead of the cost model.

For institutional/commercial/industrial (ICI) collection costs, DSM used data from SWACO on tons of material recycled from Franklin County's ICI sector in 2016 to model collection costs associated with transporting these materials to processing facilities and/or end markets.

The model utilized assumptions on the percent of this material collected by contractors, the average material density and collection container size, and the number of container lifts or pulls per hour and

route day to estimate annual collection hours for each material collected from the ICI sector. Note that for metals, paper, corrugated, plastics, and yard waste, it was assumed that some collection activity occurred as a backhaul or as part of an agreement between a processor/end user and the generator, so the cost is either accounted for in another sector (processing and wholesaler of materials), or, at little or no cost to the generator. Finally, annual pay levels were obtained for collection from CBP data for Franklin County.

Limitations

Development of many of the economic estimates used in this report relied on data sources and assumptions that present limitations as to their validity. These are summarized below.

First, employment and revenue estimates made in this report rely heavily on the D&B Hoovers database. While D&B Hoovers is one of the most comprehensive databases available, it may not be updated frequently enough to represent changes in the business environment and may include data from past years that is no longer representative of that business or location in the most recent year. In addition, in some cases it may use data from other locations of the same business, misrepresenting employment or revenues at the particular location included in this study area.

Second, for payroll, in almost all cases DSM used Economic Census data to determine average pay per employee in that type of business to estimate total payroll at each facility. Where county specific data were not available, DSM used state or even national data for that specific NAICS code, or for one similar to that business activity. These estimates may not be representative of actual pay levels at specific businesses in Central Ohio.

Third, while some revenue estimates were made for specific recyclable material wholesalers based on annual tons handled and the type of material (as reported to SWACO to measure recycling), these tonnages may be for Franklin County only and may not include all of the material handled at that location or may be inflated for that location (generated in Franklin County but not processed at that location).

Fourth, while data collection and survey work were completed in calendar year (CY) 2017, and CY 2016 served as the default base year for this report, data were used from multiple years. For example, Census data are mostly 2015 (CBP and ASM) with some 2016 BLS data, but also include Economic Census data from 2012. And, there is no year noted on the D&B Hoovers data as it is stated in the subscription that the data is updated regularly and routinely.

Fifth, in some businesses, recycling or recycling related activities represent only a portion of their revenues and employment. A primary example is data destruction businesses that recycle paper and electronics after destroying all data. In these examples, DSM allocated only 25 percent of the economic activity to that business. In other types of businesses, DSM attempted to survey the facility to obtain an actual estimate but was not always successful and so was forced to estimate based on the company's website or other information representing the company's primary activities.

Sixth, in cases where there were no data available, DSM used survey data from past projects to estimate revenues or employment based on employment and tonnage throughput respectively. However, if no economic or tonnage data were available for a location, the activity was not included.

Finally, and importantly, not all businesses that are involved in the recycling industry are included in this assessment because they may not have been identified, and therefore accounted for in these totals. In addition, some businesses that are not directly engaged in recycling, reuse or remanufacturing activities are not accounted for as direct impacts, as covered in Part 2 of this report.

For example, manufacturers or suppliers of recycling collection or processing equipment, recycling consultants, and companies that arrange for waste and recycling collection activity that occurs outside of the study region may not be accounted for in the *direct impacts* from Central Ohio's recycling economy. These however are, for the most part, accounted for in *indirect and induced impacts* as discussed in Part 3. Two examples are Elytus, located in Columbus who is a managed service provider of solid waste and recycling services to the ICI sector (see: <https://www.elytus.com/>) and Technical Rubber Company (TRC), headquartered in Johnstown but working nationally and globally to supply the tire repair and retreading industry (see: <http://trc4r.com/>). Both of these companies would be included in the multipliers associated with indirect impacts as they are services that the recycling industry requires to support their activities.

All of these businesses are important to the circular economy, and this project is the start of SWACO's ongoing effort to define and connect this economy. This includes continuing to expand the database of recycling, recycling reliant and reuse and remanufacturing industries created from this project and incorporate any missing links in the materials recovery cycle to strengthen Central Ohio's circular economy and reduce materials disposal.

PART 2: THE RECYCLING INDUSTRY SECTOR BY SECTOR

As outlined in Tables 1 and 2 in Part 1, the 25 recycling sectors were divided into three overarching categories: Recycling Industries (supply side), Recycling Reliant Industries (demand side), and Reuse and Remanufacturing Industries. These industries are described in detail in this section, including examples of local businesses and an overview of their economic contribution in Franklin County and Central Ohio. Estimates of employment, payroll and revenues are presented for each sector, following the methodology and limitations outlined in Part 1. The full results are summarized in the next section, Part 3.

Recycling Industries (Supply Side)

Residential Recycling Collection

Region	Revenues (\$)	Employees	Payroll (\$)	Tons
Franklin County	\$26,030,000	242	\$11,010,000	126,108

Municipal curbside and drop-off recycling collection programs are widespread in Franklin County and are key to high residential material recovery rates. They also represent a large contributor to the recycling economy. There has been tremendous growth in access to and participation in curbside recycling programs over the last decade with the capstone being the City of Columbus implementing their first citywide curbside recycling collection program in 2012, which collected nearly 35,000 tons of single stream recyclables last year.

Most municipalities in Franklin County provide curbside recycling collection services to residents through a contracted hauling company. While a few rely on subscription recycling collection services and/or drop off collection, roughly 96 percent of households can now recycle at the curb. Contracted haulers for many cities and towns include **Local Waste Services** and **Rumpke**, both privately owned independent refuse and recycling businesses that have grown significantly in Central Ohio over the last 20 years. For example, Local Waste Services, a family owned and locally operated hauler since April of 1999 holds a number of these municipal collection contracts and grew from a single truck operation to a fleet of over 60 vehicles and 120 employees.⁸

In total, roughly 66,500 tons of mixed paper and containers were collected from households in Franklin County in CY 2016. In addition to widespread curbside collection available to residents in the County, SWACO offers an extensive Drop-Off Recycling Program to supplement the municipal curbside programs, collecting 8,574 tons of single stream recyclables in 2016.

⁸ This includes refuse and recycling collection workers, as well as administrative and other personnel. Source: <http://www.localwasteservices.com/about/>

FIGURE 1 (at right) – Columbus’s Curbside Recycling Collection



Yard waste collection is also offered to almost all Franklin County households and an estimated 60,000 (rounded) tons were collected from residents in 2016.

Table 5-A shows the results of modeling residential collection costs.⁹

TABLE 5-A RESIDENTIAL RECYCLING COLLECTION COST MODEL RESULTS (Franklin County, OH)

	TONS COLLECTED	TOTAL EMPLOYEES (1)	AVERAGE PAY (CBP) (\$)	TOTAL PAYROLL (\$)	TOTAL REVENUES (\$)
Residential Collection					
Curbside Recycling	66,184	85	\$56,118	\$4,757,545	\$14,176,750
Curbside Yard Waste	59,925	152	\$39,283	\$5,959,339	\$11,032,966
Drop-off Recycling (2)	8,867	5.25	\$56,118	\$294,621	\$822,012
Total:	134,975	242		\$11,011,506	\$26,031,728

- (1) Collection employee counts are multiplied by 1.15 for curbside collection and 1.1 for drop-off to reflect administrative overhead costs.
- (2) Drop-off recycling includes SWACO collection program. All private and non-municipal drop-off centers are accounted for in other sectors.

In total, there are an estimated 242 drivers and collection workers employed in Franklin County collecting residential recyclables and/or yard waste. The average collection wage is estimated at \$46,000 per year (2016, excluding any benefits) contributing to a total payroll of roughly \$11 million in Franklin County alone. Note that these totals exclude collection of many other recyclable materials which are accounted for in the Materials Recycling Facilities and Recyclable Material Wholesalers.

⁹ See the section Methodology for the assumptions used in this model.

Commercial Recycling Collection

Region	Revenues (\$)	Employees	Payroll (\$)	Tons
Franklin County	\$20,290,000	108	\$5,490,000	211,867

Similar to residential recycling collection, commercial recycling collection is also a large contributor to the local economy. This sector encompasses those private businesses engaged in the collection of recyclables from businesses and institutions through a direct arrangement between the hauler or transporter and the generator.

These recycling haulers collect mixed recyclables from businesses (delivering them to materials recovery facilities for sorting as described in Sector 4), or collect specific materials such as corrugated containers, mixed paper, and metals, and in some cases plastics, electronics, or glass. In most cases, the material that is collected is processed and aggregated by Recyclable Materials Wholesalers for sale to recycling reliant manufacturers. In some cases, a large generator may consolidate material at their location for transport directly to an end user (such as clean corrugated bales being sold to a paper mill).

In total, it is estimated that 350,000 tons of recyclables are separated from refuse by businesses and institutions in Franklin County for collection by private haulers or recycling businesses directly. Table 5-B shows the breakdown of material estimates as well as employment, payroll and revenues from ICI collection activity. It is estimated that over 100 employees with a payroll of roughly \$5.5 million work in commercial recycling collection serving Franklin County businesses. These collection companies have annual estimated revenues of over \$20 million. This is in addition to revenues from recycling processors and end users who service some of their customers with their own fleet, such as Caraustar (highlighted below).

