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The Current State of Recycling in the Cincinnati Region

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Abbreviations

AD: anaerobic digester
ASU: Arizona State University
GCP: Green Cincinnati Plan
HCSW: Hamilton County Recycling and Solid Waste District
HDPE: high-density polyethylene
HHW: household hazardous waste
MRF: materials recovery facility
NGO: nongovernmental organization
OES: Cincinnati Office of Environment and Sustainability
PET: polyethylene terephthalate
ROI: return on investment
SA: stand-alone
WHO: World Health Organization
WRRF: water resource recovery facility

Executive Summary

The U.S. Chamber of Commerce Foundation (The Chamber Foundation) is the nonprofit affiliate of the U.S. Chamber of Commerce and is dedicated to strengthening America's long-term competitiveness. The Chamber Foundation educates the public about the conditions necessary for businesses and communities to thrive, how business positively impacts communities, and emerging issues and creative solutions that will shape the future.

One of these creative solutions is Beyond 34: Recycling and Recovery for a New Economy. Beyond 34 is a multistakeholder public-private initiative led by The Chamber Foundation aimed at improving the current 34% recycling rate in the United States by providing a scalable model to increase and improve recycling and recovery rates. The goal of this initiative is to help communities, businesses, and cities apply a circular economy to create a more sustainable future. The four main goals of Beyond 34 are the following:

1. Demonstrate scalable processes for improving recycling, recovery, and reuse rates in a selected U.S. region, and test ideas and best practices in a collaborative environment.
2. Provide a blueprint demonstrating how companies and communities can successfully recover materials to keep them flowing in continuous, profitable, and sustainable loops that can be replicated in other communities and material hot spots.
3. Develop strategic partnerships across the value chain that help shift the U.S. toward a more circular economy for the benefit of communities, the environment, and the economy.
4. Raise awareness of the barriers and opportunities for transition to the circular economy in the U.S. and share learnings from Beyond 34 efforts so others can better address challenges for materials recovery.

Beyond 34 launched in 2017 with a pilot program in Orlando, Florida. In 2018, The Chamber Foundation partnered with the Rob and Melani Walton Sustainability Solutions Service at Arizona State University (ASU) to refine the model in a second city, Cincinnati, Ohio. The ASU Solutions Service team will employ its expertise in waste diversion and the circular economy to provide Cincinnati-specific analyses and develop new tools to help additional communities increase and improve their recycling efforts.

The purpose of this Current State Assessment is to provide a comprehensive description of Cincinnati's current waste and recycling infrastructure to aid in completing

additional analyses and make recommendations in support of Beyond 34 and Cincinnati's waste diversion goals.

Current State of Recycling in Ohio, Hamilton County, and Cincinnati

In 2017, Ohio had a population of 11,731,418 and its residents produced a total of 4,134,024 tons of residential and commercial waste and 8,893,654 tons of industrial waste.[1] Additionally, in 2017, Ohio had a 29.1% residential and commercial recycling rate and a 55.19% industrial recycling rate.[2] Hamilton County, where the City of Cincinnati is located, has the second-highest recycling rate in the state, behind only Franklin County. In 2018, Hamilton County reported a residential diversion rate of 18%, a commercial diversion rate of 38%, and an industrial diversion rate of 73%. Of the top five most populated cities in Hamilton County, Cincinnati has the highest diversion rate. In 2018, the reported diversion rate was 22.25%. The percentage of each major category of waste in the waste stream is presented in Figure A.

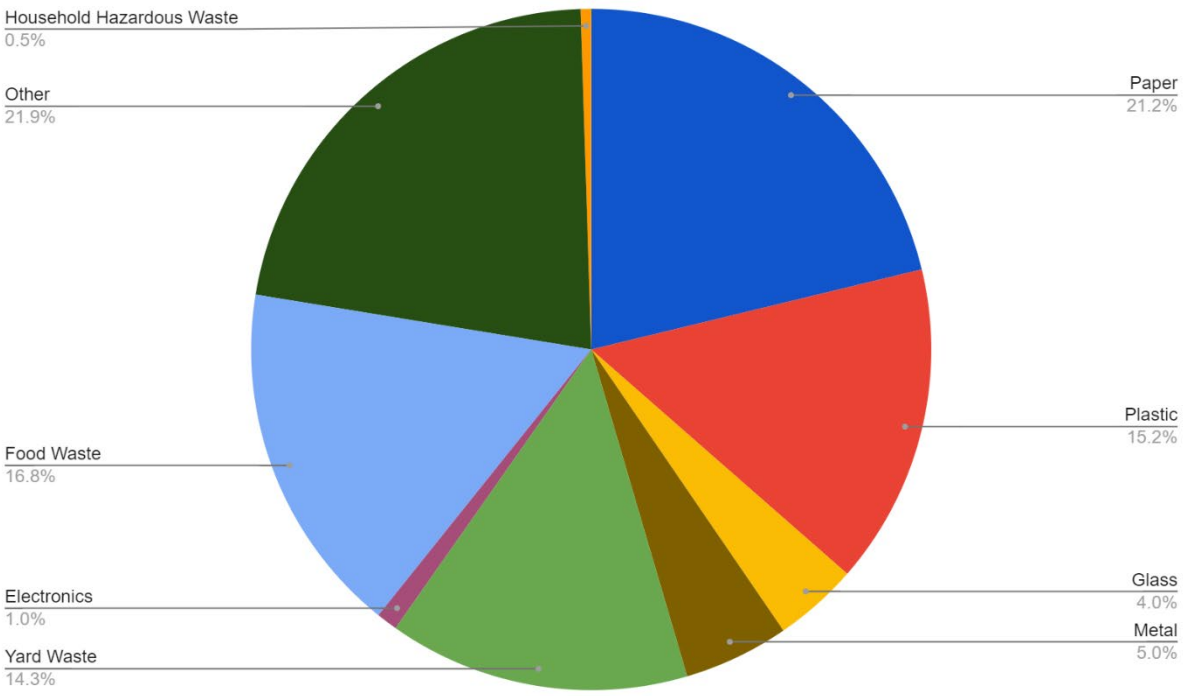


Figure A: City of Cincinnati—Waste Material Breakdown

[1] Ohio Recycling Rates and Waste Generation: https://epa.ohio.gov/portals/34/document/guidance/gd_1008.pdf
[2] Ohio 2017 Reduction and Recycling Statistics: https://epa.ohio.gov/portals/34/document/guidance/gd_1011.pdf

Table A shows the percentage of recyclable material present in Cincinnati's waste stream as well as the composition of each material type.

Table A: City of Cincinnati—Recyclable Material Breakdown

Type of Divertible Material	Percentage Recyclable Material Within Waste Stream	Composition of Material
Compostable	30.40%	Vegetative food, compostable paper, grass, leaves, brush, and wood
Recyclable paper	15.60%	Corrugated cardboard, newspaper/print, cartons, and mixed recyclable paper
Recyclable metals	5.10%	Aluminum cans, other aluminum, steel/tin cans, and other ferrous
Recyclable other	4.00%	Textiles, white goods, paint, batteries, and automotive fluids
Recyclable plastic	3.80%	Polyethylene terephthalate (PET), high-density polyethylene (HDPE), bottles, and grocery bags
Recyclable glass	3.30%	Glass bottles and glass jars

Notable Efforts in Cincinnati

In 2008, Cincinnati made history with the adoption of its first Climate Protection Action Plan, now named the Green Cincinnati Plan (GCP). The GCP is updated every five years (updated in 2013 and again in 2018). In the latest version, Cincinnati established a citywide goal to be zero waste by 2035.[3] The GCP is designed to set measurable targets and identify strategies and policies for the built environment, energy, food, natural systems, resilience, transportation, and waste to meet the city's climate goals.

