3 Residential/Business Waste Composition Analysis

Purpose

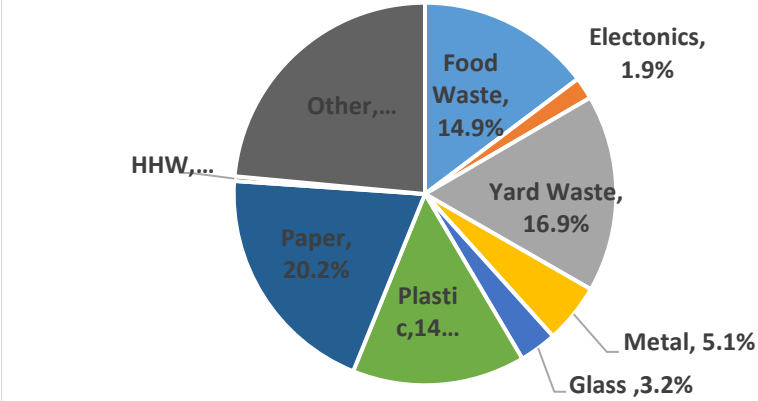
The purpose of this analysis is to examine the types of waste that comprise the largest components of the residential and business waste streams to assess the need for programs to recover these materials.

Residential Overview

In 2018, R3Source contracted with SCS Engineers to conduct a waste composition analysis of residential waste disposed of within the county.

SCS assessed waste composition over two separate field events in June and November of 2018. For each field event, SCS acquired 30 200-pound samples and sorted them into 44 material types. During each field event, SCS sampled 12 loads from City of Cincinnati Public Services waste collection vehicles and 18 from Rumpke waste collection vehicles dispatched on routes throughout Hamilton County but outside the City of Cincinnati.

Figure 1, 2018 Hamilton County Residential Waste Landfilled



As Figure 1 shows, the "Other" waste category was the largest component by weight during the sort. The "Other" category included:

- Carpet
- C&D
- Diapers
- Mattresses
- Pet waste
- Textiles
- Other Uncharacterized

Paper (20.2%) and yard waste (16.9%) were the second and third largest waste categories. However, evaluating R3Source programs and opportunities to increase diversion on a broad category level does not accurately reflect program performance or potential. For example, most Ohio solid waste districts do not have landfill diversion programs for the materials in the "Other" category, and very few of these materials have an established recycling market.

As shown in Table 1, the waste characterization study quantified 44 specific waste types.

Table 1, Residential Composition by Material		
Category	**Material**	**Percent**
Paper	Corrugated Cardboard	6.30%
	Newspaper/Print	1.10%
	Cartons	0.80%
	Mixed Recyclable Paper	6.60%
	Compostable Paper	4.80%
	Non-Recyclable Paper	0.60%
Plastic	PET Bottle/Jugs	1.70%
	HDPE Bottle/Jugs	0.70%
	Other Bottle/Jugs	0.10%
	Trays and Tubs	1.50%
	Rigid Plastics	2.20%
	Other Plastics	1.50%
	Films	5.70%
	Grocery Bags	1.40%
Glass	Glass Bottles	2.10%
	Glass Jars	0.60%
	Other Glass	0.50%
Metal	Steel/Tin Cans	0.40%
	Aluminum Cans	1.00%
	Other Aluminum	0.10%
	Other Ferrous	3.60%
	White Goods	0.00%
Yard Waste	Grass	3.00%
	Leaves	4.00%
	Brush	3.10%
	Wood	5.50%
	Other Yard Waste	1.30%
Electronics	Cathode Ray Tubes	0.70%
	Appliances	1.10%
	Portable Electronics	0.10%

Table 1, Residential Composition by Material		
Category	**Material**	**Percent**
Food Waste	Vegetative Food	10.00%
	Non-Vegetative Food	4.90%
Other	Diapers	2.10%
	Textiles	3.80%
	C&D Debris	2.90%
	Mattresses	1.10%
	Other Uncharacterized	7.70%
	Pet Waste	0.70%
	Carpet	3.00%
	Fines	2.50%
Household Hazardous Wastes	Batteries	0.00%
	Paint	0.30%
	Automotive fluids	0.10%
	Other (HHW)	0.00%

Because R3Source has detailed, material-specific data, this analysis focuses on diverting the top three residential materials from the landfill.