TABLE 5-B ICI RECYCLING COLLECTION COST MODEL RESULTS (Franklin County, OH)

	TONS COLLECTED	PERCENT COLLECTED (1)	TOTAL EMPLOYEES (2)	PAYROLL (\$)	TOTAL REVENUES (\$)
Material					
Single Stream	25,080	100%	10.3	\$523,188	\$1,933,204
Yard Waste	92,420	50%	15.3	\$781,624	\$2,888,136
Food (Composted)	4,229	100%	0.9	\$47,693	\$176,228
Corrugated Cardboard	82,768	60%	28.2	\$1,439,976	\$5,320,778
Paper	52,685	75%	17.5	\$891,144	\$3,292,819
Plastics	8,416	75%	25.1	\$1,281,159	\$4,733,944
Metals	81,721	50%	10.3	\$526,580	\$1,945,737
Total:	347,320		108	\$5,491,364	\$20,290,845

- (1) The percent of each material that was collected by a contractor and accounted for in the Collection Model.
- (2) Collection employee counts are multiplied by 1.1 percent to account for administrative functions associated with performing collection.

Organics Composting

Region	Revenues (\$)	Employees	Payroll (\$)	Tons
Franklin and adjacent counties	\$13,740,000	115	\$4,990,000	381,623

Yard waste and brush collected must be managed properly after collection and are delivered to permitted municipal and private facilities. These facilities accept and handle leaf and yard waste and brush and tree trimmings, and in some cases food scraps, biosolids and/or manure and process them to produce saleable products including organic fertilizers, garden supplements and soil amendments. These secondary products can replace fossil-based products such as mineral fertilizers and peat, and in the process reduce upstream greenhouse gas (GHG) emissions. With application, the residues of these products can close carbon and nutrient cycles and, in the end, provide a good example of the circular economy.

Thirty permitted composting facilities in Franklin County and the surrounding counties processed an estimated 200,000 tons of yard waste as well as another 100,000 tons of animal (including chicken) manures, biosolids, food waste and related organic materials.¹⁰ While facilities that handle animal manures and food waste on a large scale utilize more sophisticated composting processes and high technology in-vessel systems to control orders and material curing time; yard waste (grass, leaves and brush) and wood wastes (branches, limbs, trunks and ground untreated wood) are often composted in simple windrows, at a relatively low cost.

This sector also includes facilities that produce mulch, bark, and other soil amendments in addition to compost. For example, a grinding operation that grinds wood waste for use as landscaping materials was part of the survey and accounted for.

In total, it is estimated that these facilities employ 115 persons with an estimated payroll of \$5 million and generated total revenues of \$13.5 million in 2016. While these may be small in comparison to other industries, these facilities successfully divert large volumes of organic materials that would otherwise be landfilled.

Examples include the **City of Columbus biosolids composting facility** (which produces the **Com-Til product** made from residual bio-solids from the City of Columbus wastewater treatment plants, yard waste and wood chips) which is sold wholesale from the compost facility. The product is also sold bagged and bulked at locations throughout the region.

See: <https://www.columbus.gov/utilities/water-protection/comtil/Where-to-Purchase-Com-Til/>



¹⁰ These figures are based on capacity data for the permitted facilities supplemented by limited survey data.

Materials Recovery Facilities and Recyclable Material Wholesalers

Region	Revenues (\$)	Employees	Payroll (\$)	Tons
Franklin and adjacent counties	\$268,010,000	690	\$27,950,000	556,285

For recyclables, there is a longer path to the circular economy. Mixed recyclables go to **materials recovery facilities (MRFs)** which, through a series of mechanized and manual sorting, separate material types, and remove residue, to create saleable commodity streams. MRFs add value to recycling by allowing municipalities and private haulers to collect material commingled, making collection more efficient, and then deliver these mixed materials to the MRF which cleans, separates, and densifies materials for transport to specific end markets.

Once recyclable materials have been separated at the MRF, most still need some degree of processing to be sold. Paper and metals need to have any residues removed before baling. Glass and plastics typically need to go from the MRF to a separate processing facility to be further cleaned and sorted by color and/or type to meet end user specifications.

Recyclable material wholesalers are defined as those businesses that are primarily engaged in the “*merchant wholesale distribution of automotive scrap, industrial scrap, and other recyclable materials.*” This includes establishments which wholesale and distribute scrap iron and steel, paper and paperboard (e.g. paper stock dealers), and recovered nonferrous metals, textiles, glass, plastics, rubber, and oil.

Unlike recycling collection and organics composting, both MRFs and Recyclables Material Wholesalers are tracked by the Economic Census on a statewide basis. In 2012, the most recent published Economic Census, Ohio MRFs employed over 800 people with a payroll of over \$25 million, and generated total receipts of roughly \$280 million; while Ohio based *Recyclable Material Wholesalers* employed nearly 7,000 workers with a payroll of roughly \$310 million and over \$7.5 billion in sales in 2012 (the latest year for which data are available).

CARAUSTAR'S CIRCLE OF PAPER

Caraustar’s presence in Central Ohio exemplifies the circular economy. With a materials processing plant on Charter Road in Columbus that processes and grades paper, and a paper mill in nearby Baltimore that utilizes 100 percent recovered fiber in containerboard production, the company closes the loop for paper recycling in Central Ohio.

Caraustar’s Columbus materials recovery facility processes hundreds of tons per day of recycled fiber, removing residues and grading the paper to different market specifications. They also handle aluminum and some plastics, processing these for select markets. While they are a drop-off point for many recycling haulers in Columbus and Franklin County, they also maintain a fleet to collect paper directly from large generators before processing it and sending the baled graded corrugated to their mill to manufacture new containerboard.

Their Ohio Paperboard mill in Baltimore produces tube, core, kraft, chipboard, and linerboard all from recovered paper of which over 90 percent typically comes from Ohio waste paper generators. This mill has been operating since 1893 but was modernized to handle more recovered paper.

Together the mill and the recycling processing facility in Columbus employ over 120 people.

In total, Central Ohio MRFs and Recyclable Material Wholesalers together are estimated to employ 690 in recycling activities with an estimated payroll of \$28 million and revenues of \$268 million.

FIGURE 2 – Corrugated bales from Central Ohio Feed Caraustar’s Baltimore Paper Mill



Plastic Reclaimers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$28,370,000	181	\$7,320,000

Unlike paper and metal recycling, where recycling reliant industries purchase material direct from MRFs and brokers, plastic product producers typically purchase plastic that has been further processed. These businesses are referred to as plastic reclaimers. In some cases, plastic product producers have set up (or invested in) reclaimers to provide the recycled raw materials to feed their manufacturing process.

Plastics Reclaimers buy post-industrial and post-consumer recycled plastics from MRFs and wholesalers, or directly from large industrial and commercial generators, wash and grind the plastic, and typically pelletize the resulting flake for plastic product producers. Unfortunately, there is no specific economic census data for this business sector.

Instead, DSM identified plastic reclaimers using the Association of Postconsumer Plastic Recyclers members list, DSM’s network of industry contacts, the US Plastic Recyclers Directory for Ohio, Plastic News top reclaimers listing, and discussions with the Ohio Polymer Association. DSM also identified reclaimers operating in the Central Ohio region from reviewing recycling business listings and the D&B Hoovers database to obtain data on employment and gross revenues for some of these companies. And because DSM surveyed reclaimers in Illinois and the Northeastern States previously, DSM had developed some economic data for this business sector from previous studies that could be applied to Central Ohio plastic reclaimers.

Reclaimers often specialize in a single resin (e.g. polyethylene or polypropylene, or in an engineering or other specialty resin). Depending on the specifications of the customer/end user’s product, reclaimers

may increase the value of the flake or pellet by deodorizing, coloring, or compounding (with additives or other resins), before selling the resulting plastic pellets to a plastic products producer.

For more discussion about plastic end users, see the discussion on Plastic Product Producers.

Other Recycling Processors

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$18,360,000	137	\$5,560,000

This is a catch-all category to encompass establishments engaged in recycling that did not fall into any other recycling category. As the recycling industry evolves to include processing of many materials not previously recovered (or manufactured), this category has grown to include many new businesses and facilities. At present, this category includes:

- Battery recyclers (outside of scrap metal processors);
- Construction and Demolition debris recyclers;
- Fluorescent lamp and mercury recyclers;
- Oil and grease recyclers;
- Document destruction firms who recycle paper;
- Textile (rags and clothing) recycling.
- Waste oil and oil filter recycling; and,

This category would also include any carpet and mattress recyclers although DSM did not identify any operating in Central Ohio at this time. While it is difficult to acquire comprehensive lists for such a diverse array of niche recyclers, DSM sought out trade associations that represent specific products (e.g. batteries) or that address one or more of these functions (e.g. C&D recycling) to attempt to locate specific businesses

Through research and survey work, DSM identified over 30 establishments engaged in processing other types of recyclable materials. This includes C&D Recyclers that separate wood, metals and corrugated for recovery, or that specialize in recycling aggregates and/or concrete, and well as those that handle and recycle batteries and universal waste, or shred and recycle paper and documents.

Most of these companies are small, but together their recycling activities represent an estimated 137 employees with a payroll of over \$5.5 million.

POTENTIAL NEW MARKETS FOR RECYCLED POLYPROPYLENE

Just south of Central Ohio, PureCycle Technologies is planning to commission and start up a feedstock evaluation unit in mid 2018 as part of a planned commercial plant that will restore used polypropylene (PP) to near virgin-like qualities. The patented technology was invented by P&G and licensed to PureCycle Technologies. They hope the full-scale plant, with a maximum capacity of 125 million pounds of plastic per year, generating 105 million pounds of finished product will reach full production in 2020.