One of Cincinnati's unique resources is CincyInsights[4], a website that shares neighborhood- and city-level data based on recycling participation as well as many other metrics. The website reports a 70% citywide recycling participation rate for the year 2015. Based on the maps provided by CincyInsights, a substantially higher portion of residents participate in the recycling program versus commercial entities. This information validates the GCP's goal to increase recycling in the commercial sector by a much larger percentage than in the residential sector.

[3] Zero Waste by 2035, page 238: https://www.cincinnati-oh.gov/oes/assets/File/2018%20Green%20Cincinnati%20Plan(1).pdf
[4] CincyInsights: https://insights.cincinnati-oh.gov/stories/s/CincyInsights/s59x-yqy3/

CincyInsights had a partnership with Zerocycle[5], a company that used its resident engagement platform. When a recycling cart is emptied by a recycling collection truck, a radio frequency identification tag reader on the cart records the collection event by street address, enabling residents to visualize how their neighborhood is performing compared with other neighborhoods in the city. However, after the pilot phase, CincyInsights began a new contract with an unnamed vendor and is in the process of collecting recycling data from the new vendor.

Cincinnati's Most Impactful Stakeholders

ASU performed a stakeholder analysis in order to determine those stakeholders that have the most impact on waste diversion. The five most influential stakeholders identified are the Cincinnati Office of Environment and Sustainability, Hamilton County Recycling and Solid Waste District, Rumpke Waste and Recycling, Cincinnati Department of Public Services , and Green Umbrella. These entities and their influence are detailed below.

The Cincinnati Office of Environment and Sustainability[6] (OES), which is responsible for building a sustainable, equitable, and resilient future for Cincinnati, designed the Green Cincinnati Plan. The GCP was created by a steering committee of 30 mayor-appointed representatives from government, corporate, academic, and nonprofit sectors. The GCP identifies eight major focus areas: built environment, education and outreach, energy, food, natural systems, resilience, transportation, and waste. For the purpose of this analysis, waste and food are the primary focus. However, many of the other six focus areas play a role in Cincinnati's solid waste management goals. The OES is considered the most influential stakeholder for achieving the goals of Beyond 34 for two reasons: because the GCP secured support from the mayor and council, and because the objectives of the GCP directly align with that of Beyond 34.

Rumpke[7] corporation provides recycling, collection, and landfill services to the residents and businesses of Cincinnati. Rumpke is the primary residential curbside recycling collector for Cincinnati and operates the main material recovery facility (MRF) and landfill in the Cincinnati Metropolitan Statistical Area. The MRF services more than 200,000 homes in the greater Cincinnati area and separates more than 100,000 tons of recyclables each year. The recyclable materials include paper, plastics, metals, and glass, all separated and sold to vendors who are primarily domestic. Rumpke also provides collection for large disposal projects and yard waste in some communities and

[5] Zerocycle boasts increased participation, tonnage in two trial cities: [[Cody Boteler]] https://www.wastedive.com/news/zerocycle-increased-participation-tonnage-buffalo-cincinnati/520282/
[6] Cincinnati Office of Environment and Sustainability: https://www.cincinnati-oh.gov/oes/
[7] Rumpke: https://www.rumpke.com/

currently accepts yard waste collected by Cincinnati into its composting facility. Rumpke is considered the second most important stakeholder because of its direct relationship with recycling and waste management in Cincinnati. Rumpke is also involved in many community education and recycling events within the city.

The Hamilton County Recycling and Solid Waste District (HCSW) establishes many of the protocols, policies, and objectives for waste management in the county. The organization's objectives are as follows:

> *[HCSW is] a County organization, established by State law, responsible for ensuring that the County achieves State-mandated goals for recycling and waste reduction. The District achieves these goals through the implementation of waste reduction programs targeted to residents, communities, businesses, and schools.*[8]

Hamilton County Recycling and Solid Waste District provides governance to the City of Cincinnati for its solid waste and recycling policies. The HCSW has a committee of nine members tasked with determining recycling policies for the county. HCSW is a highly valuable and important stakeholder for two main reasons. First, HCSW and Beyond 34 share a vision that increased recycling and diversion from the landfill can generate economic growth in Hamilton County while providing its citizens with a healthier community. Secondly, Hamilton County Recycling and Solid Waste District can share the Beyond 34 blueprint built for Cincinnati to help improve recycling and diversion in other cities and towns in the county once the project in Cincinnati is completed.

Cincinnati Department of Public Services[9] is in many ways similar to HCSW. However, Cincinnati Department of Public Services is responsible for the collection of solid waste, recycling, and yard waste. Cincinnati Department of Public Services is also responsible for governing which wastes are to be recycled and scheduling collection for all neighborhoods, as well as establishing and meeting waste and recycling goals for the city. As such, Cincinnati Department of Public Services is considered a vital stakeholder because of this governance role, its 2035 zero waste goal, and its ability to generate revenue and economic growth for the city.

Green Umbrella[10] is a nongovernmental organization whose goal is to facilitate measurable sustainable improvements through collaborations with 200 nonprofits, businesses, educational institutions, and governmental entities. Green Umbrella

[8] Hamilton County Recycling and Solid Waste District: http://www.hamiltoncountyrecycles.org/about_us
[9] Cincinnati Public Services: https://www.cincinnati-oh.gov/public-services/
[10] Green Umbrella: https://greenumbrella.org/

operates around the Collective Impact Model, which is an idea that actors from a variety of sectors can coordinate to make small changes that will have a very large impact when combined. Green Umbrella is a vital stakeholder to Beyond 34 because it is the backbone organization for a substantial number of organizations and smaller stakeholders within Cincinnati. Through collaboration with Green Umbrella, recycling solutions that require coordination between all sectors of Cincinnati become more feasible. Similarly, Green Umbrella has goals that align with Beyond 34.

Summary of Findings

The various components of the Current State Assessment provide the foundation not only for the in-depth and complete analysis of Cincinnati's opportunities for increasing diversion and achieving its zero waste goals but also for strong support in achieving Beyond 34's broad goals. The findings presented herein will require more in-depth research and further analysis, which is occurring in the following Beyond 34 work products:

1. The *Economic Impact Assessment* will identify and quantify the economic impact of waste diversion options for the currently recycled and additionally recoverable tons of plastic, glass, metals, and paper in the City of Cincinnati's municipal waste stream.
2. The *Opportunity Analysis* will be completed with the objective of providing diversion improvement scenarios segmented by highest diversion potential and a feasibility analysis on each diversion opportunity including estimated costs and return on investment (ROI) for stakeholders where data are available.
3. The *Institutional Analysis* will incorporate personal communication with key local stakeholders to best understand the formal and informal "rules of play" within stakeholder groups, and will provide greater insights to opportunities and challenges that are embedded in the larger waste and recycling system.
4. The *Roadmap and Implementation Plan* is the final deliverable and will be developed using the input and information gathered from local stakeholders. An initial draft will detail prioritized projects, and where data are available it will provide costs, ROI, and identified partners. This roadmap will provide stakeholders and funders with the ability to see the larger zero waste vision for the region. It will clearly state what data are used to measure progress, the diversion impacts by project, and how the region will continue working collaboratively on increasing recycling in the short and long term after the Beyond 34 efforts are completed.

When all these additional analyses are completed and viewed holistically with this Current State Assessment, the findings presented in this report will eventually tie directly to Beyond 34's goals. At the project's completion, Cincinnati will be able to better understand and develop scalable processes for their waste diversion programs, provide blueprints for material recovery, identify impactful partnerships, and broadly raise awareness for the potential for a circular economy.