Business Overview

R3Source did not characterize the business waste stream in 2018. Therefore, R3Source used business waste composition data from the Solid Waste Authority of Central Ohio (SWACO), which manages waste from Franklin County.

Figure 2, Business Waste Landfilled

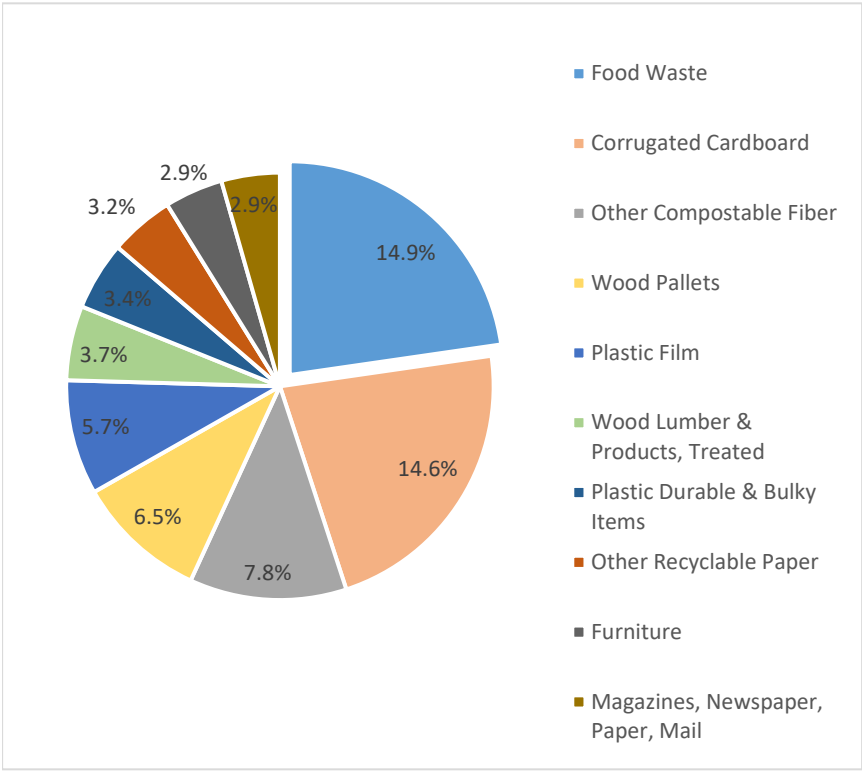


Figure 2 shows the top ten materials that businesses dispose of in Franklin County.

Similar to residential waste, food waste and cardboard are the predominant two materials in the business waste stream. In contrast to residential waste, “other compostable fiber” is the third most significant waste material and plastic film is fifth.

Current Activities to Recover the Most Significant Materials of the Waste Stream

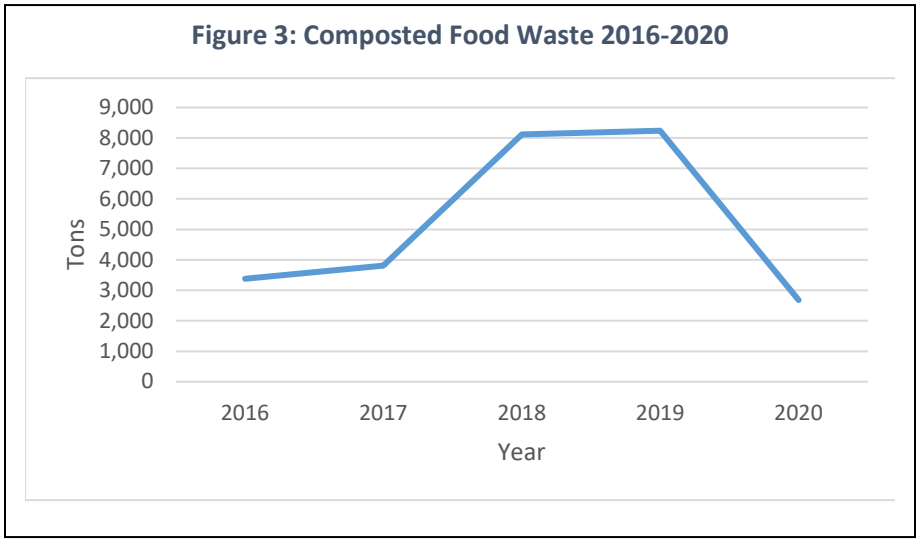
Table 1 shows vegetative and non-vegetative food waste (combined 14.90%), mixed paper (6.60%), and plastic film (5.70%) are the three most significant components of the residential waste stream. However, R3Source will focus on increasing the recovery of cardboard (6.30%) instead of mixed paper as it is becoming a significant part of the residential waste stream Figure 2 shows that the three most prominent materials in the business waste stream are food waste (14.9%), corrugated cardboard (14.6%), and other compostable fiber (7.8%). Below is a description of current activities to divert these waste materials from the landfill.