The technology PureCycle Technologies uses removes contaminants, odors and colors from recycled polypropylene, enabling consumers to purchase more products made from recycled plastic. The technology is expected to handle feedstocks which are multi-colored and heavily contaminated.

Recycling Reliant Industries (Demand Side)

While Central Ohio is an important economic engine for the State of Ohio, it is not home to many recycling reliant industries, many of which are located outside of the Central Ohio region defined for this study. However, materials produced by Central Ohio recycling industries supply these manufacturers, so it is important to understand these activities in relation to Central Ohio's recycling industries.

GLASS: Container Manufacturers and Product Producers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$18,960,000	86	\$5,050,000

In general, there are three main markets for recycled glass or cullet: container manufacturing; fiberglass manufacturing; and, construction aggregate, including cements, road base, and engineering grade fills. In most cases glass container and product manufacturers purchase glass that has been cleaned in a secondary step, similar to plastic reclaimers, and often referred to as glass beneficiation facilities. Rumpke Recycling's Dayton Glass plant, highlighted on the next page, provides an excellent example of this.

In 2010, there were six manufacturing plants in Ohio sourcing recycled glass. These included:

- Owens-Brockway Glass Container, Inc. (O-I) produces clear bottles at its' manufacturing facility in Zanesville, OH;
- Owens Corning (OC) has two fiberglass manufacturing facilities in Ohio (Newark and Mount Vernon); and,
- Johns Manville has one fiberglass plant in Defiance and a second in Waterville.

In addition, Potters Industries near Cleveland produces glass beads, primarily for highway safety marking systems using recycled cullet, and Greer Whitacre in Alliance was sourcing relatively small quantities of recycled glass cullet for brick and block applications.

While none of these facilities are located in Central Ohio, they source from Central Ohio, with two fiberglass plants (both Owens Corning) and one glass container manufacturer (Owens- Brockway) located in the broader Central Ohio region. All three are large employers.

Glass manufacturing is an important part of Ohio's historical manufacturing base, and source recycled cullet from four glass beneficiation facilities in Ohio. Because of energy savings associated with substituting glass cullet for raw materials and, in the case of fiberglass, increased demand for insulation

manufactured with recycled glass, both the container glass and fiberglass industries would like to source significantly more recycled glass cullet than is currently available from Ohio municipalities. In 2010, cullet use by these industries was estimated at 110,000 tons in Ohio, with estimated demand ranging from 275,000 to 295,000 tons statewide (almost three times as much as sourced).^{11 12}

Cullet use, and recycled content varies among plants based on the products produced, plant operation, proximity to clean cullet and the cullet color (flint, green and amber). For fiberglass, John's Manville states that their plants average 25 percent use¹³. For Owens Brockway (whose worldwide headquarters is in Perrysburg, Ohio), 35 percent of worldwide input was cullet in 2014 and they are said to use more post-consumer glass - 4.5 million tons - than any other glass-container maker.

In total, an estimated 86 employees with a payroll of roughly \$5 million and sales of \$19 million (rounded) represent recycled glass cullet's contribution to the glass industry in Central Ohio. It is important to note that the glass industry itself is much larger than these estimates.

RUMPKE'S GLASS CLOSES THE LOOP

In business since 1932, Rumpke is now one of the nation's largest privately-owned waste and recycling firms with more than 2,000 employees in Ohio. Headquartered in Cincinnati, Rumpke serves all of Central Ohio with a large collection fleet and a recyclables processing facility in Columbus that accepts single stream recyclables from residents (including the City of Columbus) and businesses throughout Central Ohio. Annually Rumpke's MRF separates roughly 20,000 tons of glass from incoming mixed material streams.

Specifications for both container and fiberglass cullet require that recycled glass be mostly free of residue, moisture and contaminants. Rumpke, with financial assistance from Ohio EPA, undertook rigorous R&D over more than a decade to determine how best to process glass from their MRFs to create cullet that met Ohio manufacturers' specifications. This resulted in the development of a processing facility in Dayton to accept mixed glass from Rumpke's three single stream recycling processing facilities.

Rumpke's \$1 million renovation at the Dayton Glass Plant in 2016 makes it one of the country's most advanced mixed glass processing facilities. Extended conveyors, an enhanced dust collection system and technology to remove fines (materials such as paper labels, dust, dirt and other organic materials) and optically sort glass cullet by color help ensure a cleaner end-product. The facility successfully processes 50,000 tons of broken glass annually into raw materials for fiberglass insulation and glass container manufacturing in the region. This investment ensures that glass, which makes up 15-20 percent of the single stream recyclables collected from SWACO municipalities, continues to have viable end markets and helps to close the loop for glass recycling in Ohio.

¹¹ DSM Environmental Services. Ohio Department of Natural Resources. Ohio Glass Recycling Study, FINAL REPORT, February 28, 2011. No updated estimate is available.

¹² They can use both container glass and float (plate) glass to meet this demand.

¹³ See: <http://www.jm.com/en/sustainability/environmental-responsibility/> An average of 25 percent recycled content was averaged across North America (as certified by Scientific Certification Systems) which includes an average of 20 percent post-consumer, with the balance consisting of post-industrial recycled glass



FIGURE 3 – Photo at left and below, Cleaning Up Glass for Higher End Uses at Rumpke's Dayton Glass Plant



METALS:

Recycling reliant industries that utilize metals include nonferrous smelting and refining, steel mills and foundries. In 2015, the US recycled 58.3 million metric tons of metal (about 49 percent of the apparent supply). About 90 percent of recycled metal was iron and steel.^{14 15}

Iron and Steel Mills

Ohio produces an estimated 14.5 million tons of steel annually¹⁶, second only to Pennsylvania. This represents roughly 18 percent of US steel production.¹⁷ Roughly 50 percent of Ohio steel is produced in electric arc furnaces that typically rely on 90 percent scrap (recycled) metal to produce new steel.

According to the Ohio Steel Council, the industry's *total economic impact* on Ohio's economy is an estimated \$7.2 billion, including direct, indirect and induced economic impacts. Nearly 100,000 jobs can be linked to Ohio's steel industry – through direct employment or through indirect and induced impacts – and in total generate \$4.8 billion in wages. Ohio also ranks second in manufacturing products from purchased steel. In addition, 13 companies on Fortune magazine's US 1,000 or Global 500 lists have iron and steel industry establishments in Ohio with three of them operating their world headquarters in the State.¹⁸

Ohio steel companies buy nearly 8 million tons per year from Ohio's scrap dealers, shredders and buy-back centers.¹⁹ Ohio's steel making production cycle and high recovery exemplifies the circular economy.

¹⁴ US Dept of the Interior, US Geological survey. USGS 2015 Minerals Yearbook. Recycling - Metals. May 2017.

¹⁵ Imports and exports may result in these figures differing from other US scrap metal totals.

¹⁶ Ohio Steel Council, Economic Impact, most recent data available.

¹⁷ Based on the World Steel Association's for US steel production in 2016.

¹⁸ Ohio Research Office, A State Affiliate of the U.S. Census Bureau. Advanced Manufacturing: Ohio Iron and Steel Industry. January 2016.

¹⁹ Ohio Steel Council website: <http://www.ohiosteel.org/economic-impact/facts-and-figures/sustainability/>. 2014.

Nonferrous Secondary Smelting and Refining Mills and Product Producers

Nonferrous metals (those that do not contain iron) are used in a wide variety of products, including containers, electronics, automobiles, and household appliances. Manufacturers smelt (chemically reduce), refine, and sometimes blend nonferrous scrap along with metals from primary metal production and fabrication processes. The most common nonferrous metals recovered in the United States are aluminum, lead, copper, and zinc followed by chromium, nickel, and magnesium.

Aluminum is used by container and packaging manufacturers as well as in the transportation, construction, and electrical sectors. Copper is used in power, lighting, and communications transmissions. While the domestic use of lead has decreased in most products, it is still found in storage batteries for automobile ignition starters, and uninterruptible and standby power supplies (necessary for computers, emergency lighting, and telephones). Finally, zinc is primarily used to galvanize products found in the automobile, steel, and construction industries, but secondary zinc is often used to produce brass and bronze or blended for alloys.

Economic Impact of Nonferrous Processors and Steel Mills

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$360,320,000	623	\$49,780,000

There are two Central Ohio steel mills operating – NuCor Steel in Marion, and AK Steel’s Mansfield Mill. Depending on the mill capacity, furnace type, and available scrap supply, different quantities of scrap metal are used.

DSM used the ASM’s economic data (2015) - the most recent economic data available for Ohio for NAICS code 33111 *“Iron and Steel Mills and Ferroalloy Manufacturing”* to determine average pay in those establishments. Employment and total receipts were obtained on a location specific basis. And furnace types for each location were determined from the recent report on the Ohio Iron and Steel Industry and confirmed by website information.²⁰

Both mills operate electric arc furnaces, so are assumed to rely primarily on scrap, with a combined capacity of nearly 1.3 million tons. Together these three facilities

HISTORIC SCRAP METAL BUSINESS FEEDS THE INDUSTRY

I.H. Schlezinger located on Joyce Avenue in Columbus is one of the region’s largest scrap metal processors, serving both large businesses as well as households. The company has a 100-year history in the region and continues to be independently-owned providing jobs for over 40 employees last year.

The company maintains a fleet and equipment to collect and transport metals from large customers to their processing facility as well as offers small businesses and households a paved, drive-thru area to drop off materials, weighing and unloading as each customer remains in their vehicle.

The facility first screens all material for radioactive or hazardous wastes, then sorts and bales or shreds by grade to the appropriate specification for different end markets. Grades are shipped by rail and truck to markets internationally as well as domestically including local markets in Central Ohio.