Introduction

The U.S. Chamber of Commerce Foundation and Beyond 34

The U.S. Chamber of Commerce Foundation (The Chamber Foundation) is the nonprofit affiliate of the U.S. Chamber of Commerce and is dedicated to strengthening America's long-term competitiveness. The Chamber Foundation educates the public about the conditions necessary for business and communities to thrive, how business positively impacts communities, and emerging issues and creative solutions that will shape the future.

Beyond 34: Recycling and Recovery for a New Economy is a multistakeholder public-private initiative aimed at increasing the current 34% recycling rate in the United States by providing a scalable model to increase and improve recycling and recovery rates.

Led by the U.S. Chamber of Commerce Foundation, Beyond 34 launched in 2017 with its first pilot program in Orlando, Florida. It is now partnering with Arizona State University (ASU) and the City of Cincinnati to apply its model to the city. The goal is to help communities, businesses, and cities apply a circular economy to create a more sustainable future.

Rob and Melani Walton Sustainability Solutions Service

The Rob and Melani Walton Sustainability Solutions Service is an education and research program at ASU that was established to advance sustainability solutions locally and globally. The Solutions Service engages diverse teams of faculty, students, entrepreneurs, researchers, and innovators to collaborate and deliver sustainability solutions throughout the globe, to provide learning opportunities for future and current sustainability leaders, and to engage audiences of all ages to take action on and celebrate sustainability solutions.

In 2015, the Solutions Service focused its waste diversion and circular economy expertise under the Resource Innovation and Solutions Network to advance integrated resource management through a global network of partners using collaboration, research, innovation, and application of technologies to create economic value, driving a sustainable circular economy.

City Selection Process

The Beyond 34 initiative began the selection process by comparing seven cities: Cincinnati, Indianapolis, Kansas City, Nashville, New Orleans, Phoenix, and Portland. Portland was selected as a benchmark for waste diversion, and Phoenix was selected as a baseline to verify the decision matrix outcomes. Portland was used as the benchmark because it is known for having successful recycling programs and high diversion rates. Oregon's recycling laws and mandates are not as strict and forceful as California's, which made Portland more comparable to the areas researched for the decision matrix. In addition, Oregon was ranked as the second-best diversion state in the United States as of 2015. Phoenix was used as a baseline due to the Solutions Service's extensive knowledge of its waste system and ensured that the ranking system and aggregation processes worked as expected.

The first step toward city selection was the creation of 35 binary and nonbinary decision criteria. These criteria were developed to properly gauge the viability of executing successful waste diversion and recycling programs in each city. The Copeland Ranking Aggregation method[11] was applied in order to rank the cities, due to the nature of the binary and nonbinary decision criterion. Binary data are scored as a 1 for "yes" and a 2 for "no." For the nonbinary data, each city was ranked 1 to 7 in each criterion, with 1 being the highest score. Then all cities were compared on all criteria and the total "wins" and "losses" were compared based on rankings that established a city selection. These 36 criteria were grouped into the five categories presented in Table 1 (next page).

[11] D.G. Saari. and V.R. Merlin, "The Copeland Method. I. Relationships and the Dictionary"; Economic Theory; Vol. 8, No. I; June, 1996; 51-76.

Table 1: City Selection Criteria

People and Place	Government and Policy	Economic Considerations	Waste Recycling Infrastructure	Recycling Performance
Population density	City council support	"Pay-as-you-throw" program	Managers of Material Recovery Facilities	Current diversion rate
Projected population growth rate	Next council election date	Fee for recycling	Automatic recycling program	Current contamination rate
Local recycling organization	City manager	Cost per collected ton of waste	Frequency of recycling stream collected	Residential participation rate
Percentages of residential waste and industrial waste	Mayor's support toward recycling and pro-environmental policies	Annual cost of waste and recycling	Number of material categories	Commercial participation rate
	Local chamber	Existence of materials going to local processors	Hauling in city	Tracking the volume of recycled materials, customer satisfaction, etc.
	Recycling education website		Customer of city hauling	
	Recycling education budget		Customer of private hauling	
	Number of paid staff		Drop-off areas for recycling	
	Zero waste plans		Waste characterization	
	Material ban policy			
	Illegal dumping or burning ban policy			
	Strategic partnership			

Based on the analysis of these 35 criteria, the seven cities are ranked as follows:

1. Portland
2. Phoenix
3. Cincinnati
4. Nashville
5. New Orleans
6. Kansas City
7. Indianapolis

Because Cincinnati was rated third behind the benchmark and baseline, as seen above, it was chosen as the next Beyond 34 city.

Objective

The purpose of this Current State Assessment is to provide a comprehensive description of Cincinnati's current waste and recycling infrastructure to aid in completing additional analyses and make recommendations in support of Beyond 34 and Cincinnati's waste diversion goals. It is organized in the following four sections:

1. Current State of Recycling in Ohio, Hamilton County, and Cincinnati
2. Stakeholder Analysis
3. Economic Considerations
4. Summary of Findings

1. Current State of Recycling in Ohio, Hamilton County, and Cincinnati

Using waste data provided by the state of Ohio, Hamilton County and Cincinnati were evaluated in this holistic assessment. The current state of Cincinnati's waste and recycle streams provide the initial foundation upon which Cincinnati and Beyond 34 can identify potential opportunities for further diversion.

1.1 Ohio

In 2017, Ohio had a population of 11,731,418 and its residents produced a total of 4,134,024 tons of residential and commercial waste (Table 2) and 8,893,654 tons of industrial waste[12] (Table 3). Commercial waste consists of waste generated from businesses or trades including retail, sport, recreation, education, and entertainment. Industrial waste is often defined as waste produced by an industrial activity such as factories, mills, or mining operations. Additionally, in 2017, Ohio had a 29.10% residential and commercial recycling rate and a 55.19% industrial recycling rate.[13]

[12] Ohio Recycling Rates and Waste Generation: https://epa.ohio.gov/portals/34/document/guidance/gd_1008.pdf
[13] Ohio 2017 Reduction and Recycling Statistics: https://epa.ohio.gov/portals/34/document/guidance/gd_1011.pdf

Table 2: State of Ohio—Residential and Commercial Waste Material Breakdown

Material Type	Waste Amount (Tons)	Percentage of Total Waste
Yard waste	1,242,817	30.32%
Corrugated cardboard	822,243	20.06%
Metal	526,437	12.84%
All other paper	450,189	10.98%
All else	282,549	6.89%
Commingled recyclables	256,582	6.26%
Scrap tires	162,721	3.97%
Wood	141,350	3.45%
Glass	112,343	2.74%
Food	101,635	2.48%
Total amount of waste (tons)	4,134,024	100%

Table 3: State of Ohio—Industrial Waste Material Breakdown

Material Type	Waste Amount (Tons)	Percentage of Total Waste
Metal	4,101,824	46.12%
Fuel gas desulfurization	2,253,785	25.34%
Corrugated cardboard	592,128	6.66%
Wood	466,026	5.24%
Glass	159,645	1.80%
Food	322,544	3.63%
Plastics	225,722	2.54%
All else	282,549	6.99%
All other paper	150,539	6.66%
Total amount of waste (tons)	**8,893,655**	**100%**

Figure 1 (next page) details the population versus recycling rate for the residential/commercial sector and Figure 2 (next page) details population versus industrial recycling rate for Hamilton County with respect to other counties. (see Appendix A1 for data).