Vegetative and Non-Vegetative Food Waste

Because current programs and facilities do not differentiate between vegetative and non-vegetative food waste, R3Source reports reference year quantities combined. However, R3Source will attempt to itemize these food types in future reports as the types of programs and infrastructures necessary to divert these materials may differ. Table 2 presents the amount of Hamilton County food waste that facilities and haulers/grocery stores composted in 2020. This information is from OhioEPA reports.

Table 2, OhioEPA-Reported 2020 Food Waste Composting		
Facility	**County**	**Tons**
London Correctional Institution	Madison	571
Findlay Market In-Vessel Composting Facility	Hamilton	28
Hauler/Grocery Food Waste Data	Not Available	2,082
TOTAL		**2,681**

Figure 3 demonstrates the fluctuation in OhioEPA-reported tonnages between 2016 and 2020 and that there was a significant decrease between 2019 and 2020. This reduction is likely due to COVID-19 creating a disruption in food waste collection from schools and businesses, and composters reporting to OhioEPA.



In addition to quantities that large-scale generators and composters reported to OhioEPA, multiple small-scale food waste recovery organizations operated in Hamilton County during the reference year. In 2020, these facilities and programs diverted 4,772 tons of food from landfills. The

manufacturing sector (which is excluded from Figure 3) experienced an 88,775-ton increase in food recovery due to one new industry responding to the industrial survey. The total amount of food diverted from landfills by manufacturing industries in 2020 was 111,950 tons.

In 2020, R3Source's Smart Kitchen Initiative offered assistance to reduce pre-consumer food waste and/or donate prepared foods from mid to high-volume food service operators. R3Source paid up to 50% of the cost to install food tracking technology. R3Source staff worked with one business to improve food rescue operations. Overall, this program has seen a low demand, and staff is working on aligning the program to serve this sector better.

In 2020, R3Source conducted two workshops to reduce food waste. R3Source partnered with Rust Belt Riders on the first workshop, which targeted small-scale community composting programs where Rust Belt Riders taught 30 individuals from Hamilton County how to operate a small-scale composting operation successfully. Quite a few attendees started composting after the workshop. Rust Belt Riders is an organic waste management company from Cleveland that collects and processes food waste.

R3Source invited Chef Rob White to the second workshop to teach food waste prevention techniques to restaurant managers and employees. Approximately 30 restaurant representatives attended the workshop. R3Source planned follow-up engagements for both workshops, but R3Source delayed them due to COVID.

R3Source also partnered with local organizations to rescue surplus food and redistribute it to food-insecure residents in 2020. R3Source staff attended four distribution days and passed out a *The Fruit and Vegetable Storage Guide* to residents, offered many new online pieces of training, and created an informational video series on ways to reduce food waste.

R3Source issued an RFP and hired Rasor, a local marketing firm, to conduct research and develop a campaign to reduce residential food waste. The campaign work continued into 2021.

R3Source distributed $116,164 to 14 organizations (including both non-profit and for-profit organizations) for innovative projects such as equipment to maintain community compost sites and cold storage to help pantries rescue food.

Food Waste Gap Analysis and Solutions

Many solid waste planning organizations are transitioning from focusing on end-of-life management for food waste (i.e., composting) to a sustainable materials management (SMM) philosophy. SMM is an approach to using and reusing materials most productively throughout their entire lifecycle. It represents a change in how our society thinks about using natural resources and environmental protection[1].