²⁰ Ohio Research Office, A State Affiliate of the US Census Bureau. Advanced Manufacturing: Ohio Iron and steel Industry. January 2016.

are estimated to employ over 600 workers with a payroll of nearly \$50 million and represent sales of roughly \$360 million.²¹ This can be attributed to Central Ohio's recycling reliant industry.

Nonferrous and Ferrous Foundries

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$333,360,000	1,034	\$59,080,000

According to the American Foundry Society (AFS), more than 11.5 million tons of castings were produced in the U.S. in 2016m and valued at more than \$30.3 billion. The U.S. is the world's third-largest producer of castings (after China and India). There are currently 1,956 operations representing over 200,000 jobs in the U.S. (80 percent of which are small businesses with less than 100 employees).

According to the 2015 ASM data, over 14,000 were employed in Ohio foundries with a payroll of over \$750 million. For Central Ohio, economic data on both ferrous and nonferrous foundries were obtained primarily from Economic Census data (2012) with input from technical reports from the AFS, and the Nonferrous Founders Society to allocate scrap percentages. In total DSM identified three nonferrous and eight ferrous foundries in the Central Ohio region employing an estimated 1,034 in this recycling reliant industry.

PAPER: Pulp and Paper Mills and Paper-based Product Manufacturers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$54,420,000	117	\$8,610,000

According to the American Forest and Paper Association (AF&PA), approximately 80 percent of all U.S. paper mills use some recovered fiber in producing paper products, including paper-based packaging, tissue, office papers and newspaper²² The U.S. paper recovery rate made its third consecutive annual increase, rising to an all-time high of 67.2 percent in 2016. This comes close to AF&PA member companies' goal to increase the rate to more than 70 percent by 2020.

NEW RECYCLED CONTAINERBOARD MILL

Pratt Industries has broken ground on a recycled containerboard mill in Wapakoneta, Ohio. At full capacity this facility will produce nearly 400,000 tons of 100 percent recycled containerboard annually and is expected to create 300 high paying "Green Collar" jobs.

This new mill will consume thousands of tons of recycled mixed paper and OCC from the Central Ohio region. Demand for recycled paper, the feedstock for this mill, will ramp up quickly and when the plant reaches full capacity it will consume more than four hundred and fifty thousand tons of paper annually. (Source: Pratt Industries, February 2018.)

²¹ For Nonferrous processors, only 30 percent of employment, payroll and revenues were allocated to represent the percent scrap input assumed to be used. For Steel Mills with electric arc furnaces, 100 percent of economic data was applied to represent an assumed 100 percent scrap use.

²² See AF&PA's website (February 2018) at: <http://www.afandpa.org/issues/issues-group/paper-recycling-a-true-environmental-success-story>

Consumption of recovered paper at U.S. paper and paperboard mills was 30.8 million tons in 2016 – down just 0.1 percent compared with the 2015 level – while exports rose 1.3 percent to 21.8 million tons. Recovered paper is also used outside of the paper industry, including in cellulose insulation, hydro-seeding mulch, pressed paperboard and molded fiber products (e.g. egg cartons, tableware, berry baskets and food service cartons), construction paperboard (e.g. for poured concrete spacers), and masking tape backing.

Only one paper mill remains in Central Ohio - **Ohio Paperboard in Baltimore** now owned by Caraustar Industries.²³ And there is one paper-based product manufacturer - **Advanced Fiber Technology** which manufactures cellulose insulation from waste paper in Bucyrus (Crawford County). Their insulation is manufactured with a minimum of 85 percent recycled post-consumer newsprint.²⁴

While both paper manufacturers and waste paper insulation manufacturers rely on recovered paper, they also use some percentage of virgin wood. DSM's methodology measures activity at the first stage of manufacturing only. For paper, this is at the mill where a roll of paper is made and excludes any conversion of paper to products such as containers or envelopes, even if they had some or all recycled content. Together the existing paper mill and paper product manufacturer in Central Ohio is estimated to represent 117 jobs with a payroll of \$8.6 million and revenues of over \$50 million.

ASPHALT AND AGGREGATE: Pavement Mix Producers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$17,080,000	31	\$2,570,000

Recycled asphalt pavement (RAP) consists of old asphalt pavement milled and ground into aggregate. RAP can substitute for a portion of aggregate required in bituminous concrete (i.e. asphalt pavement) in both the base course and surface course.



According to the National Asphalt Pavement Association's (NAPA) 2016 Industry Survey on Recycled Materials and Warm-Mix Asphalt Use, 76.9 million tons were estimated to be used nationally in asphalt mixtures. NAPA reports that RAP is recycled at a greater rate than any other material in the United States and lowers overall material costs, allowing road owners to complete more maintenance within limited budgets. In addition to RAP, reclaimed asphalt shingles (RAS) are also used in asphalt pavements. Other recycled materials

²³ Over the last 15 years however three paper mills in Central Ohio closed – Sonoco closed their uncoated recycled paperboard mill in Lancaster in May 2009 and the Middletown Paperboard and Franklin Boxboard plants were closed in 2004 and 2011 respectively. The Franklin plant had been in operation for 100 years.

²⁴ Source: See <http://www.advanced-fiber.com/>

used in asphalt pavements include ground tire rubber (GTR), steel slag, blast furnace slag, and cellulose fibers.

The average percent RAP used nationwide in asphalt mixtures was 20.5 percent in 2016. In Ohio, the reported average RAP in 2016 was 27 percent with an estimated 3.96 million tons stockpiled. DSM identified two major companies producing RAP within Central Ohio, ***Kokosing Materials, Inc. and Shelly Materials, Inc.*** These companies represent a total of seven locations operating within the Central Ohio region.

PLASTICS: Plastic Converters and Product Manufacturers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	\$16,430,000	75	\$4,050,000

Plastic Converters and Product Manufacturers purchase recycled plastic flake, granulate, and/or pellets for use in the production of new plastic packaging and products. Most establishments in the United States use post-industrial plastic scrap (which is generally cleaner and more consistent) which has been processed by a plastics reclaimer or grinder. A few are use post-consumer resins (PCR), and others reclaim material themselves before manufacturing.

Examples of (recycled) plastic product manufacturers include manufacturers of plastic lumber and furniture, plastic bags, railroad ties, clamshell packaging, plastic tackle and tool boxes, custom injection molding and packaging inserts.

In most cases the recycled plastic resin is mixed with virgin resin to produce the final product. Just as in the case with other recycling reliant industries, the economic activity from plastic product manufacturing was allocated for this report by applying the assumed average recycled resin content of the products manufactured to the economic and employment data.

The recycled content varies by product, company and year. Many plastic product manufacturers fill custom orders and are bound to the constraints of product specifications. If the specifications allow for a certain amount of recycled plastic, then the manufacturer has the option to purchase and use the recycled resin. The plastic product manufacturing industry is also reflective of the broader economy with recycled feedstock competing with virgin feedstock and therefore low oil and virgin resin prices make it difficult for PCR to compete.

One local example is **AXION Structural Innovations' ECOTRAX®** Composite Railroad Ties, which are manufactured in Central Ohio, and produced from 100 percent recycled material. They replace the need for traditional railroad ties – which may leach toxic chemicals into the environment -- and are impervious to the elements. Unlike wooden railroad ties, plastic ties also do not rust, splinter, or rot. AXION also makes construction mats, composite blocks, beams, boards, and pilings all from recycled resins.²⁵

In the end DSM identified 4 establishments in Central Ohio with roughly 75 jobs attributable to the use of recycled plastics and representing an estimated payroll of over \$4 million and revenues of roughly \$16.4 million. This is only a small portion of Ohio's plastic products industry (most located outside of Central Ohio), which employs the most people in plastic products in the United States, followed by the states of California, Michigan, Texas and Indiana.²⁶

According to the Freedonia Group, the US demand for PCR plastics was forecasted to rise 6.5 percent per year to 3.5 billion pounds in 2016 with the gains driven by a number of factors, including a growing emphasis on sustainability among packaging and consumer product manufacturers, advancements in processing and sorting technologies, and an improved collection infrastructure, which raises the plastic recycling rate. However only about half of the plastic collected for recycling makes its way to manufactured products in the US market, with the rest exported. If this were to change, there would be ample opportunities in Ohio to close the loop at home.

²⁵ Source: <http://www.axionsi.com/>

²⁶ Size and Impact of the U.S. Plastics Industry. SPI: The Plastics Industry Trade Association, 2015.

ADVANCED DRAINAGE AND GREEN LINE POLYMERS

Advanced Drainage Systems (ADS), headquartered in Hilliard, is the leading manufacturer of high performance thermoplastic corrugated pipe, providing water management and drainage products for use in construction and related infrastructure applications, and is one of the largest domestic recyclers of HDPE plastic.

Founded in 1966, the Company operates a global network of approximately 60 manufacturing plants and over 30 distribution centers, of which 7 plants are in Ohio. With estimated revenues of \$1.257 billion in 2017, ADS used 255 million pounds of post-consumer plastic and 170 million pounds of post-industrial plastic to produce an array of pipe and accessory products.

ADS purchases and processes a wide variety of reusable HDPE products through their Green Line Polymers, Inc. wholly owned subsidiary. These purchases occur throughout the U.S. and ADS has a strong emphasis for materials located in Ohio. Overall, products produced contain 57% recycled resin content.

In Central Ohio they employ roughly 281 in both production and management/sales with a manufacturing facility in London.