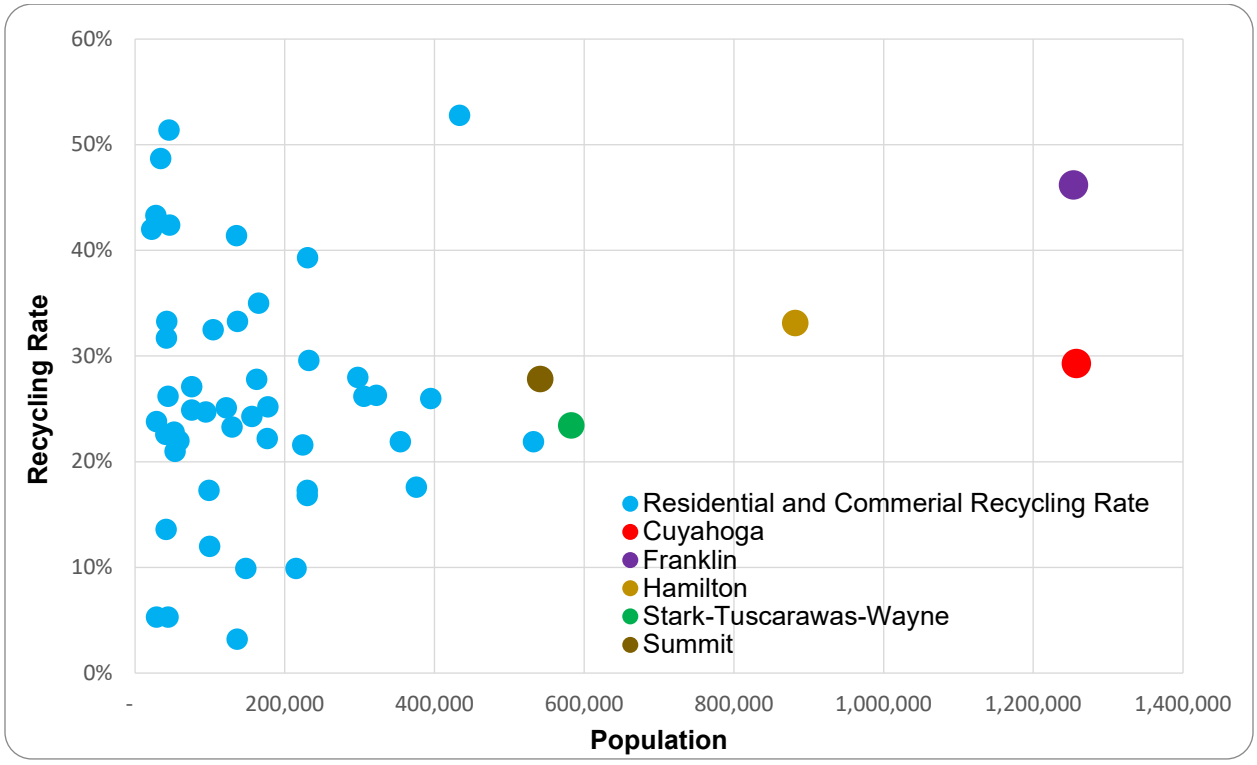


Figure 1: Counties of Ohio: Population vs. Residential/Commercial Recycling Rates

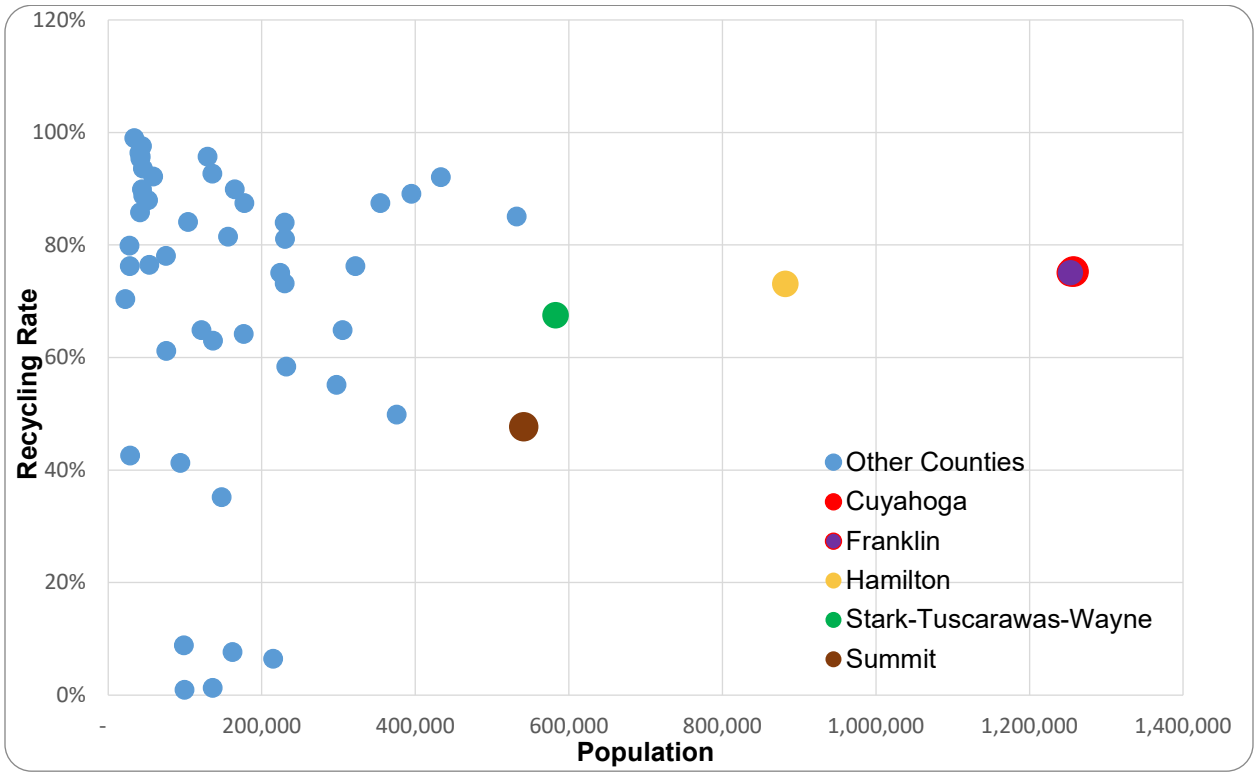


Figure 2: Counties of Ohio: Population vs. Industrial Recycling

1.2 Hamilton County

Of the five largest counties within Ohio, Hamilton County has the second-highest recycling rate, behind only Franklin County. In 2018, Hamilton County had an estimated population of 816,684, and its residents produced 309,404 tons of residential waste, 1,033,239 tons of commercial waste, and 956,007 tons of industrial waste (Table 4). In that same year, Hamilton County reported a residential diversion rate of 18%, a commercial diversion rate of 38%, and an industrial diversion rate of 73%.

Table 4: Hamilton County—Waste and Material Breakdown

Type of Waste	Quantity (Tons)	Diversion Rate	
Residential	309,404	18.00%	
Commercial	1,033,239	38.00%	
Industrial	956,007	73.00%	
Breakdown of Household Waste	**Quantity Totals (Tons)**	**Diversion Rate**	**Percentage of Total Landfilled Waste**
Other	59,814	0.00%	23.80%
Paper	78,773	35.49%	20.20%
Yard waste	61,069	30.54%	16.90%
Food waste	37,494	0.00%	14.90%
Plastic	41,121	9.36%	14.80%
Metal	11,238	16.22%	3.70%
Glass	13,924	41.17%	3.30%
Electronics	4,728	0.00%	1.90%
Household hazardous waste (HHW)	1,243	0.00%	0.50%

Figure 3 shows the population and recycling rates in all the cities in Hamilton County, with Cincinnati being the highest populated in the county.

