Recycling Economic Information (REI) Report

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1. Background

Recycling is a critical part of the U.S. economy – contributing to jobs, wages, and government tax revenue. Recycling has been an important component of the Environmental Protection Agency's (EPA) decades-long efforts to implement the Resource Conservation and Recovery Act (RCRA) and its more recent efforts to pursue a Sustainable Materials Management (SMM) approach, which aims to reduce the environmental impacts of materials across their lifecycle. EPA's SMM program provides data, information, guidelines, tools and technical assistance on resource conservation, recycling, resource recovery, waste reduction and landfilling issues.

In summary, the 2020 REI Report found:

- **526 MMT of recycled goods produced;**
- **681,000 jobs, $37.8 billion in wages, and $5.5 billion in tax revenue generated; and**
- **Ferrous metals recycling top contributor to all economic indicators.**

Recycling is also a way to conserve resources and protect the environment. Environmental benefits include reducing the amount of waste sent to landfills and combustion facilities; conserving natural resources, such as timber, water and minerals; and preventing pollution by reducing the need to collect new raw materials. Economic and community benefits include increasing economic security by tapping a domestic source of materials, supporting American manufacturing, and creating jobs in the recycling and manufacturing industries.

However, the U.S. recycling system – including the collection, processing, recycling and manufacturing of materials into new products – is facing challenges, including changes to international markets, waste streams and processing infrastructure that has not kept pace with evolving materials. Understanding the link between recycling, job growth and the economy will be an important element in addressing these challenges.

In 2001, EPA laid the foundation for a better understanding of the economic benefits of recycling by publishing the U.S. Recycling Economic Information (REI) report. This report estimated the contributions of recycling to national economic activity. Since this landmark publication, significant changes have occurred regarding the scope and magnitude of recycling activities, their contributions to the national economy and the data and methodologies available to analyze economic activity attributable to recycling.

EPA updated the 2001 REI report in 2016 using a waste input-output (WIO) approach. The 2016 REI report built on the official Input-Output (IO) tables maintained by the United States Bureau of Economic Analysis (BEA), which describe the economic transactions between industries and are used to formulate U.S. monetary and fiscal policy and used data from the base year 2007.The U.S. official IO table shows flows of transactions between industries but does not distinguish between recycling operations and recyclable material flows. Recyclable material flows include products and materials that may be collected, processed and incorporated into another product for final or intermediate use. Recycling operations are the processes involved in the recycling of materials or the use of recycled materials in final or intermediate products. Separating out the recycling activities is complicated because they are either embedded in the broader activities of a manufacturing sector or aggregated within the waste management and remediation services industry. Therefore, to isolate the impact of recycling, EPA identified nine material sectors *a priori*, then developed a methodology to identify the direct and indirect impacts of recycling.

The 2020 REI report presents the results for nine material categories, using the same WIO model and a methodology consistent with the 2016 report. The report:

- estimates the contribution of recycling to the nation's economy through jobs, wages, and tax revenue, as an aggregate and for each material;
- updates the 2016 REI report, building on transparency and improving the underlying data and methodology;
- compares the results between the updated model and the 2016 version of the model; and
- provides the foundation to integrate data with the U.S. Environmental Economic Input-Output (USEEIO) Model.

Below we describe an overview of the WIO methodology (Section 2), the 2020 REI report updates (Section 3) and results (Section 4), as well as a comparison of the results between the 2016 and 2020 report (Section 5). Finally, we present next steps to address data gaps as part of future updates to the model (Section 6).

2. Waste Input-Output Methodology

This report approached recycling as the recovery of useful materials from the municipal solid waste (MSW) stream, along with the transformation of those materials, to make new products and analyzed nine material categories, including paper, aluminum, glass, plastics, ferrous metals, rubber, food and organics, electronics and construction and demolition (C&D) material. This report also included recovery and refurbishing or remanufacturing for reuse of products and materials that have reached the end of their intended useful life, such as wood flooring from C&D materials.

This report applied a Waste Input-Output (WIO) methodology using United States Bureau of Economic Analysis (BEA) Input-Output (IO) data to estimate the total economic impacts of recycling for 2012[1], which includes both direct and indirect impacts of recycling, described as follows:

- **Direct impacts** are associated with the actual transformation of recyclable materials into marketable products. This includes, for example, the number of employees involved with recycling operations that produce steel castings from iron and steel scrap, or the transformation of aluminum scrap into semi-fabricated products.