RUBBER: Rubber Product Manufacturers

Region	Revenues (\$)	Employees	Payroll (\$)
Central Ohio	> \$14,600,000	36	\$1,460,000

Ohio generates approximately 12 million used tires per year, with an estimated 1.3 million tires from Franklin County. Ohio's Scrap Tire Law gives Ohio EPA the authority to regulate scrap tires until they are properly disposed, recycled into another product or converted into energy. Through Ohio EPA's registration program, tire dealers and repair shops know they are dealing with legitimate scrap tire businesses rather than illegal dumpers when disposing of used tires. Collection outlets for used tires are multiple and include retailers, municipal drop-offs, SWACO facilities and mobile drop-offs. After collection, most tires are transported for processing.

Liberty Tire's Recycling facility in Grove City processes the vast majority of the tires collected in the region to produce crumb rubber products for use in a wide variety of molded products including welcome mats, railroad ties, acoustical underlays, and portable speed bumps. In addition to molded rubber products and coatings, crumb rubber enhances surfaces such as highways and horse tracks, as well as civil engineering applications substituting for stone aggregates. The Grove City facility produces civil engineering products for use in landfill construction in Ohio. The facility provides 36 jobs and processes roughly 5.5 million tires annually.²⁷

In nearby Shelby County **Boomerang Rubber, Inc.** (Botkin's, Ohio) manufactures truck bed mats, splash guards and agricultural mats from post-industrial uncured rubber scrap. They also grind their own cured flash (trim) and add it back into the product feedstock (see www.boomerangrubber.com). Through these two examples, a closed loop for tires can be found in Ohio.



²⁷ Note that revenues are not available for this facility and payroll is estimated based on estimated employment and census data.

Reuse and Remanufacturing Industries

The reuse and remanufacturing industries are varied and include retail and wholesale resale of used products, as well as repairing or remanufacturing products for introduction back into the consumer marketplace.

Computer and Electronic Appliance Demanufacturers

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$28,970,000	198	\$7,240,000

The electronics recycling industry has evolved and grown significantly over the last two decades as technology and electronic products continue to both advance and become obsolete. According to the 2017 Global E-waste Monitor report from the United Nations University (UNU), 44.7 million metric tonnes of e-waste were generated in 2016, with the value of the raw materials found to be roughly US \$64.7 billion.²⁸

FIGURE 4 – Life Cycle Stages of Electronics (Source: US EPA)



In the US, 3.4 million tons of e-waste were estimated to be generated in 2014 excluding appliances, of which 41 percent (by weight) were estimated as recycled.²⁹ When the EPA first documented the value of the recycling and reuse industries, electronics were categorized as a reuse industry although today many materials are recovered for recycling and not reuse purposes. Today, facilities sort, dismantle, remove valuable components and materials, shred and sell different parts of electronic devices. Other facilities simply perform intake and sorting and ship to processors.

In Central Ohio, DSM identified 20 electronic recycling businesses/facilities. Many of these facilities perform data security and other IT functions, which are not counted as recycling related activities in this

²⁸ The World's E-Waste Is Piling Up at an Alarming Rate, Says New Report. Science Alert. December 13, 2017.

²⁹ Electronic Products Generation and Recycling in the United States, 2013 and 2014 U.S. Environmental Protection Agency Office of Resource Conservation and Recovery December 2016.

study, but roughly 50 percent of employment and revenues for those locations were accounted for in the total estimate for the electronics recycling industry.

Because of the rapid growth and change in demand for various electronic components, and the recycling opportunities available, this industry was very difficult to characterize. DSM estimates that roughly 200 people were employed in reuse/manufacturing and recycling related activities at these establishments, generating estimated revenues of roughly \$29 million.

Resale of Used Motor Vehicle Parts

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$19,360,000	169	\$6,600,000

The wholesaling and reselling of used motor vehicle parts is an active part of the reuse economy. This sector is primarily tracked as NAICS code 423140 - *Motor Vehicle Parts (Used) Merchant Wholesalers*. It comprises establishments “primarily engaged in the merchant wholesale distribution of used motor vehicle parts (except used tires and tubes) and establishments primarily engaged in dismantling motor vehicles for the purpose of selling the parts.” Motor vehicle parts are first removed and sold for reuse (or in some cases the high metal value) before the vehicle is crushed and processed as scrap metal.

DSM used the Automotive Recyclers Association, United Recyclers Group and Hoovers to compile a list of businesses operating in this sector. DSM then used Hoovers and the Bureau of Labor Statistics (2016) data points to estimate employment, revenue and payroll. A total of 32 establishments were identified with an estimated 169 employees and receipts of roughly \$19 million.

ARROW ELECTRONICS IN GAHANNA

ARROW ELECTRONICS IN GAHANNA

Arrow Electronics, Inc. opened one of the largest IT asset disposition facilities in 2016 by upgrading its existing value recovery processing facility in Gahanna. The state-of-the-art upgrades Arrow made to the 400,000 sq. ft. facility include automation and layout improvements to increase processing efficiency and chain-of-custody security, which have greatly increased processing capacity at the facility.

Arrow works with customers around the world to securely refurbish computers, servers, smartphones, printers and other electronic devices for additional use, or repurpose component parts for other uses. Whenever possible, Arrow emphasizes extending the life of these devices by selling them, redeploying them within organizations or donating them.

The facility has a fully automated production conveyor system allowing for equipment to be tested and inspected as well as for data removal and software installation to prepare assets for resale. This process flow system requires minimal touch points, providing a secure chain-of-custody and resulting in a fast, efficient refurbishment process.

Retail Used Merchandise Sales

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$34,050,000	1,008	\$19,220,000

Used merchandise sales are a large contributor to reuse activity. This sector is covered under NAICS code 453310 - *Used Merchandise Stores* – and comprises “establishments primarily engaged in retailing used merchandise, antiques, and secondhand goods (except motor vehicles, such as automobiles, RVs, motorcycles, and boats; motor vehicle parts; tires; and mobile homes).” This sector includes antique stores, used apparel stores, used book dealers, used household appliance stores, thrift stores, used sporting goods stores, used building material stores, flea markets, used furniture stores, salvage shops and other types of second-hand stores.³⁰

DSM used data from Hoovers and the Bureau of Labor Statistics (2016) to compile data on establishments, employment, payroll and gross receipts in order to estimate values for this sector. DSM verified all larger businesses listed through internet research and telephone calls.

DSM identified over 200 retailers of used merchandise in the seven-county area. **Goodwill Industries** is the most established used merchandise reseller with 9 locations in Franklin County alone. Goodwill not only helps to divert thousands of tons of materials from disposal but provides good jobs and workplace training and development programs for an important part of the region’s population, the developmentally disabled.



In total, these 200+ establishments identified were estimated to employ over 1000 with receipts of over \$34 million. While generally small in terms of economic contribution, they contribute widely to diversion of materials from landfilling.

Tire Retreaders

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$6,900,000	49	\$1,990,000

Another important reuse industry are those businesses engaged in collecting, retreading and reselling retread tires. This sector is covered under NAICS code 326212 *Tire Retreaders*, which comprises “establishments primarily engaged in retreading or rebuilding tires.” Retreads are made from tires that are worn yet otherwise structurally sound or that have a good foundation. The first step in

³⁰ Pawn shops are not included in this sector (although sometimes are classified under this NAICS code) and have been removed from the database because they are viewed as primarily a financial services firm, not a used goods recycler. See Operating pawnshops (NAICS 522298), All Other Nondepository Credit Intermediation

retreading is inspection, then buffing (where the remaining tread is removed), then preparing the casing, and applying the new tread.

DSM reviewed the Tire Retread Information Bureau (TRIB) database and the Retread Tire Association (RTA) database for establishment counts for Central Ohio. TRIB and RTA only provide establishment locations and do not maintain industry economic data at the State level, therefore DSM used data gathered from phone surveys, Hoovers, and the Bureau of Labor Statistics data (2016) for employment, payroll and gross receipts. To avoid double counting, DSM only included tire retreading companies that were retreading within their establishment location and did not send their tires out to another company for retreading.

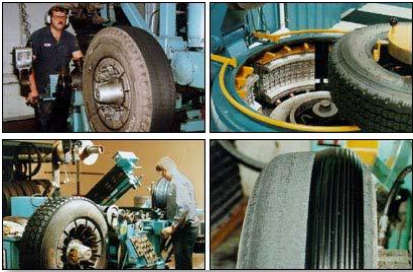


Photo Source: Tire Retread Information Bureau

Wood Reuse

Region	Revenues (\$)	Employees	Payroll (\$)
Franklin and adjacent counties	\$31,430,000	188	\$7,300,000

The strategic location of Columbus with Interstate 70 bisecting the City, and major rail and highway networks nearby contributes to a large population of wholesalers and distributors. With these businesses comes the need for packaging, including pallet remanufacturers.

This category consists of all establishments that accept clean wood (primarily wood pallets and crates and some dimensional lumber) and either remanufacture pallets and other wood packaging or chip clean wood to create a saleable product. DSM attempted to survey all of the companies located in Central Ohio from the Hoovers database list to determine the percent of wood reuse, employment size, annual throughput of the company and gross receipts.

The list from Hoovers was supplemented with data from the National Wooded Pallet and Container Association, SWACO Recycling Database and internet searches to ensure the largest companies were contacted.