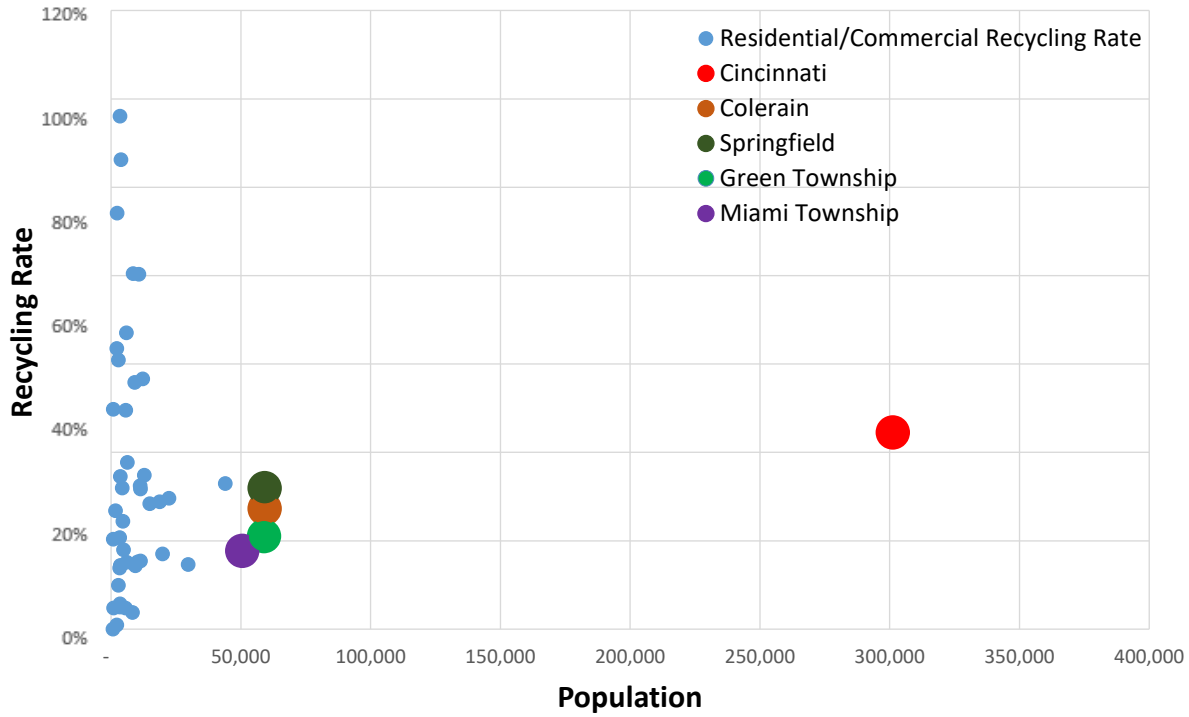


Figure 3: Hamilton County—Population vs. Recycling Rates

Figure 4 (next page) highlights some of the recycling facilities within Hamilton County.

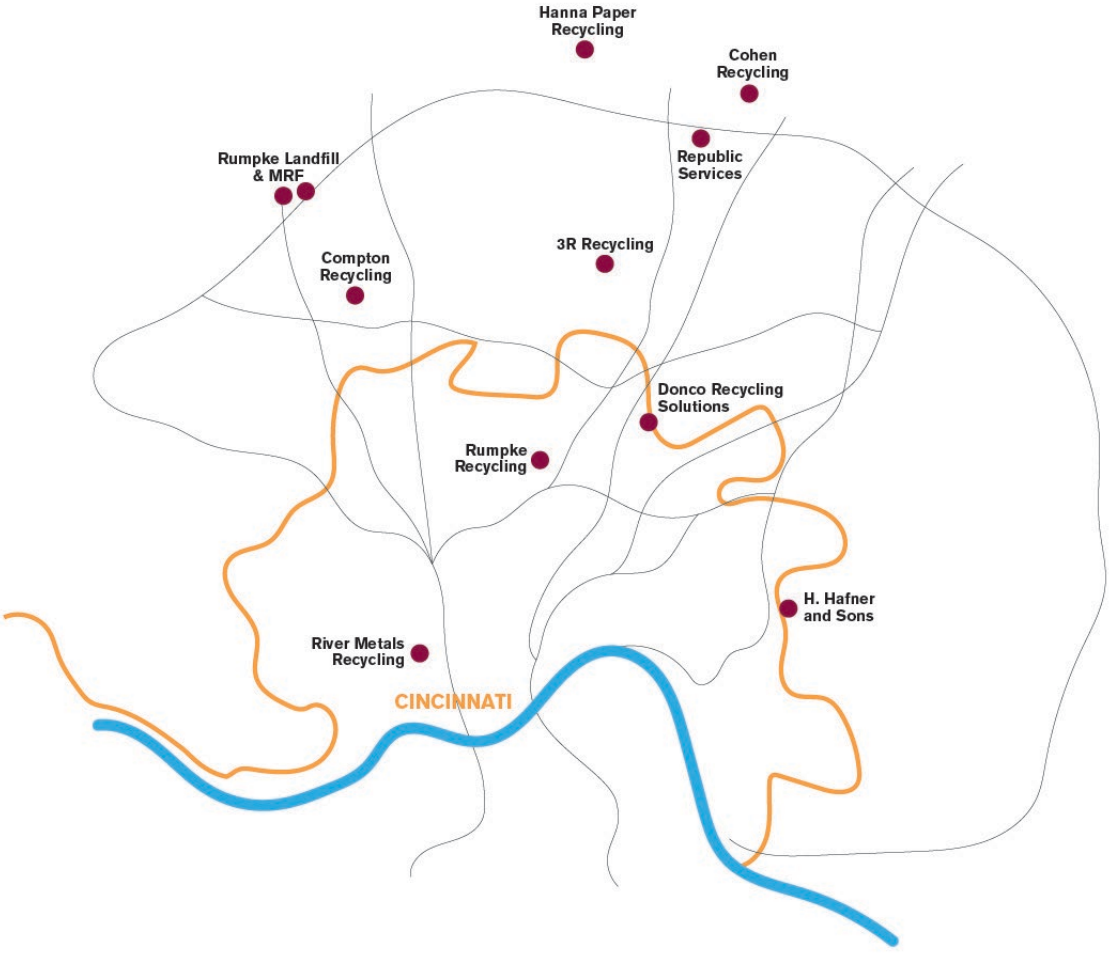


Figure 4: Hamilton County—Facilities Map

1.3 Cincinnati's Residential Waste Generation

Of the top five most populated cities in Hamilton County, Cincinnati has the highest diversion rate. In 2017, Cincinnati had a population of 301,301 and a reported diversion rate of 24.58%. In 2018, the reported diversion rate was 22.25%. The percentage of each major category of waste in the waste stream for 2017 is presented in Figure 5. Complete data for all cities within Hamilton County is in Appendix 2.