- **Indirect impacts** include upstream supply chain economic activity that supports recycling processes. Using the steel recycling example, these impacts include the number of employees who work for suppliers of steel recycling facilities (e.g., electric utilities) and employees of other suppliers throughout the upstream supply chain.

Together, both direct and indirect impacts represent the total impacts on jobs, wages and tax revenue from recycling (Figure 1). This accounting of the economic impacts of recycling is hereafter referred to the "Total Impacts Approach."

[1] 2012 is the data year for the most recent BEA IO accounts, which is why the 2020 WIO report estimates the recycling impacts for this year.

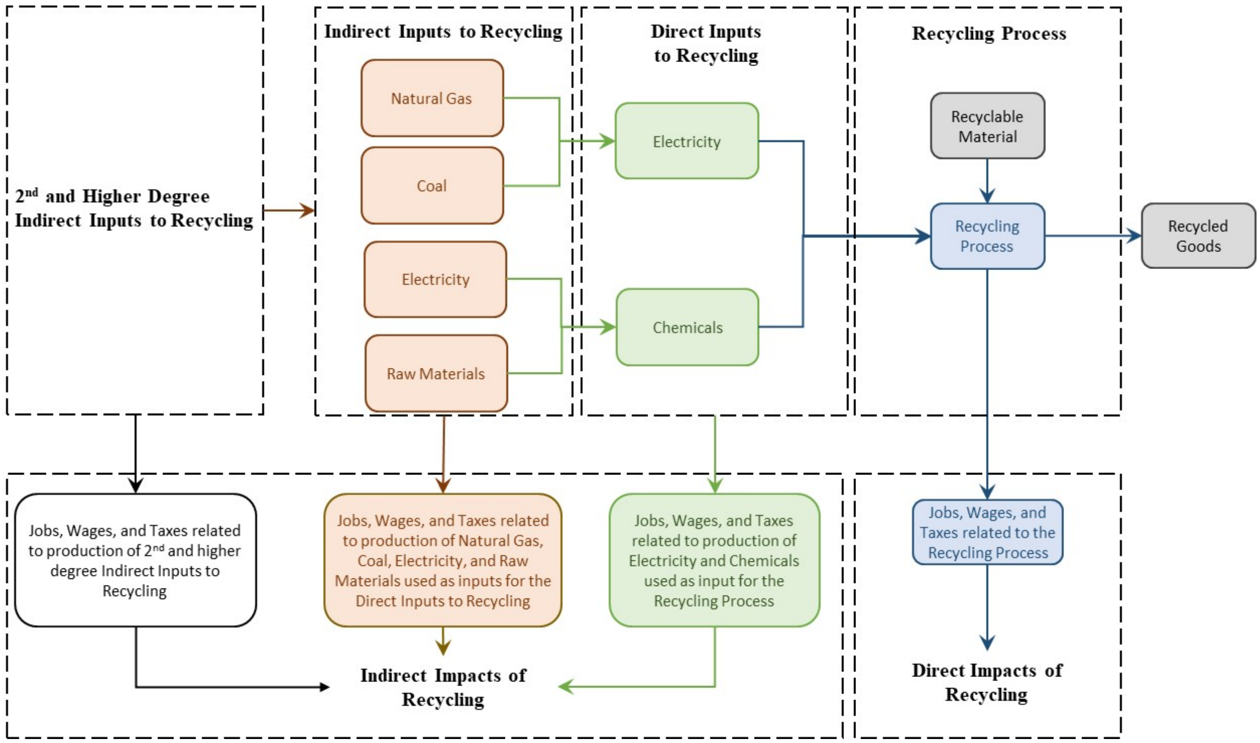

Figure 1. Scope of Total (Direct and Indirect) Impacts of Recycling Approach

BEA data are used to track and understand the performance of the U.S. economy across multiple sectors and industries. BEA tables represent, in monetary terms, the flow of goods and services, or commodities, produced by the industries in the economy. These data can be used to compute the total amount of commodity inputs required to produce a unit of commodity output for each of the 405 commodities tracked by BEA. This report used BEA data from 2012, which represents the latest year the data is available.