REMAUFACTURING AT BDL SUPPLY

REMAUFACTURING AT BDL SUPPLY

BDL Supply has been a leader in protective packaging in the Midwest with three locations in Central Ohio, including a 400,000 square foot facility in Columbus where wooden pallets and crates are repurposed for redistribution into the supply chain. Over 12,000 pallets are repaired and rebuilt each day in Central Ohio for reuse by customers throughout the region.

Roughly 60 percent of BDL's pallets are repurposed for redistribution avoiding the use of new lumber and wood packaging in pallet and crate manufacturing. For pallet and crate wood that is beyond repair, BDL processes the wood to create three products: wood chips for landscaping and other uses; an absorbent product; and, "Easy Heat" wood pellets

BDL Supply also helps customers operate a sustainable supply chain through handling not only their damaged wood packaging but also collecting corrugated cardboard, plastic shrink-wrap and other materials for recycling and end markets. This includes providing logistics for recycling and reuse of computers and electronic equipment through their local partner, Southeastern Data (Columbus).

Establishments whose primary business is to grind green wood to produce mulch or other products, were accounted for in Organics composting, above. However, pallet manufacturing companies that grind waste wood for use as fuel products, such as ***BDL Supply***, were included in this sector.

In the end DSM identified 15 companies with 16 locations in Central Ohio with estimated receipts of roughly 31.4 million related to pallet remanufacturing and that employ 188 people.

Materials Exchanges

Materials Exchanges are businesses or entities that provide a virtual marketplace where generators of used materials and those seeking these products can facilitate a transaction to exchange the good or material and reuse these otherwise end-of-life materials. However, because virtual exchanges do not have physical space or storage or other mechanism to physically handle materials exchanged, it is difficult to quantify the economic value of the activity. They also often fall outside the tax structures, unless a business quantifies and reports on such an exchange.

Formerly called waste exchanges, material exchanges are often organized around the following materials, with some transactions occurring with an agreed upon price for items while others donating items:

- Building Materials – Lumber, tools, windows, doors, light fixtures, paint, plumbing supplies and fixtures, and many other items needed for constructing or refurbishing a building.
- Office Furniture and Supplies – Desks, tables, chairs, filing cabinets, credenzas, shelving units, and other equipment and supplies can be reused in offices, schools, and other settings.
- Art Materials – Fabric, paints, papers, wood, stage props, and a wide variety of other items can be used for school or other organizations' creative projects.
- Medical Equipment and Supplies – Equipment and supplies that are obsolete to one hospital, clinic or organization may find a home in another facility, especially those in less-industrialized nations.
- Surplus Food Items – Boxed, bagged, canned and even prepared food from grocery stores, warehouses, manufacturers' over-runs and discontinued items, catered events, restaurants can be donated to homeless shelters, soup kitchens, and other organizations serving disadvantaged people.

OHIO MATERIALS MARKETPLACE

The Ohio Materials Marketplace helps Ohio companies access cheaper raw material feedstocks, and avoid landfill disposal fees. Participants not only benefit from economic savings by sourcing cheaper feedstocks from both industrial by-products and post-consumer recycled materials, but businesses that use the marketplace find outlets for their by-products and waste materials are able to avoid costly landfill tipping fees and waste hauling services.

The Materials Marketplace - which received the 2015 Gold Excellence Award from the International Economic Development Council - helps bring these circular economy benefits to the state of Ohio.

More information can be found at:
<https://ohio.materialsmarketplace.org/>

- Household Items – Appliances, clothing, furniture, dishes, vehicles, paint, and virtually anything else generated by homeowners might be exchanged through a list serve or materials exchange.

Marketplace participants benefit from economic savings by sourcing cheaper feedstocks from both industrial by-products and post-consumer recycled materials. DSM identified formal materials exchanges through the U.S. EPA website and Ohio state websites. The Ohio materials marketplace is one example: <https://ohio.materialsmarketplace.org/>

Two well-known entities, Freecycle and Craigslist, fall under the definition of a materials exchange in whole or in part. However, the direct economic contribution of these organizations occurs outside the region and is therefore not included, despite the volume of material reuse that may be occurring because of their existence. Craigslist was credited with diverting 5 million tons of stuff from landfills (Yes Magazine, March 3, 2015) but said to employ less than 30 people (Source: Forbes Magazine, 2015). While this resource may not add significantly to the recycling and reuse industries, it can be a significant driver in not only reducing waste locally but also connecting a buyer and seller in a region to keep the dollars local for some larger items.

There is no economic data for this sector although DSM estimates at least 2 people work on this in Central Ohio.

Other Reuse

This is the second catch-all category, intended to capture all businesses and non-profit organizations not elsewhere classified that either provide a service or purchase or obtain used materials, equipment, or merchandise for repairing, cleaning, or otherwise putting back into use.

DSM's ability to identify such businesses was limited to their inclusion on one of the recycling directories consulted at the outset of the project, the result of internet searches for "reuse in Ohio" or identification by one of the local contacts.

One example found is **Spirit Services** which not only sells new uniforms and other products but provides industrial laundering of all types of items. Working closely with large clients, such as the Maryville Honda plant, a closed loop system of cleaning and returning used gloves at the plant was established to replace the wasteful practice of disposing of the gloves.

Finally, the 'sharing economy' should be recognized as an important contributor to the circular economy as it maximizes the utility of assets through hiring, renting, lending, swapping, and even bartering, often facilitated by technology. In summary, it avoids the production of new assets by sharing existing ones.

Obvious examples are companies such as Zipcar, which capitalized on the idle capacity of cars (said to be unused in the US for an average of 23 hours a day) by developing platforms that charge for usage.³¹ Since Zipcar's early adoption of the concept, many companies and services have entered the sharing marketplace offering transportation (Uber, Lyft and Citi Bike), overnight accommodations (Airbnb) and even scenic campsites (see Hipcamp at: <https://www.hipcamp.com/>)

The sharing economy's primary benefits are economic (with more efficient use of assets at a lower cost), environmental (with more sustainable use of resources) and communal (forcing connections among the asset owner or service provider and the user).³² Technology platforms enable the sharing to occur among two parties that otherwise would not interact.

Like the materials marketplace, it is impossible to make an estimate of the economic impact, and employment related to these activities. However, it is important to recognize that this activity leads to the more efficient use of many resources and avoids or delays material consumption.

³¹ World Economic Forum. Towards the circular economy: Accelerating the scale-up across global supply chains. See: <http://reports.weforum.org/toward-the-circular-economy-accelerating-the-scale-up-across-global-supply-chains/>

³² Ibid.

PART 3: RESULTS

In total, an estimated **372 establishments make up Central Ohio's recycling industries and are estimated to employ over 5,000 and produce annual revenues of roughly \$1.29 billion**. Figure 5 illustrates how these total revenues are distributed between the recycling, recycling reliant and reuse/remanufacturing industries.

In reviewing these data, it is critical to recognize that the study region was expanded to include Ashland, Crawford, Harding, Knox, Muskingham, Marion, and Richland counties for the *Recycling Reliant Industries* only. In addition, recycling collection activity is only documented in Franklin County and not expanded to the adjacent counties of Delaware, Fairfield, Franklin, Licking Madison Pickaway, and Union as was done for all other sectors. Analyzing the exact regions would produce different results.

FIGURE 5 – PERCENTAGE OF TOTAL ANNUAL REVENUES IN EACH MAJOR RECYCLING INDUSTRY

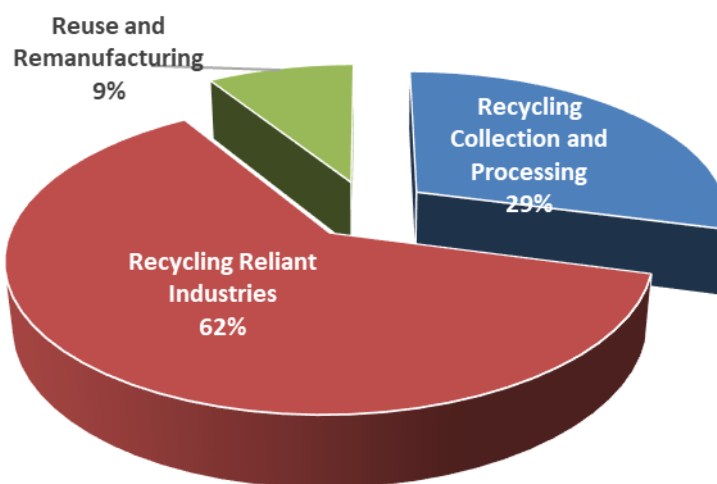


Figure 5 above illustrates the contribution of revenues from each major sector and Table 6 below summarizes the breakdown of revenues, employment and payroll from these three over-arching categories. A detailed breakdown by sector follows in the next section.

TABLE 6 – SUMMARY OF TOTAL ESTIMATED ANNUAL REVENUE, EMPLOYMENT AND PAYROLL FROM THE MAJOR RECYCLING SECTORS

SECTOR	Establishments	Revenue (\$)	Employees	Payroll (\$)
Recycling Collection and Processing	140	\$374,800,000	1,471	\$62,320,000
Recycling Reliant Industries	32	\$802,030,000	2,001	\$130,600,000
Reuse/Remanufacturing	200	\$120,710,000	1,612	\$42,350,000
Total:	372	\$1,297,540,000	5,084	\$235,270,000

Detailed Results by Sector

Table 7 details the results from compiling data points on each sector of the recycling industries.