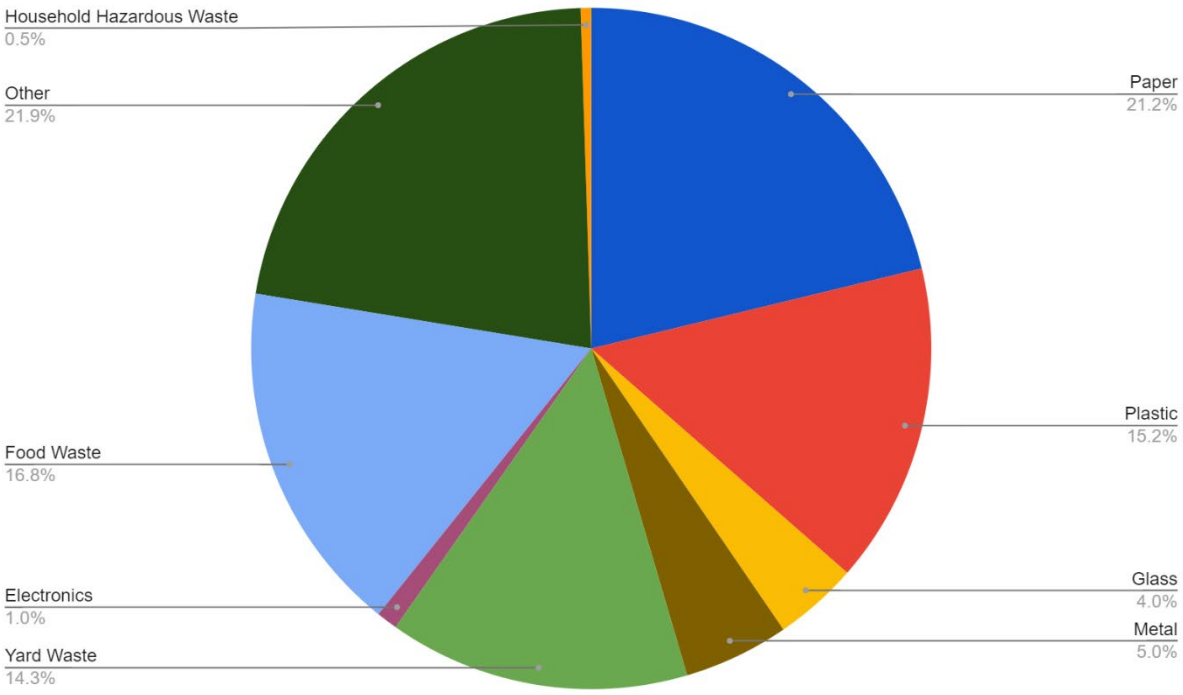


Figure 5: City of Cincinnati—Waste Material Breakdown

Table 5 shows the percentage of recyclable material present in Cincinnati's waste stream as well as the composition of each material type.

Table 5: City of Cincinnati—Recyclable Material Breakdown

Type of Divertible Material	Percentage Recyclable Material Within Waste Stream	Composition of Material
Compostable	30.40%	Vegetative food, compostable paper, grass, leaves, brush, and wood
Recyclable paper	15.60%	Corrugated cardboard, newspaper/print, cartons, and mixed recyclable paper
Recyclable metals	5.10%	Aluminum cans, other aluminum, steel/tin cans, and other ferrous
Recyclable other	4.00%	Textiles, white goods, paint, batteries, and automotive fluids
Recyclable plastic	3.80%	Polyethylene terephthalate (PET), high-density polyethylene (HDPE), bottles, and grocery bags
Recyclable glass	3.30%	Glass bottles and glass jars

All calculations and percentages in Table 5 are derived from the 2018 Waste Characterization Study performed by SCS Engineers.[14] Table 5 provides the basis for the largest diversion opportunities. In addition, this table, when compared with Figure 5, highlights discrepancies in material capture rates. For example, the total amount of paper in the waste stream is 21.2%. However,15.6% of this paper could be recycled if captured from the waste stream. An additional 5.0% of the paper stream is compostable and is calculated as a compostable material. This means that for paper the capture rate isn't as high as for other materials. Plastic is a good example of a material with a high recyclable capture rate. Of the 15.2% of plastic found in the waste stream, only 3.8% is considered recyclable. This shows that the plastic material considered recyclable is making its way into the blue recycle bins. One example of the type of plastic not considered recyclable is plastic film. Plastic film accounts for almost half of the 15.2% of the plastic in the waste stream.[15]

[14] There were 24 residential waste samples collected from Cincinnati from a total of 60 samples collected for all of Hamilton County.
[15] Hamilton County Waste Composition 2018 Study: http://www.hamiltoncountyrecycles.org/UserFiles/Servers/Server_3788196/File/EnvironmentalServices/SolidWaste/About/Hamilton%20County%20WCS%202018%20Final%20Report.pdf

Below is a brief description of the highest waste and recyclable category based on the Hamilton County waste categorization for Cincinnati. These percentages are also seen in Figure 5 above.

Plastic

The plastic category represents 15.2% of the material collected within the waste stream, which is the fourth highest material by percentage. This category is reserved for materials such as Polyethylene terephthalate (PET) bottles, PET jugs, High-density polyethylene (HDPE) bottles, HDPE jugs, trays, tubs, rigid plastics, films,[16] grocery bags, and other plastics. The recyclable materials within this category are PET bottles, PET jugs, HDPE bottles, and HDPE jugs, accounting for 3.8% of the total 15.2% in the waste stream.

Food Waste

The food waste category represents 16.8% of the material collected in the waste stream, which is the third-highest material by percentage. This category is reserved for materials such as vegetative foods and nonvegetative foods. Currently, Cincinnati has no outlet to process food waste. However, 30.4% of the material within the waste stream is organic, and food waste processing represents one of the most viable ways to increase the diversion rate for the city.

Paper

The paper category represents 21.2% of the material collected within the waste stream, and it is the second-highest material category by percentage. This category is reserved for materials such as corrugated cardboard, newspapers, prints, cartons, mixed recyclable paper, compostable paper, and nonrecyclable paper. The recyclable materials within this category are corrugated cardboard, news, prints, cartons, and mixed recyclable paper. These recyclable materials account for 15.6% of the material in the waste stream. The high amount of recyclable paper found in the landfill stream highlights an opportunity for increased recycling capture for this material.

Other

The other category represents 21.9% of the material collected within the waste stream, which is the highest material by percentage. This category is reserved for materials such as diapers, textiles, large appliances, construction and demolition debris,

[16] The films category of materials mainly consists of plastic wrap and other shopping bags.

mattresses, uncharacterized materials, pet waste, carpet, and fines. The recyclable materials within this category are textiles and appliances. Approximately 4% of the other materials in the waste stream is recyclable.

1.4 Cincinnati's Commercial and Industrial Waste Generation

Because the City of Cincinnati does not service these sectors, there is no waste characterization or waste breakdown data available. To evaluate opportunities to increase waste diversion in these sectors, waste generation trends of the largest employers in Cincinnati by industry have been reviewed. This approach could identify opportunities for increased diversion and collaboration between these industries and the city.

Based on Cincinnati workforce data, the four largest industries in Cincinnati by the number of employees are the following:

- Health care and social assistance
- Retail trade
- Accommodation and food services
- Manufacturing

Typical categories of waste generated by three of these industries have been examined and cross-referenced with information regarding the largest amounts of waste generated in Cincinnati. Manufacturing has not been examined as thoroughly, in part due to the massive variety of waste that manufacturers generate.

1.4.1 Health Care and Waste Generation

Health care is the leading employer in Cincinnati. The World Health Organization (WHO) estimates that roughly 85% of waste generated by health care activities is general municipal solid waste, consisting largely of paper, plastic, packaging, and organics. One important opportunity for improved diversion rates from health care activities is correctly educating and encouraging employees about separating the benign general waste from hazardous waste such as radioactive materials, chemicals, or blood-contaminated sharps. The WHO estimates that when contamination occurs, hazardous waste generated increases from 15% to 70%. While hazardous waste separation from general waste is common practice in the United States, errors still occur, so the WHO promotes yearly training. As such, commonalities exist between industries. A successful example of a healthcare waste partnership is summarized in the inset box.

In 2009, Kaiser Permanente and Goodwill of Southern California partnered to address hard-to-recycle plastic film. Kaiser Permanente produced 20 tons per year of a blue wrap, a nonwoven material made from polypropylene used for wrapping surgical instruments for sterilization. Goodwill, which recycles unsold products and other challenging items such as mattresses, cleaned any contamination from the blue wrap and sold it to a recycler that reprocesses film into plastic pellets to make products such as lawn furniture or carpeting. Such partnerships create mutual benefits and increased economic value.