[1] United States Environmental Protection Agency

ReFED is a national organization that many be considered the leader in applying SMM principles of food waste management. ReFED is a non-profit dedicated to ending food loss and waste across the United States by advancing data-driven solutions. ReFED has established a strategic planning document with a food waste diversion goal of 50% by 2030, with specific action items for the entire "life" of food (Figure 4).

Figure 4, ReFED Food Hierarchy

R3Source already applies much of the SMM concept toward food management through its grants and programs, especially in strengthening food rescue. However, as discussed below, R3Source has limited influence on harvesting, distributing, managing food product inventory, or using food. Additionally, there continue to be numerous barriers even in the areas where R3Source has the most significant opportunities to reduce food waste.

Barriers to Food Waste Diversion

"Wasted food occurs for many reasons including convenience, misaligned incentives or goals, and complex consumer behaviors. Most are a result of solvable problems related to logistics or transportation; scarce or isolated information (within food businesses, between businesses, e.g., farmers, distributors, and grocers, and between entities, e.g., municipalities and NGOs); inefficient operating practices; or public policies that fail to incentivize waste reduction behaviors. Any solution must address one or more of these problems as means to preventing, recovering for human consumption, or recycling wasted food for alternative applications"[2].

R3Source has the most significant opportunity to influence activities to reshape consumer environments, strengthen food rescue, and recycle anything remaining. The barriers to implementing these action items are presented in Table 3.

Table 3 Action Item Implementation Barriers

Reshape Consumer Environments	Strengthen Food Rescue	Recycle Anything Remaining
• Food image expectations • Date label confusion • Core business alignment	• Transportation costs • Liability concerns • Connecting generators and rescuers • Insufficient onsite storage and refrigeration	• Limited food waste composting infrastructure • Cost

[2] Roadmap To Reducing Food Waste, H. Briggs, J.D. Lindeberg, A. Rein, B. Chorn and K. Tanger BIOCYCLE JUNE 2016, VOL. 57, NO. 5, P. 32

Potential Solutions to Address Implementation Barriers

- **Food Image Expectations –** Since the last plan update, multiple initiatives have emerged to decrease the perception and increase awareness about imperfect food still being edible. Even some home food preparation kits focus on imperfection as an attractive characteristic. R3Source may develop a comprehensive campaign to educate consumers that imperfect food is still tasty. The outreach initiative would also emphasize the relationship between food waste and climate change. R3Source may also help institutional cafeterias adjust their procurement specifications and connect them with produce distributors that offer imperfect produce.

  Beyond food aesthetics, food establishments serve more food than most individuals can consume to meet the expectation of "large quantity value." Several years ago, the USDA studied portion sizes in restaurants. USDA found that, on average, every meal or snack is eaten away from home is 134 more calories than people would get if they ate the same meal or snack at home. These "value" servings create both environmental and health issues. To address this, R3Source could work with several local restaurant groups to explore the viability of serving smaller portions.

- **Label Confusion –** Nationally, 84% of people report sometimes or always throwing out past-date food, even though this food may be perfectly good to eat. Additionally, research shows that standardizing date labeling can save 582,000 tons of food annually. While R3Source cannot directly impact food labeling, opportunities exist to support legislation that could standardize labeling. In 2021, the U.S. Congress introduced the Food Date Labeling Act which would require food products to have standard date labels and would require federal agencies to create a consumer education campaign to address misconceptions. "Best if Used By" would be used on products labeled to indicate quality, while "Use By" would instead be used on a select number of products to indicate the date after which there may be safety concerns.

- **Core Business Alignment –** As discussed in the Business Sector Analysis, it is challenging to have businesses allocate staff time to separating recyclables and organics as it typically does not align with their core business. This became more problematic due to employee shortages caused by COVID-19. The Business Sector Analysis recommendation of targeting businesses by SIC code will also apply to food waste generators and R3Source will share success stories amongst similar businesses. For example, R3Source could target food trucks for one year. R3Source could make presentations at their meetings, prepare a fact sheet, help food trucks procure compostable plates, napkins, and flatware, provide containers at food truck rallies/commissaries, evaluate apps such as Street Finder, and help contract for food scrap collection.