While the BEA data contain information on economic transactions between different industries, they do not account for transactions involving specific recycled or recyclable materials. Instead, recycling activities are embedded within industries that describe broader manufacturing processes. As mentioned earlier, for the purposes of the REI report, recycling is the recovery of discarded materials from the waste stream and the processing of that material into new products. This effectively displaces the use (and demand) of virgin materials required to meet consumer demand. To achieve an accurate estimate of the economic impacts of recycling, the framework must account for the life cycle of the materials being analyzed, including material collection, conversion, sale, distribution and consumption of recycled goods, but also the economic transactions that stem from these activities. The WIO accounts for this by distinguishing between the direct and indirect impacts from recycling activities.

The WIO builds on the BEA IO tables by including specific categories of recyclable (waste) materials, recycled goods and recycling processes as discrete sectors in the tables. Specifically, the following recycling data are incorporated in the WIO:

- **Recyclable material production**: Data that reflect the amount, in dollars, and types of materials generated by industry or households that are recycled at end of life (e.g. scrap or waste).

- **Recycling process inputs**: Data that reflect the materials required (other than the recyclable material) in the process of generating recycled goods from recyclable materials (e.g. electricity, chemicals, transportation, fuels, etc.).
- **Recycled good production**: Data that reflect the physical quantity of recycled materials that are produced by recycling sectors and are then available for consumption within the economy (e.g. recycled plastic resin).
- **Recycled good consumption**: Data that reflect the quantity and destination of recycled goods within the economy.

These recycling data are incorporated for each of the nine material categories within the WIO. Table 1 summarizes the materials and recycling processes included in the analysis, which forms the basis of the WIO model developed to estimate the economic impacts of these recycling activities.

Table 1. Materials Included in the Scope of the 2020 Recycling Information Report

Material Category	Material Subcategories	Material description
Ferrous metals	Iron, steel	Ferrous metal scraps recovered from discarded appliances, automobiles, containers, etc.
Nonferrous metals	Aluminum	Aluminum scraps recovered from discarded beverage cans, other containers and miscellaneous sources.
Glass	N/A	Glass cullet recovered from discarded glass bottles and jars.
Paper	Newsprint, paperboard	Paper and paperboard recovered from discarded paper waste (e.g. used newspapers and paperboard containers).
Plastics	High density polyethylene (HDPE), Polyethylene terephthalate (PET), Polypropylene (PP)	Plastic scraps recovered from discarded bottles and other miscellaneous sources.
Rubber	Rubber crumb, ground rubber	Waste rubber recovered from discarded tires
Construction and Demolition (C&D)	Concrete, wood, gypsum drywall, brick and clay tile, asphalt shingles, asphalt pavement	Material recovered from debris in road and building construction and demolition.
Electronics	Computers, displays, keyboards and mice, television, mobile devices	Discarded electronics that are recovered for refurbishing, remanufacturing or resale.
Organics	Gleaned produce; deceased animal stock; crop residue; animal, grain and dairy by-products; fats, oils, and greases (FOG); salvaged, spoiled and rescued food; yard trimmings	Produce and salvaged food recovered from farms, retailers and food service facilities that otherwise would have been wasted. Spoiled foods and other by-products diverted from the solid waste stream. These materials are used to produce a number of recycled goods including animal feed, biodiesel, compost and others.

These data extend the original BEA IO data through a hybrid table, which links the physical flows of recycling inputs and outputs to monetary flows in the economy. For example, for the glass recycling sector, the WIO tracks the value of recyclable glass consumed to generate a physical quantity of recycled glass. In addition, the WIO models the inputs, in dollars, needed to process the recyclable glass, such as the utility and fuel costs (e.g. electricity and natural gas), materials costs (e.g. ground minerals) and equipment costs (e.g., machine shops). The output of the recycling sector, the recycled glass, is then tracked as inputs to other sectors of the economy.

The WIO model also incorporates data on economic impacts of U.S. industries, including recycling sectors – specifically, employment, wages and tax revenues. These data were collected from publicly available sources, including the Census Bureau Statistics of U.S. Businesses (SUSB), the U.S. Agricultural Census, the U.S. Census of Governments and the Internal Revenue Services (IRS) Statistics of Income (SOI) program. By associating economic sector classifications in the original data source with the sectors used in the IO tables, the economic data were integrated into the WIO framework. Economic data were attributed to recycling processes using the material flow information to calculate the share of production from these sectors that can be attributed to recycling.