1.4.2 Retail Stores and Waste Generation

The retail sector is the second largest industry in Cincinnati. The largest diversion opportunity retail stores can control is recycling and reuse of their packaging[17] and other paper materials. Retailers can also pay specific attention to how packaging plays a role in their overall supply chain in order to increase efficiencies as they reduce the amount of material coming from their suppliers. Furthermore, retail stores can reuse packaging and other paper materials in their operations and logistics processes, and they can partner with a waste hauler to collect and transport all recyclable materials.

1.4.3 Food Services and Waste Generation

Kroger Company,[18] one of the world's largest food retailers, is headquartered in Cincinnati and has approximately 14,800 employees. In addition to major food retailers, other major foodservice providers include leisure, hospitality, and accommodation service industries. Food waste produced from these services is categorized as organics.

[17] The packaging materials category includes cardboard, fluid containers, polystyrene packing "peanuts," plastic films, shrink wraps, and bags.
[18] Kroger Company Headquarters: https://www.kroger.com/

Taking the household level food waste into account with food retailers, food service providers, and food manufacturers in the city, it becomes evident that a food waste solution will be necessary to combat the amount of organics going to the landfill. Food waste reduction and policy initiatives are being led by Green Umbrella through its Greater Cincinnati Regional Food Policy Council, and are being addressed in three ways:

- Preventing food from being wasted by standardizing labeling procedures and implementing waste analytics for measurement
- Recovering food that would have otherwise been wasted and redistributing it to those in need (also known as food recovery)
- Recycling food waste, further supporting the building of an anaerobic digester and/or a composting facility in Cincinnati

Each of these three steps represents opportunities for engagement by Beyond 34. All the largest industries discussed in detail above relate directly to the three largest waste types (plastic, paper, and organics) in Cincinnati's municipal solid waste, which accounts for more than half of all household landfill waste generated, at 53.4%.

1.4.4 Largest Manufacturer in Cincinnati

Due to the variety of waste manufactures generate, an in-depth analysis of the entire manufacturing industry in Cincinnati was not feasible, although the largest manufacturer was identified. AK Steel is the largest manufacturer in Cincinnati based on the number of local manufacturing employees, producing carbon steel for automotive, manufacturing, and distribution markets. Sources of solid wastes in steel manufacturing are broadly separated into three categories: fly ash, ferruginous metals, and nonferruginous metals. Fly ash is typically produced in furnaces as a byproduct of coal. Fly ash can be recycled and reused as aggregate in cement, concrete, and bricks.[19] Ferruginous metals are metals that contain iron, such as many types of steel and cast iron. These metals can have high recycling potential because they can replace raw materials such as iron ore or limestone.[20] Nonferruginous metals are those that do not contain iron, such as aluminum, copper, or tin, and are also highly recyclable.

Based on publicly available data, the AK Steel factory in Cincinnati recycled approximately 210,000 tons of solid waste in 2017, tied for first among the nine AK Steel factories in the nation. As a company, AK Steel recycled 55% of all its waste,

[19] Exploring uses of fly ash: M. Rycroft https://www.ee.co.za/article/exploring-many-uses-fly-ash.html
[20] Ferrous vs. nonferrous metals: All Metals Fabrication https://www.allmetalsfab.com/ferrous-non-ferrous-metals-whats-difference/

which is more than 885,000 tons of recycled waste. Of all the waste generated, only 3% was considered hazardous waste and only 1% of the total waste was incinerated.

1.5 Cincinnati's Residential and Commercial Collection Protocols

The City of Cincinnati is responsible for hauling waste from single-family households, multifamily households with fewer than four dwelling units, and other dwellings that do not include businesses or "a building owned by a political subdivision of the State of Ohio or a federal or state agency."[21] According to Cincinnati's Zoning Administration, a dwelling is "a building that contains no more than four 'dwelling units' and includes an attached single-family dwelling."[22] All other dwelling units are considered commercial entities and, per Cincinnati Public Health Services, are required to enter into a contract with a registered waste hauler in Cincinnati. There are four registered waste haulers in Cincinnati: Bavarian Trucking Company, Best Way Disposal, Republic Services, and Rumpke Waste and Recycling. All these waste haulers support various forms of recycling.

Residential waste must be placed in a registered city-issued cart. The cart must not weigh more than 75 pounds once filled; however, additional carts can be requested through Cincinnati Department of Public Services . As per the city charter, the City of Cincinnati is responsible for providing weekly garbage collection to the residents for free. Costs for this service are collected by general fund tax revenue. Additionally, from April through the second week of January, yard waste is collected separately, concurrent with the recycling service, which is discussed further in the following section. The City of Cincinnati also offers opt-in recycling collection every two weeks for residents; however, Rumpke is responsible for all recycling collection per their contract with the city. One notable exception to recycling collection is that Simple Recycling also picks up clothing, textiles, housewares, and small appliances on regular recycling days. In 2018, Simple Recycling collected roughly 60 tons of textiles from 105,000 households. Cincinnati is one of only a few cities in the U.S. to offer this service.

At this time, less is known about the process for commercial waste haulers. However, the Green Cincinnati Plan (GCP), discussed in Section 4.1, states that in 2013 Cincinnati passed an "ordinance requiring all commercial waste haulers to have a franchise agreement with the city."[23] Part of the ordinance involved a fee charged to waste haulers for any waste collected from a commercial building and taken to a solid

[21] Cincinnati Public Services: https://www.cincinnati-oh.gov/public-services/garbage-yard-waste/
[22] Cincinnati Zoning Administration: https://www.cincinnati-oh.gov/buildings/zoning-administration/view-the-draft-land-development-code/6-definitions/
[23] Green Cincinnati Plan, page 242: https://www.cincinnati-oh.gov/oes/assets/File/2018%20Green%20Cincinnati%20Plan(1).pdf

waste facility. As such, the waste collectors would increase their price to the commercial waste generators to accommodate the fee. There is no fee for materials sent to a recycling facility.

Currently, per the GCP, the franchise fee is 10% of the gross revenue of the waste generator. The GCP discusses doubling this fee to 20%, which would provide greater incentives for waste generators to minimize their waste. The GCP also states that revenue generated would be used to smooth the transition and provide education or incentives. Relatedly, the GCP also states that one of Cincinnati's goals is to increase commercial recycling rates by 20%.

1.6 Cincinnati's Yard Waste Collection Protocols

Yard waste[24] within the City of Cincinnati is collected by the city's solid waste service every other week from April through the second week of January[25] and is scheduled on the same day as recycling collection. Yard waste must be placed in marked cans with handles, paper bags designed for it, or bundled with cotton or twine and can not weigh more than 25 pounds. The city will not collect material placed in city-issued garbage or recycle bins. Large wood waste items greater than six inches in diameter, such as branches, logs, or tree trunks will not be accepted by any City of Cincinnati curbside programs. Residents needing to haul large wood waste items are required to organize collection methods themselves or through private contractors.

In addition, the City of Cincinnati is working to increase the tree canopy throughout the city. Taking Root is a coalition of organizations committed to planting two million trees in the Cincinnati region by 2020. Between 2013 and 2018, 300,000 trees were planted. Presumably, this initiative could result in sizable increases in yard waste.

1.7 Bans and Restrictions

In the City of Cincinnati, there are legally enforced dumping bans, such as tire dumping, and other environmental crimes enforced by the Environmental Crimes Task Force and the Cincinnati Department of Public Health. In alignment with these laws, Keep Cincinnati Beautiful,[26] Green Umbrella,[27] and Simple Recycling[28] facilitate residential and industrial recycling.