- **Transportation Costs** – Many food recovery organizations continue to work under a volunteer model where they do not charge food donors for collecting and transporting edible food. As fuel

prices increase, this approach may not be sustainable for some organizations. R3Source may want to target the major food donors and help them assess savings from reducing the food waste in their trash collection (i.e., container size and collection frequency) and apply some of these savings to compensate rescue organizations for collection costs.

- **Liability Concerns –** Enhancing food recovery efforts is essential to reducing food waste, but many food businesses avoid donating for fear of liability. Strengthening food rescue through liability protections and donation education can save 1.1 million tons of food annually in the U.S.[3] In November 2021, a bi-partisan Senate committee introduced legislation to expand liability protection for food donation to reduce wasted food nationwide. In December, a bipartisan coalition of representatives introduced the House version (HR 6251).

  The bill enhances the coverage of the Bill Emerson Good Samaritan Food Donation Act (Emerson Act), which promotes food donation by providing civil and criminal liability protection to food donors and food recovery organizations. The Emerson Act provides a broad base of liability protection that was intended to encourage food donations. Yet, donors are often unaware of the Act's protections or have outstanding questions regarding the Act. Many food manufacturers, retailers, and restaurants still cite fear of liability as a primary deterrent to donating food.

  The Food Donation Improvement Act will help to clarify some of the ambiguous terms in the Emerson Act, promote awareness of the Act, and extend liability protection to support modern food donation. R3Source could encourage regional legislators to support the bill and make potential food donors and local food recovery organizations aware of its introduction and legislative status.

- **Limited Infrastructure –** During the reference year, an estimated four to six small-scale and individual facilities composted food waste on a total of approximately 1,500 to 2,000 square feet of land. Ideally, R3Source would like to see that increase to 10,000 square feet at 20 locations. Communities can use RRI dollars to develop new composting sites, and R3Source offers a Waste Reduction Innovation Grant. The Waste Reduction Innovation Grant helps fund the innovative waste reduction, reuse, food rescue, composting, and recycling programs that significantly reduce waste in Hamilton County, Ohio. The grant requires a 25% match, and the non-profit match may be "in kind." Establishing a composting site may take over a year to create a marketable product that generates revenue for the match. Therefore, R3Source may consider expanding the "in-kind" match to new small composting businesses.

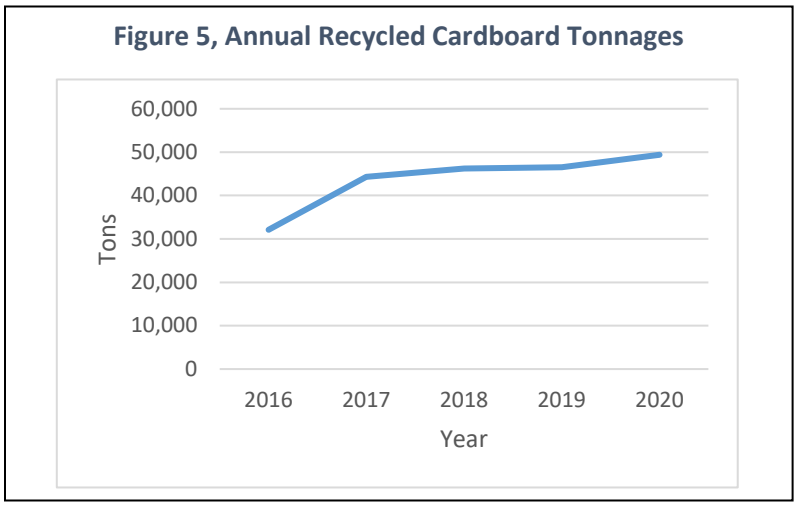
  In addition to small composting facilities, a private company is developing large-scale anaerobic digestion (AD) plant that they plan to open in 2023. The AD plant will have the capacity to process 195,000 tons of food waste annually. Ideally, the operator would like pre-consumer food waste with high liquid content. The AD plant will produce renewable natural gas and a soil amendment. R3Source may help the AD plant secure this feedstock by informing food waste generators about the project including large manufacturing industries within SIC code 20, institutions and businesses with cafeterias, and produce distributors. Because of having both an energy and soil amendment product to sell, the AD plant may be cost-competitive with landfill disposal.