3. 2020 Recycling Economic Information Report Updates

The purpose of the present report is to update and refine the 2016 WIO model with the latest recycling economic information and detailed benchmark IO accounts from the BEA. Specifically, the underlying economic and recycling data were updated to reflect the most recently available detailed IO accounts from the BEA representing data from 2012.

While the primary focus of this report was to update the model using 2012 BEA data, EPA made additional updates to increase the transparency and accuracy of the model. Specifically, this model reflects:

- **The use of publicly available data**. The recycling data used in this report are from publicly available sources, including the U.S. EPA Facts and Figures report (US EPA, 2014), U.S. Geological Survey Commodity reports (USGS, 2016) (USGS, 2016b) and industry association reports such as the Post Consumer Plastic Bottles Recycling report (ACC, 2014).

- **Updated 2012 economic and production data.** The model includes updated 2012 industry transaction data and sector economic impact data (employment, wage, tax revenue) for all U.S. industries, as well as updated 2012 data on the production and consumption of recycling flows (i.e., the total quantity of recyclable materials collected and produced within the U.S.) for the nine material categories.

- **Updated allocation to recycling sectors.** Sector economic impacts (employment, wage, tax revenue) were assigned to recycling sectors based on the proportion of recyclable material to total material for the material categories. For example, the estimated proportion of recyclable material to total material in iron and steel recycling in 2012 is 59%. Therefore, the ferrous metals recycling sector was allocated 59% of the employment, wages and tax revenue from each of the sectors associated with iron and steel production. These economic impacts as allocated to recycling sectors are used for calculating the direct impacts of recycling processes.

- **Updated recycling process input data**. These data were updated using publicly available sources or an employment allocation approach to reflect the commodities consumed by recycling sectors to transform recyclable materials into recycled goods.

- **Transparent model calculations.** The model was developed as a fully integrated and responsive Excel model that responds to changes in data inputs or assumptions, with well documented tables and equations. This structure will enable more transparent integration with other EPA products, including *Advancing Sustainable Materials Management: Facts and Figures* and the U.S. Environmentally Extended Input Output (USEEIO) model.

4. 2020 REI Report Results – Total Impacts Approach

Based on the updated and available data and WIO total impacts approach, the 2020 REI report estimates that U.S. recycling processes generated 526 million metric tons of recycled goods (Table 2). As presented in Table 3, recycling accounted for approximately 0.5% of all employment, 0.6% of wages and 0.8% of all tax revenue in the U.S. in 2012. This represents 681,000 jobs, $37.8 billion in wages and $5.5 billion in tax revenue.

As illustrated in Figure 2, ferrous metals, C&D and nonferrous metals, respectively, represent the top three contributors to the economic impacts of recycled goods. On a metric tonne basis, however, the refurbishment of electronics is the most valuable contributor to economic impacts followed by nonferrous metals and plastics (see Table 4).

Our analysis found a considerable portion of the economic impacts for most recycling sectors occur indirectly rather than as a direct result of the recycling activity. Specifically, indirect impacts contributed 45%, 43% and 41% of employment, wage and tax contributions, respectively. This is because purchases made as part of the supply chain of recycling are substantial contributors to economic impacts. It also highlights the importance of including the upstream impacts when considering total benefits from recycling activities.

Table 2. Summary of Recycled Good Production Between 2007 (2016 REI Report) and 2012 (2020 REI Report)

Commodity	2007 (Tonnes)	2012 (Tonnes)**	Percent change from 2007*
Recycled ferrous metals	33,287,587	53,300,000	+60%
Recycled nonferrous metals (aluminum)	1,524,071	3,270,000	+115%
Recycled glass	2,053,020	2,486,184	+21%
Recycled paper	30,290,546	27,213,728	-10%
Recycled plastics	2,413,112	1,215,759	-50%
Recycled rubber crumb	1,100,016	992,007	-10%
Tire-derived fuel	1,923,495	1,294,580	-33%
Other recycled rubber	600,448	386,234	-36%
Recycled construction and demolition	318,419,727	372,913,275	+17%
Recycled electronics	388,404	299,371	-23%
Animal meal, meat, fats, oils and tallow**	8,364,137	8,364,137**	0%**
Animal feed	2,742,531	16,470,850	+501%
Biodiesel**	2,524,963	2,524,963**	0%**
Biogas	17,402,653	457,910	-97%
Compost	5,830,932	15,990,927	+174%
Mulch & wood chips	5,532,740	13,206,082	+139%
Community food service	2,742,531	5,917,125	+116%
Total	437,140,913	526,303,132	+20%