TABLE 7 – ESTIMATED ANNUAL REVENUES, EMPLOYMENT AND PAYROLL FROM EACH OF THE RECYCLING SECTORS (1)

SECTOR		Establishments	Revenue (\$)	% Recycling or Reuse	Net Revenue (\$) (2)	Employees	Net Employees (2)	Payroll (\$)
Recycling Collection	Residential Curbside Recycling Collection		\$26,030,000	100%	26,030,000	242	242	\$11,010,000
	Commercial Recyclables Collection	34	\$20,290,000	100%	20,290,000	108	108	\$5,490,000
Recycling Processing	Compost/Organics Processors	30	\$21,400,000	64%	13,740,000	190	115	\$4,990,000
	Materials Recovery Facilities and Recyclable Material Wholesalers	38	\$285,570,000	94%	268,010,000	740	690	\$27,950,000
	Plastics Reclaimers	5	\$28,370,000	100%	28,370,000	181	181	\$7,320,000
	Other Recycling Processors/Manufacturers	33	\$52,250,000	35%	18,360,000	419	137	\$5,560,000
Recycling Reliant Industries	Glass Container Manufacturing Plants and Glass Product Producers	3	\$72,000,000	26%	18,960,000	302	86	\$5,050,000
	Nonferrous Secondary Smelting and Refining Mills and Product Producers, and Steel Mills	3	\$363,020,000	99%	360,320,000	658	623	\$49,780,000
	Nonferrous and Iron and Steel Foundries	12	\$547,850,000	61%	333,360,000	1,548	1,034	\$59,080,000
	Paper and Pulp Mills and Paper-based Product Manufacturers	2	\$55,200,000	99%	54,420,000	120	117	\$8,610,000
	Pavement Mix Producers (asphalt and aggregate)	7	\$61,010,000	28%	17,080,000	110	31	\$2,570,000
	Plastics Converters and End Users	4	\$85,170,000	19%	16,430,000	454	75	\$4,050,000
	Rubber Product Manufacturers	1	\$1,460,000	100%	1,460,000	36	36	\$1,460,000
Reuse and Remanufacturing	Computer and Electronic Appliance Demanufacturers	20	\$74,250,000	39%	28,970,000	335	198	\$7,240,000
	Motor Vehicle Parts (used)	32	\$28,160,000	69%	19,360,000	246	169	\$6,600,000
	Retail Used Merchandise Sales	126	\$34,050,000	100%	34,050,000	1,008	1,008	\$19,220,000
	Tire Retreaders	4	\$13,640,000	51%	6,900,000	96	49	\$1,990,000
	Wood Reuse	16	\$57,020,000	55%	31,430,000	342	188	\$7,300,000
	Material Exchange Services and Other Reuse	2	NA					
	Totals	372			\$1,297,540,000	7,133	5,084	\$235,270,000

(1) Revenue, Net Revenue and Payroll figures are rounded to the nearest \$10,000, and totals may not add due to rounding.

(2) Net Revenue and Net Employees represent the percent of total revenue and total employees estimated to be related to and/or engaged in recycling related activities. Payroll is based on the net employee count.

As illustrated by Table 7, with the exception of two sectors (rubber product manufacturers and tire retreaders), **each of the recycling sectors contributes over \$10 million to the Central Ohio economy.** And **recycling collection activity in Franklin County alone contributes over \$45 million and employs an estimated 350 people with a payroll estimated at \$16.5 million.** Also shown in Table 7 is the significant contribution of the metals industries – steel mills, non-ferrous smelting and foundries.

Comparison of the Relative Size of the Recycling Industry (Supply Side), Recycling Reliant (Demand Side) and Reuse Industries

Table 8 illustrates the revenue, employment and payroll of the recycling related activities in each sector and calculates the percentage contribution within each major category. Highlighted in gray are the largest contributors within the Recycling, Recycling Reliant and Reuse/Remanufacturing Industries. The terms “Net Revenues” and “Net Employees” refer to the recycling related activities only, which are a percentage of total economic activity at each location.

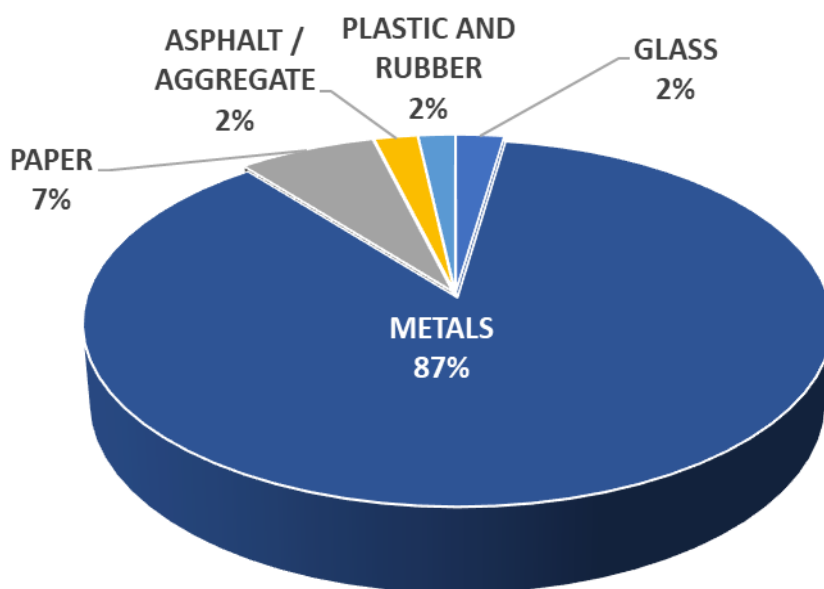
TABLE 8 – CONTRIBUTION OF EACH RECYCLING SECTOR

	SECTOR	Establishments	Net Revenue (\$)	% of Total	Net Employees	% of Total	Estimated Payroll (\$)	% of Total
Recycling Collection	Residential Curbside Recycling Collection		\$26,030,000	7%	242	16%	\$11,010,000	18%
	Commercial Recyclables Collection	34	\$20,290,000	5%	108	7%	\$5,490,000	9%
Recycling Processing	Compost/Organics Processors	30	\$13,740,000	4%	115	8%	\$4,990,000	8%
	Materials Recovery Facilities and Recyclable Material Wholesalers	38	\$268,010,000	72%	690	47%	\$27,950,000	45%
	Plastics Reclaimers	5	\$28,370,000	8%	181	12%	\$7,320,000	12%
	Other Recycling Processors/Manufacturers	33	\$18,360,000	5%	137	9%	\$5,560,000	9%
	Subtotal:	140	\$374,800,000	100%	1,471	100%	\$62,320,000	100%
Recycling Reliant Industries	Glass Container Manufacturing Plants and Glass Product Producers	3	\$18,960,000	2%	86	4%	\$5,050,000	4%
	Nonferrous Secondary Smelting and Refining Mills and Product Producers, and Steel Mills	3	\$360,320,000	45%	623	31%	\$49,780,000	38%
	Nonferrous and Iron and Steel Foundries	12	\$333,360,000	42%	1,034	52%	\$59,080,000	45%
	Paper and Pulp Mills and Paper-based Product Manufacturers	2	\$54,420,000	7%	117	6%	\$8,610,000	7%
	Pavement Mix Producers (asphalt and aggregate)	7	\$17,080,000	2%	31	2%	\$2,570,000	2%
	Plastics Converters and End Users	4	\$16,430,000	2%	75	4%	\$4,050,000	3%
	Rubber Product Manufacturers	1	\$1,460,000	0%	36	2%	\$1,460,000	1%
	Subtotal:	32	\$802,030,000	100%	2,001	100%	\$130,600,000	100%
	Reuse and Remanufacturing	Computer and Electronic Appliance Demanufacturers	20	\$28,970,000	24%	198	12%	\$7,240,000
Motor Vehicle Parts (used)		32	\$19,360,000	16%	169	10%	\$6,600,000	16%
Retail Used Merchandise Sales		126	\$34,050,000	28%	1,008	63%	\$19,220,000	45%
Tire Retreaders		4	\$6,900,000	6%	49	3%	\$1,990,000	5%
Wood Reuse		16	\$31,430,000	26%	188	12%	\$7,300,000	17%
Material Exchange Services and Other Reuse		2						
Subtotal:		200	\$120,710,000	100%	1,612	100%	\$42,350,000	100%
Totals	372	\$1,297,540,000		5,084		\$235,270,000		

As shown in Table 8, the largest contributors to the recycling industries are MRF's, and Recyclable Material Wholesalers - which is driven primarily by the large scrap metal businesses in Central Ohio. Also illustrated in Table 8 is the large contribution of retail used merchandise sales to revenues produced from Central Ohio's reuse and remanufacturing industry.

Finally, as shown in Table 8, and illustrated in Figure 6 below, the largest contributor to the recycling reliant industries are the metal industries contributing an estimated 86 percent to the total revenue estimate for this category.

FIGURE 6 – NET REVENUES (RECYCLING ACTIVITY) FOR THE RECYCLING RELIANT INDUSTRIES IN CENTRAL OHIO



Indirect and Induced Impacts

In addition to the estimated 5,000 jobs with an annual payroll of \$235 million and \$1.29 billion in revenues from recycling industries in Central Ohio, **there are indirect and induced impacts that roughly double the direct impact.**

Indirect impacts measure the value of additional economic demands that the direct economic activity places on the *supplying industries* in the region. When firms produce goods or conduct business, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, parts suppliers, trades (e.g. plumbing electrical) manufactured goods, financial and legal services, raw and processed commodities and a variety

of professional services are necessary to produce the gross receipts estimated from the direct economic impacts.