[3] ReFED

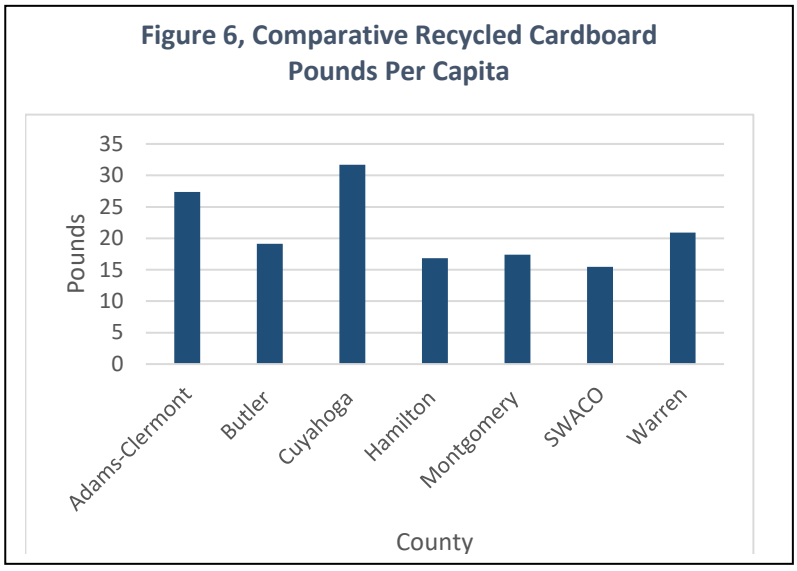
R3Source may create a public-private partnership to attract a processing facility that could accept food scraps. R3Source may meet with other districts that have private food scrap processors to understand the public-sector role in progressing their development.

Cardboard

Hamilton County has a strong infrastructure for paper recycling, with at least ten companies in the county (not including paper shredding companies). The majority of these private sector processors accept many types of paper such as cardboard, mixed paper, office paper, newspaper, and magazines.



In 2020, approximately 49,400 tons of cardboard products were recycled by the residential and commercial sectors. This tonnage is based on voluntary survey data from residential and commercial recyclers. Figure 5 outlines the tons of cardboard recycled from 2016 – to 2020. Even with the market volatility due to the 2018 Chinese National Sword, cardboard recycling quantities in Hamilton County have remained mostly constant since the last plan update.



R3Source ran a cardboard campaign from November 16, 2020 through January 11, 2021. Sinclair/Local 12 was the digital advertising partner. R3Source targeted Hamilton County residents with website display ads, pre-roll videos, OTT (streaming television) and Facebook ads.

Figure 6 details the amounts of cardboard recycled compared to other solid waste management districts in 2020. This data is presented on a per capita basis. As previously stated, the tons of material recycled are based on voluntary survey responses. Caution should be used when interpreting Figure 6; low per capita tonnages could reflect a low response rate to the solid waste district's recycling survey or other factors unique to the solid waste district.

Barriers to Cardboard Recycling

As discussed in this and the Business Analysis and Residential Recycling Infrastructure Analysis, the infrastructure for recycling cardboard includes businesses subscribing for service, drop-off sites, and residential subscription and non-subscription curbside recycling. Despite extensive recycling opportunities, cardboard is still almost 8% of the residential landfill-disposed waste stream. There may be several reasons for the amount of disposed cardboard.

- **Subscription Recycling** – The Residential Recycling Infrastructure analysis shows that residents in 15 communities subscribe to curbside recycling. The average pounds of collected recyclables per household were 60% less than in non-subscription communities. In Cuyahoga County, 57 of 59 communities have non-subscription curbside recycling. The per capita cardboard recycling rate is approximately 47% higher than in Hamilton County.

- **Survey Data** – R3Source has data from communities, MRFs, and targeted large-cardboard commercial generators. However, obtaining this information from the approximately 20,000 businesses in Hamilton County has proved challenging. Thus, there is likely more cardboard recovery in the commercial sector than R3Source reports.