*Note: *Percentage change values greater than 0 show a net increase in quantity of recycled goods, while values less than 0 show a net decrease.*
*** Data from 2012 for these specific sectors were not available. Accordingly, 2007 data were used and are reflected as no change in the table.*

Table 3. Summary of Economic Impacts of Recycling, 2012 Data

Economic Impact	Units	US Total	Total Impacts Approach
Total Economic Impacts			
Employment	# jobs	143,739,789	681,004
Wages	$1,000	$6,568,987,567	$37,837,425
Tax Revenue	$1,000	$704,394,773	$5,460,992
Percent of Total			
Employment			0.47%
Wages			0.58%
Tax Revenue			0.78%
Primary Factors			
Employment	jobs / 1000 short tons		1.17
Wages	$ / short ton		$65.23
Tax Revenue	$ / short ton		$9.42

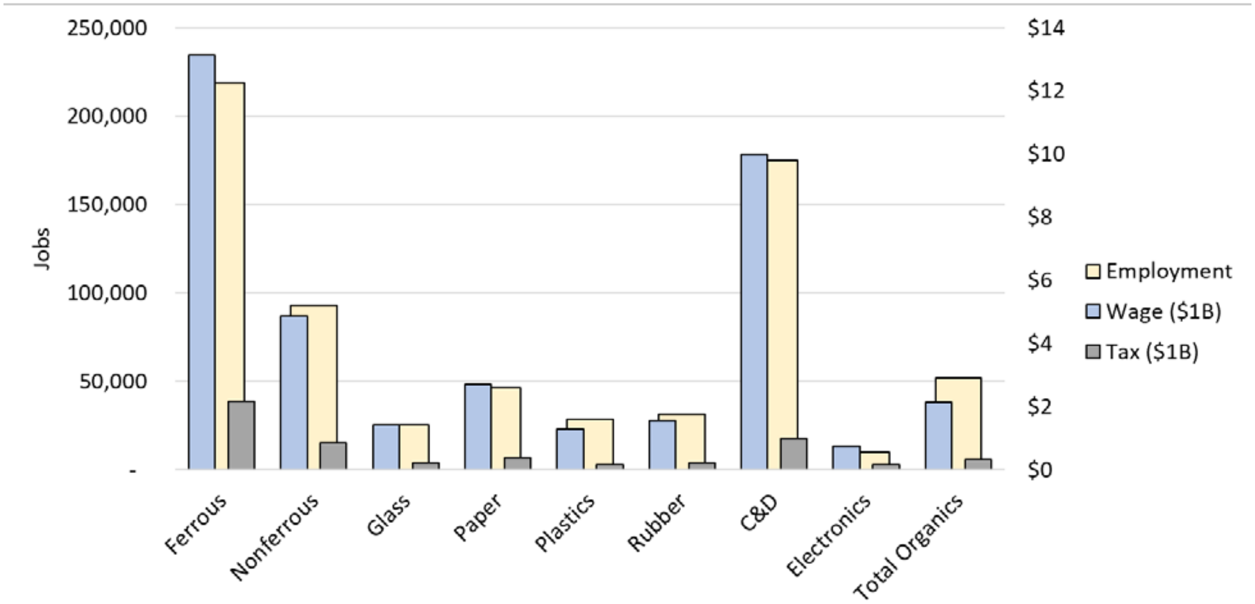

Figure 2. WIO Model Results – Total (Direct and Indirect) Impacts from Recycling, 2012 Data

Table 4. Total Primary Factors (Employment, Wage and Tax Revenue) per 1,000 tonnes of Recycled Good

Commodities	Employment	Wage ($1,000)	Tax ($1,000)
Recycled ferrous metals	4.11	$246.63	$40.57
Recycled nonferrous metals (aluminum)	28.49	$1,489.06	$265.24
Recycled glass	10.18	$566.11	$83.85
Recycled paper	1.69	$99.43	$14.22
Recycled plastics	23.46	$1,047.41	$139.76
Recycled rubber crumb	11.86	$579.45	$75.81
Tire-derived fuel	11.86	$579.45	$75.81
Other recycled rubber	11.86	$579.45	$75.81
Recycled construction and demolition	0.47	$26.79	$2.62
Recycled electronics	33.00	$2,525.37	$546.27
Animal meal, meat, fats, oils and tallow	1.28	$66.40	$11.61
Animal feed	0.12	$5.57	$0.48
Biodiesel	0.40	$29.60	$10.07
Biogas	2.08	$114.01	$20.73
Compost	0.27	$13.35	$3.94
Mulch & wood chips	0.46	$15.82	$1.90
Community food service	4.59	$159.53	$16.15