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

Input/Output (I/O) models are used to solve for these iterative rounds of transactions until all of the possible inter-industrial transactions have been accumulated. The most widely used I/O model in the United States is the IMPLAN model, which DSM had originally proposed to use for this project. However, I/O models require a specified geographical area – typically a county or a state - and as this project progressed it became apparent that many of the Recycling Reliant industries were outside of Franklin County and the contiguous counties. Incorporating economic data for the recycling reliant industries, which represent 39 percent of the estimated total employment, 55 percent of wages, and 62 percent of gross revenues (Table 6, above) was critical to the project, making it impossible to run a single, comprehensive I/O analysis for this report.

In addition, because material recycling collection and processing activities supply inputs to the Recycling Reliant industries, there is significant double counting if one runs an I/O model with the combined labor and revenues of both the recycling and recycling reliant industries. For this reason, DSM did not provide estimates of total indirect and induced employment and payroll for DSM's study undertaken for six northeast states, including Pennsylvania, that are members of the Northeast Recycling Council (NERC); instead, simply reporting the multiplier for each recycling sector studied.

However, based on other recycling economic information studies that DSM has completed for the neighboring state of Pennsylvania and the states of Illinois and New York, it is likely that applying the relevant multiplier for each sector included in the SWACO study would result in roughly doubling of employment, wages and gross revenues associated with the indirect and induced impacts. This would

INDIRECT AND INDUCED IMPACTS

Indirect impacts come from companies like Technical Rubber Company (TRC), whose global headquarters are in Johnstown next to one of many of TRC's manufacturing facilities. The Johnstown facility employs 270 to produce products used by tire retreaders (including those in Central Ohio) to repair the tire carcass for retreading. Suppliers like TRC are part of the indirect economic impacts resulting from the reuse and remanufacturing industry. (See TRC4r.com for more information.)

Induced impacts are the result of household spending on food, fuel and services as result of income earned from direct and indirect employment.

mean that ***the total impact of the recycling industry in Central Ohio is likely to be close to \$500 million in payroll for roughly 10,000 employees, and \$2.5 billion in total revenues.***

In essence recycling industries are an important example of an industry stimulating the economy in at least three ways. First, a Central Ohio based recycling industry provides direct employment and income within the region. Second, this direct employment and income stimulates employment and income in many other sectors of Central Ohio, doubling the direct impacts. And, third, the recycling industry provides a local source of inputs to recycling reliant industries in the region. Using an Ohio paper mill as an example, the mill can either import pulp from Michigan or Canada, or it can use secondary fiber collected locally. To the extent that it uses secondary fiber from the region, it multiplies the impact of the recycling industry by increasing employment in the local recycling industry. These employees go on to spend a significant amount of their labor income in Central Ohio, resulting in higher induced impacts when compared to the paper mill importing pulp from Michigan or Canada.

Modeling these impacts are difficult with the approach taken in this study since the study region is not a single region, but a series of counties, expanded to incorporate recycling reliant industries just outside the immediate seven county study area, but the impacts are real, non-the-less.

Impact of Increasing Recovery of Materials and Organics from Landfill

The 2016 RRS report to SWACO based on a 2013 waste characterization study of the SWACO landfill³³ indicated that roughly 713,000 of the 997,000 tons landfilled³⁴ at the SWACO landfill had some value, either for materials recovery or organics recovery. One question that SWACO hoped to address as part of this economic analysis was what impact increased materials and organics diversion would have on employment and payroll in the Central Ohio region.

The answer is more complex than a single linear extrapolation from the data presented here, but a rough estimate can be made based on the following assumptions.

First, the estimated 713,000 tons represents a 100 percent recovery rate for each of these materials, which is impossible to achieve for any single material, and certainly could not be achieved for all recyclable materials. Given that the easiest (and most economical) to recover recyclable and organic materials are already being diverted, it is likely that recovering another 35 percent of the remaining materials would be the maximum feasible recovery rate. This would result in additional diversion of roughly 250,000 new tons of materials and organics over time.

Table 9 (on the next page) illustrates these assumptions. Note that since food waste is currently diverted at very low rates, an additional 40 percent of food waste was applied.

³³ GT Environmental, 2013. Solid Waste Authority of Central Ohio Final Waste Characterization Study prepared by GT Environmental, Inc

³⁴ Note that the RRS report was based on 2014 landfill tonnages.

TABLE 9 – POTENTIAL ADDITIONAL RECOVERY FROM LANDFILLED MATERIALS

Landfilled Materials (1)	Additional Recovery		
	(tons)	(%)	(tons)
OCC	111,266	35%	38,943
Mixed/Other Paper	173,988	35%	60,896
Plastic Bottles	47,407	35%	16,592
Metals	41,053	35%	14,369
Glass	26,880	35%	9,408
YW/Wood Waste	110,453	35%	38,659
Food Waste	124,626	40%	49,850
Textiles	78,197	35%	27,369
All Other Landfilled	263,591	0%	
Total:	977,461		256,086

Many of the recycling collection and processing industries have some capacity to absorb new materials with limited change in employment. Similarly, most of the recycling reliant industries can change their mix of recycled versus virgin materials input with little change in employment. Although, this is not necessarily the case for increased diversion of organics – especially food waste – where the collection and processing infrastructure are not already in place.

Adding the marginal impact of increasing materials diversion, and the added impact of increasing food waste diversion, it is likely that diverting 250,000 new tons of materials from the SWACO landfill could result in an increase of roughly 20 percent in employment, payroll and gross revenues from recycling related industries. This could also add another 5 percent in recycling reliant industries who might use these materials.

This could mean that by diverting an additional 35 percent of material from the landfill, an additional 400 jobs, \$19 million in new payroll and \$115 million in new gross revenues could be created in Central Ohio, with indirect and induced impacts from this job and revenue growth potentially doubling these economic impacts.³⁵

³⁵ Note that this project was initiated before the impacts of the China Sword had hit the hardest and DSM has not studied the current and specific impacts on the Central Ohio region. Much of the economic data used for this report was from 2015 and from the most recent data updated to the D&B Hoover's subscription database that was accessed by DSM in 2017.

PART 4: CONCLUSIONS AND OPPORTUNITIES

Central Ohio's \$1.29 billion in estimated direct economic impacts from the recycling industry is a significant boost to the regional economy. Providing an estimated 5,084 direct jobs with an estimated payroll of \$235 million, the recycling economy is also a significant contributor to employment.

In addition, Central Ohio provides several successful examples of the circular economy with, for example, waste corrugated being collected for recycling, processed and eventually consumed by a local mill to produce recycled containerboard that may potentially be sold back into the regional economy. In addition, where many states are lacking access to glass end markets, Central Ohio collects, separates, and beneficiates cullet streams that are fed back into both glass container and fiberglass plants in the greater region, producing products that can potentially be marketed back into the region.

Finally, a robust reuse and remanufacturing industry exists in the seven-county region with 200 establishments identified providing an estimated 1,600 jobs. Pallet remanufacturing is a strong component of the circular economy, recirculating rebuilt pallets back into many businesses and removing broken pallets which are then repaired – with one Columbus business (***BDL Supply***) remanufacturing 12,000 pallets each day.

But given Ohio's rich and diverse manufacturing industry, there are many opportunities to expand the circular economy. With Pratt building a new paper plant in Ohio (but outside of the region), corrugated and other fiber from the region will have another relatively local market. And if Ohio's Plastic Product producers were to demand even 5 percent more recycled content, there would be tremendous opportunities for both reclaimers (to clean up both post- industrial and PCR plastics) and for processors to feed these plants.

Finally, in reviewing SWACO's 2013 waste characterization study³⁶, the roughly 110,000 tons of corrugated and 174,000 tons of mixed paper estimated to be landfilled have the potential for diversion to local processors and recyclable material wholesalers. Diverting even 35 percent of this landfilled material would not only save landfill capacity but produce revenue (potentially \$5 million) and create jobs in both materials processing and resale of fiber.³⁷ This material might also serve as potential feedstock to the existing Baltimore Paper mill or in the future, the new Pratt mill, strengthening the circular economy.

In addition, glass and PET/HDPE plastics disposed at roughly 27,000 and 47,000 tons respectively, could also serve as feedstocks for local processors - with glass then further processed at Rumpke's Dayton plant and separated plastics delivered to local plastic reclaimers. Both these materials have local markets that could potentially handle additional feedstock, assuming it can meet the market and product specifications.

³⁶ GT Environmental, 2013. Solid Waste Authority of Central Ohio Final Waste Characterization Study prepared by GT Environmental, Inc.

³⁷ Based on historical prices prior to 2018 China Sword actions.

Finally, food waste, which was estimated at roughly 125,000 tons disposed in the 2013 study has the potential to be diverted for composting or anaerobic digestion in the region. While there are existing composting facilities that can handle limited amounts of food waste (such as *Price Farm Organics*, which can accept clean, uncontaminated commercial food residuals), there may be demand for developing a facility capable of handling larger quantities of food waste with some contamination.

SWACO helps to play an important role in the circular economy by facilitating transactions between large generators of recyclables and food waste and the recycling industries and end users/markets. This report provides an up-to-date database of the existing recycling and recycling reliant industries in Central Ohio, which, when combined with data on additional recyclables and organic waste being landfilled, can provide the impetus for expanding employment and revenues from increased diversion.

SWACO might offer market development and equipment grants to help stimulate diversion activity for some materials where greater market potential exists, such as plastics, food waste and even fibers.

Finally, by sharing this information, companies that may not be identified by this report but that fit into the circular economy may contact SWACO to help facilitate materials recovery opportunities and strengthen the potential to create a more robust circular economy.