- **Capacity** – Due to the influx of cardboard coming into homes from online shopping and home delivery service, residents do not always have enough capacity in their 96-gallon bins. Capacity in business recycling dumpsters can also be an issue when employees and custodial crews do not break down cardboard boxes.

Potential Solutions to Address Cardboard Recycling Barriers

- **Subscription Recycling** – R3Source may continue working with the Hamilton County townships that do not contract for trash, recycling, and yard waste collection on behalf of their residents. Beyond increasing cardboard recycling, encouraging townships to procure solid waste services will most likely decrease open dumping and contamination at recycling drop-off sites.

- **Survey Data** – As discussed in Data Collection Analysis, R3Source may explore electronic survey platforms and mailing lists to ascertain better recycling data.

- **Capacity** – R3Source may create an outreach campaign that reminds residents of drop-off sites during times in the year where cardboard generation increases, such as the holidays. The campaign could also encourage residents to combine purchases with online retailers that offer this option and remind households to break down boxes. Beyond the impact on landfill diversion, the outreach could also address how combining purchases reduces greenhouse gas emissions. Concerning the business sector, R3Source could help businesses conduct a cost-benefit analysis of purchasing a cardboard baler (i.e., savings from reduced container pulls and revenue from selling baled cardboard). Beyond economic benefits, cardboard balers save space and employee time.

- **Establish Cardboard Business Co-ops** – Most businesses generate some amount of cardboard regularly. However, businesses where a significant portion of their waste stream is cardboard often include:

- Retailers
- Restaurants
- Food Catering
- Distribution
- Wholesalers

While the percentage of cardboard is high, the quantity may not be enough to warrant purchasing their own baler or encourage a private recycler to collect the material from their business establishment. R3Source could use an electronic database to identify businesses that may generate a percent of cardboard and are proximately located to each other. Through the business waste audit program, R3Source could quantify the amount of cardboard they generate, help them cooperatively procure a recycler to collect the cardboard, and assist them with purchasing a baler for all of the businesses to use. R3Source could also help them to develop a financial model to allocate the costs and potential revenues from recovering cardboard among all co-op members.

Plastic Film

Plastic film consists of plastic bags, garbage bags, snack bags, and shrink wrap. According to the Hamilton County and SWACO waste characterization studies, plastic film accounts for 5.7% of the residential and business waste streams. Using this statistic, residents disposed of almost 20,000 tons of plastic film, and Hamilton County businesses disposed of approximately 50,000 tons 2020. Plastic film is an increasing component of the waste stream. Plastic film provides 6% of all packaging, 43% of plastic packaging, and 17.5% of all plastic in the waste stream.[4] Different resins and colors make plastic film difficult to recycle. More than 55% of the plastic film uses low-density polyethylene (LDPE) or linear LDPE resin and approximately half of plastic film is pigmented[5].

Recyclers do not accept plastic film in curbside or traditional recycling drop-offs; however, nearly every major grocery store or national retailer has a take-back program for plastic grocery bags. The commercial sector (non-manufacturing) has outlets for plastic film if there is a large enough quantity. Many of the large retail chains, for example, have programs for shrink wrap recycling if it is clean and dry.

There are a half-dozen existing outlets that accept plastic film for recycling, this film usually needs to be clean, dry, and baled. Local processors of plastic film include:

- 3R Recycling
- Cohen Recycling
- Customized Recycling Programs
- Eco Development
- Recycling Express
- Royal Paper Stock
- Cincinnati Recycling and Reuse Hub

A new facility, Brightmark Industries, opened in Ashley, Indiana which accepts and processes all plastic types- two through seven–even those co-mingled with different kinds of plastic or “contaminated” with

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ReFED
Miller, Waste 360, October 1, 2010
[5] I.B.I.D.

food, dirt, moisture, paper, etc. Brightmark processes the plastics in an anaerobic environment, removing the oxygen required for combustion. Their technology uses the technique of pyrolysis to break the chemical bonds in plastic in the absence of oxygen (incineration/combustion requires fire/oxygen) so that the raw materials can be broken down into their original chemical chains, recaptured, then transformed into other valuable products, like fuels and wax or even into new plastic products.