5. Comparison to Prior Report

Underlying changes in the economy, changes in the quantity of recycled goods produced and changes in recycling production processes all affect the economic impacts of recycling activities. In this section, results from the 2007 model (2016 REI report) are compared with those from the present 2012 model (Section 5.1). Next, key takeaways based on these results are summarized (Section 5.2).

5.1. Results Comparison

Table 5 summarizes the changes in employment, wages and tax revenue between 2012 (current model) and 2007 (previous model).

It is important to note that overall employment and tax revenue fell in the U.S. between 2007 and 2012 (US Census Bureau, 2012); this in turn directly affects the employment and tax revenue from recycling sectors in 2012, as well as indirectly affects the economic impacts of recycling through the upstream supply chain.

A comparison between the 2016 and 2020 REI Report found:

- **Increase in wages ($1.2 billion) but decrease in employment (76,000) and tax revenue ($1.3 billion) for recycling sectors since 2007.**
- **The decreases in employment and tax revenue are consistent with trends in the wider U.S. economy between these two years.**
- **Increases in economic impacts from ferrous metals, glass, and organics recycling.**
- **Decreases in economic impacts from nonferrous metals, C&D, paper, plastics, and electronics recycling.**

Table 5. Summary of changes in economic impacts of recycling between 2007 and 2012 (2012-2007)

Economic Impact	Units	US Economy	Recycling Sectors (Total Impacts)
Total Economic Impacts			
Employment	# jobs	-2,799,889	-76,321
Wages	$1,000	$616,507,963	$1,200,828
Tax Revenue	$1,000	-$48,901,461	-$1,334,252
Percent Change			
Employment		-1.9%	-10%
Wages		+10%	+3.3%
Tax Revenue		-6.5%	-20%
Primary Factors			
Employment	jobs / 1000 short tons		-0.40
Wages	$ / short ton		-$10.82
Tax Revenue	$ / short ton		-$4.69

Figure 3 shows the changes in economic impacts between 2007 and 2012 for the nine material categories. The ferrous commodity shows a large increase, while the nonferrous, plastics and C&D commodities show considerable decreases in the timeframe considered.

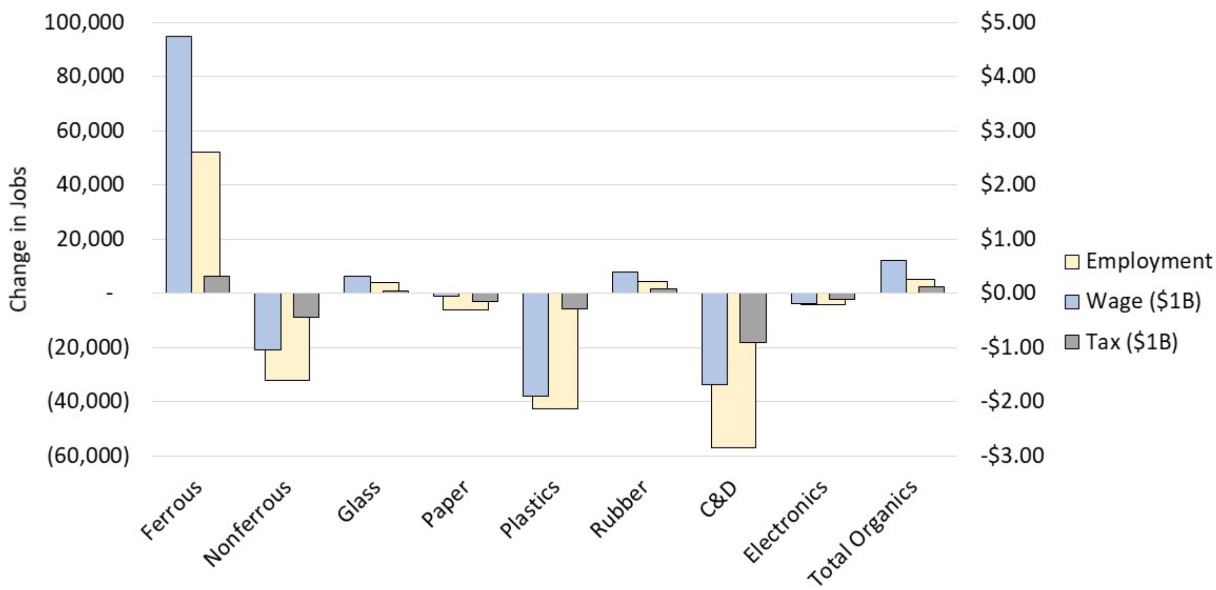

Figure 3: Change in Impacts Between the 2007 and 2012 Models Using the Total (Direct and Indirect) Production of Recycling Approach

Changes in total impacts reflect both direct and indirect impacts. The indirect primary factors highlight the economic impacts from upstream supply chains per unit of recycled goods produced. Changes between 2007 and 2012 in indirect primary factors for each commodity are shown in Table 6. These changes reflect changes in employment, wage and tax revenue from upstream sectors in the economy from which recycling sectors make purchases. More efficient use of materials or energy by recycling processes can result in lower indirect impacts due to economies of scale and a resulting reduction in purchases made from other sectors. For example, if a recycling process handles a larger volume of recyclable material between 2007 and 2012 using the same amount of electricity, this would result in lower indirect economic impacts per unit of recycled material output. Similarly, indirect primary factors will also change in response to changes in economic conditions throughout the economy, irrespective of conditions in the recycling sectors. As a result, some recycling sectors will experience a decrease in economic impacts despite increases in the total quantity of recycled goods.

Table 6: Percent Change in Indirect Primary Factors for Recycling, 2007 to 2012

Commodity Code	Commodity Description	Employment	Wage	Tax
RD0001	Recycled ferrous metals	-18%	+4%	-16%
RD0002	Recycled nonferrous metals (aluminum)	-80%	-78%	-78%
RD0003	Recycled glass	-9%	0%	-11%
RD0004	Recycled paper	-4%	+4%	-7%
RD0005	Recycled plastics	-95%	-95%	-94%
RD0006b	Recycled rubber crumb	+158%	+195%	+165%
RD0006c	Tire-derived fuel	+158%	+195%	+165%
RD0006	Other recycled rubber	+158%	+195%	+165%
RD0007	Recycled construction and demolition	-40%	-33%	-62%
RD0008	Recycled electronics	-5%	20%	+5%
RD0009	Animal meal, meat, fats, oils and tallow*	n.a.	n.a.	n.a.
RD0010	Animal feed*	n.a.	n.a.	n.a.
RD0011	Biodiesel*	n.a.	n.a.	n.a.
RD0012	Biogas*	n.a.	n.a.	n.a.
RD0013	Compost*	n.a.	n.a.	n.a.
RD0014	Mulch & wood chips*	n.a.	n.a.	n.a.
RD0015	Community food service	-47%	-45%	-50%

** Several organics sectors did not have indirect impacts in the 2007 model. n.a. indicates a percent change is not applicable due to a division by 0.*

For example, the reduction in economic impacts from recycled nonferrous metals are likely caused by the decrease in indirect primary factors. While the changes in direct impacts for nonferrous commodities show an increase from 2007 to 2012, the changes in total impacts show a net decrease. This means that the large decrease in indirect primary factors for this commodity – negative 80% for employment, and negative 78% for wages and taxes (as shown in Table 6) – is enough to overcome the increases in direct primary factors. Increased efficiency of resource use, absent other changes, will cause indirect (and in cases like the nonferrous commodity, total) economic impacts from recycling activities to drop. That is, using fewer direct inputs (e.g., less energy or fewer materials) could result in fewer jobs, wages and tax revenue from upstream activities in exchange for a more efficient use of materials. However, due to the interconnected nature of the WIO model, identifying the exact cause of the decrease in indirect primary factors would require additional research.

Another factor driving the difference in results in Figure 3 are changes to the REI modeling methods for estimating recycling process inputs, which can result in substantial changes in total impacts. In this case, the recycling process inputs data for plastics and C&D recycling are estimated from publicly available process-based life cycle assessment data sources, and thus may reflect a difference in scope compared to the 2007 model.