The Cincinnati Recycling and Reuse Hub (Hub) currently sends plastics to Brightmark. R3Source may work with the Hub to estimate their capacity to accept the additional plastic film. Based on this assessment, R3Source may promote the Hub to residents and businesses as an outlet for plastic films. R3Source may also facilitate the development of additional plastic film preprocessing infrastructures through its grant programs.

Commercial Other Compostable Fiber

Other commercial compostable fibers include fiber-based items that are food-soiled or constructed of fiber grade or condition not considered recyclable but are acceptable for composting. Examples include napkins and paper towels, shredded paper, and molded pulp packaging such as egg cartons. Currently, no composting facilities in Hamilton County accept other commercial fibers. The closest registered composting facility accepting other commercial fibers is Go Zero in Springfield, Ohio. Go Zero will collect organics, including other commercial fibers, from businesses for a fee. R3Source could provide businesses with information about Go Zero's services when conducting waste audits and work with local companies that sell compostable restaurant supplies to inform their customers about organizations such as Go Zero. R3Source could also promote organizations that accept compostable paper on their website. In addition, R3Source may create a public-private partnership to attract a processing facility that could accept commercial compostable fiber.

Landfill Diversion Goals

R3Source could establish goals for diverting an incremental amount of the top three residential, business, and manufacturing materials from landfills. R3Source could also establish goals for residential, commingled recyclables and yard waste recovered from transitioning residents from subscription to non-subscription recycling and yard waste collection. Table 4 shows these goals and the annual quantity of material recovered.

Table 4: Goals and Recovered Quantities

Generator	Material	Incremental Landfill Diversion Goal	Annual Tonnage Recovered
Residential	Food Waste	15%	6,159
Residential	Cardboard	10%	1,736
Residential	Plastic Film	5%	785

Table 4: Goals and Recovered Quantities			
Generator	**Material**	**Incremental Landfill Diversion Goal**	**Annual Tonnage Recovered**
Residents in Townships with Subscription Recycling	Commingled Recyclables	50%	14,782
Residents in Townships with Subscription Yard Waste Collection	Yard Waste	50%	3,329
Business	Food	25%	23,904
Business	Cardboard	20%	18,738
Business	Other Compostable Fiber	15%	7,508
Industrial	Food Waste	75%	6,150

Table 5, Summary of Potential R3Source Actions to Address Identified Gaps		
Infrastructure Improvement Suggestions	**Gap Addressed**	**R3Source Program**
Change consumer perception of “imperfect” produce	People throwing away edible food	Conduct a campaign to educate consumers that imperfect food is still edible
Standardize food labels	Edible food disposed of due to food label confusion	Evaluate supporting label standardization legislation
Align food waste reduction with core business	Alleviating concerns that implementing food reduction programs will hurt business	Work with businesses to minimize the impact on core services

Table 5, Summary of Potential R3Source Actions to Address Identified Gaps		
Infrastructure Improvement Suggestions	**Gap Addressed**	**R3Source Program**
Strengthen rescue through liability protections and donation education	Food that could be donated discarded due to liability concerns	Evaluate supporting liability protection legislation
Increase the number of small (less the 500 square feet) composting facilities	Limited food processing infrastructure	Consider expanding the "in-kind" match to new small composting businesses
Facilitate the development of large, private food processing capacity		Help facilities secure feedstock Research how the role of the public sector in progressing the development of processing facilities
Increase the number of townships that contract for curbside recycling	Limited access to curbside collection of cardboard	Continue working with the Hamilton County townships that do not contract for recycling collection
Use cart capacity more efficiently	Limited capacity in carts for cardboard	Educate residents on combining purchases, breaking down boxes, and availability of cardboard drop-off site
Assist small businesses in cost-effectively recycling cardboard	Cardboard being a predominant material in the business landfilled waste stream	Help establish cardboard co-ops for businesses
Identify outlets that accept plastic film commingled with other plastics	Plastic film is an increasing component of the waste stream	Assess the Recycle Hub's capacity to accept plastic film; possible promote Recycle Hub
Increase awareness of other compostable paper recovery opportunities amongst businesses	A limited number of businesses diverted other compostable paper	Promote businesses, such as Go Zero, directly and on the R3Source website