5.2. Key Takeaways

The 2020 Recycling Economic Information (REI) report uses the U.S. Bureau of Economic Analysis’s (BEA) 2012 Input-Output (IO) data to assess the total economic impact of recycling activities, including jobs, wages and tax revenues, and improve the methodology of the 2016 report. Compared to the prior report, which referenced 2007 BEA IO data, this report has found the following:

- Recycling accounted for approximately 0.5% of all employment, 0.6% of wages and 0.8% of all tax revenue in the U.S. in 2012. This represents 681,000 jobs, $37.8 billion in wages and $5.5 billion in tax revenue.
- Wages due to recycling increased by $1.2 billion from 2007 to 2012. However, the number of jobs and tax revenues due to recycling decreased by 76,000 and $1.3 billion, respectively. Between 2007 and 2012, the U.S. economy experienced an overall decrease in employment (US Census Bureau, 2012) (US Census Bureau, 2007) , and these recycling figures reflect those broader economic trends.
- Ferrous metals, construction and demolition (C&D) and nonferrous metals represented the top three contributors to total economic impacts in 2012. That said, while the ferrous metals industry experienced gains in jobs, wages and tax revenues between 2007 and 2012, and therefore had a larger economic impact than before, the nonferrous metals and C&D industries saw decreases in all three categories, rendering a smaller economic impact in 2012 than in 2007.
- The updated IO model found that a considerable portion of the economic impacts occur indirectly, rather than arising directly from recycling activities themselves. Specifically, indirect impacts contributed 45%, 43% and 41% of employment, wage and tax contributions, respectively. As upstream recycling processes become more efficient, these indirect impacts are likely to increase and result in fewer job, wage and tax revenue gains in exchange for a better, more sustainable use of materials.

6. Looking Forward

Although the 2020 REI report represents analytical improvements to the prior report, areas for future refinement of the data and model exist. Key data gaps and uncertainties include:

- **Recycling process input data.** The data availability for inputs to recycling supply chains is poor. Recycling process inputs are calculated in two ways: one common method is to use data collected for process-based life cycle assessment, which quantifies the physical inputs to a process; alternatively, the process inputs can be estimated from IO data of similar sectors. While both approaches can be used, there are tradeoffs between them. Process-based data for recycling process inputs may provide more accurate and detailed data than IO based estimates. However, unless detailed purchase information is available, process-based data requires assumptions around the price of purchased commodities. This generates additional uncertainty when adapting for an IO approach as the price assumptions may not correctly reflect the prices paid for the commodities, and ultimately may affect the direct or indirect primary factor estimates for recycled commodities. Conversely, IO based estimates tend to be more comprehensive than process-based estimates, as they include many more sectors. However, using this method to estimate recycling inputs requires identifying an appropriate proxy industry. This can create uncertainty if the sector used as a proxy is not particularly similar to the recycling sector. For either approach, surveys on recyclers, which contain commodity consumption and purchasing information would help address this uncertainty.
- **Recycled content data.** An alternative approach for estimating the economic impacts of recycling is based on calculating the economic impacts of household and government demand proportional to the recycled content of the materials that make up that demand. Estimates of

recycled content for each industrial sector are necessary for this approach. Those data, which are distinct from data used in the allocation of sector economic impacts, were not updated for the 2012 model given the challenge in identifying high quality publicly available data. The lack of more recent publicly available data to estimate the recycled content of the various commodities in the WIO model increases the uncertainty of the results from this approach, as it relies on data that are older than data used in the other approaches.

This update to the WIO model is designed to integrate with the U.S. Environmentally Extended Input Output (USEEIO) model (Yang, 2017), which tracks emissions and resource use for U.S. industries. As such, with additional data collection, future versions of the WIO could integrate the environmental impacts of recycling sectors in addition to the existing economic impacts to better understand the net benefits of recycling.

While the economic impacts documented in this report are pronounced, the effects of recycling reach beyond employment. This report is just the beginning of EPA's work to document the economic impacts of Sustainable Materials Management. Recycling is just one, albeit vital, component of SMM and additional work is needed to document the economic impacts of other parts of the material life cycle. Along with the social and environmental benefits of recycling, the economic impacts show a positive role of recycling within the U.S. Thus, adopting SMM practices can help improve our social impacts, provide employment and vital wages, while conserving environmental resources.