[24] City of Cincinnati: https://www.cincinnati-oh.gov/public-services/garbage-yard-waste/yard-waste/
[25] City of Cincinnati: https://www.cincinnati-oh.gov/recycling/gold-team-schedule/
[26] Keep Cincinnati Beautiful: https://www.keepcincinnatibeautiful.org/programs/
[27] Green Umbrella: https://www.cincinnati-oh.gov/oes/linkservid/6CE53223-9206-9F36-DB7FA3444F16A1A0/showMeta/0/
[28] Simple Recycling: https://simplerecycling.com/supplies/

1.8 Green Cincinnati Plan

In 2008, Cincinnati made history with the adoption of its first Climate Protection Action Plan, now named the Green Cincinnati Plan. The GCP is updated every five years (updated in 2013 and again in 2018). In the latest version, Cincinnati established a citywide Zero Waste Goal by 2035.[29] The GCP is designed to set measurable targets and identify strategies and policies for the built environment, energy, food, natural systems, resilience, transportation, and waste to meet the city's climate goals. This section is focused on the GCP goals[30] for food and waste to align with the goals of Beyond 34.

Food

1. Ensure 100% of residents have convenient access to healthy, affordable foods.
2. Reduce food waste by 20% by 2025.
3. Triple average of urban food production.
4. Double the number of residents consuming local foods.

Waste

1. Goal of generating zero waste by 2035.
2. Decrease residential tonnage of waste transferred to landfills by 20%.
3. Increase participation in city curbside recycling programs by 5% for residential areas and by 20% for commercial areas.

One of Cincinnati's unique resources is CincyInsights, a website that shares neighborhood- and city-level data based on recycling participation as well as many other city metrics. In 2015, CincyInsights stated that the citywide recycling participation rate was 70%. Based on the maps provided by CincyInsights, a substantially higher portion of residents than commercial entities in Cincinnati participate in the recycling program. This information validates the GCP's goal to increase recycling in the commercial sector by a much larger percentage than in the residential sector.

In addition, CincyInsights had a partnership with Zerocycle,[31] a company that used its resident engagement platform. When a recycling cart is emptied by a recycling

[29] Zero Waste by 2035, page 238: https://www.cincinnati-oh.gov/oes/assets/File/2018%20Green%20Cincinnati%20Plan(1).pdf
[30] Green Cincinnati Program: https://www.cincinnati-oh.gov/oes/citywide-efforts/climate-protection-green-cincinnati-plan/
[31] Zerocycle boasts increased participation, tonnage in two trial cities: C. Boteler https://www.wastedive.com/news/zerocycle-increased-participation-tonnage-buffalo-cincinnati/520282/

collection truck, a radio frequency identification tag reader on the cart records the collection event by street address, enabling residents to visualize how their neighborhood is performing compared with other neighborhoods in the city. However, after the pilot phase, CincyInsights began a new contract with an unnamed vendor and is in the process of collecting recycling data from the new vendor.

The historical evolution of Cincinnati's efforts in recycling and diversion is summarized in Appendix A3.

2. Stakeholder Analysis

The stakeholder analysis is designed to examine the influential and impactful stakeholders in Cincinnati's waste and recycling system. The analysis also aims to establish how Beyond 34, in coordination with Cincinnati, can continue to engage with each stakeholder to accomplish beneficial objectives for all parties. This analysis identified many stakeholder facilities outside of Cincinnati that could provide further recycling and diversion opportunities.

2.1 Waste Value Chain Map

The waste value chain map in Figure 6 presented presents a general flow of the stakeholders and their roles in creating a circular waste cycle. Each of these stakeholder categories will play a significant role in Beyond 34's efforts.

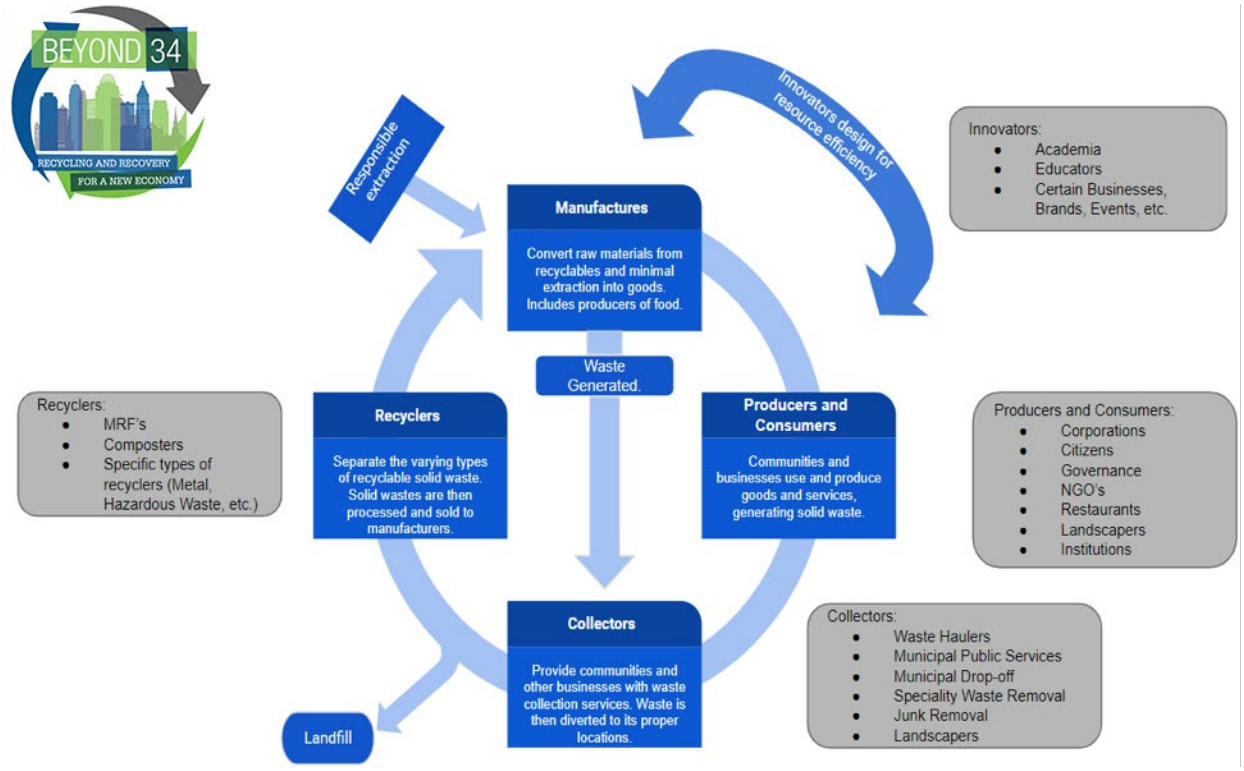


Figure 6: Waste Value Chain Map

2.2 Waste Value Chain Map Description

The stakeholder map shown in Figure 7 is derived from a stakeholder analysis performed on the 11 stakeholders shown in Table 6. The stakeholders were categorized based on their influence in Cincinnati versus how their stated interests align with Beyond 34 goals. “Influence” refers to the impact each of these stakeholders has on the goals of Beyond 34. It should be noted that, while stakeholders can have a negative influence on projects, the current stakeholder analysis shows the potential for this to be negligible in Cincinnati as all stakeholders analyzed are in favor of Beyond 34’s goals. The influence[32] of these stakeholders was measured across two main categories: stated support[33] and proximity to Cincinnati. Proximity to Cincinnati relates to the geographical region in which the stakeholder has influence. Similar organizations relating to an area larger than Cincinnati, as an example a county-level organization versus city-level was rated as less influential unless there is a direct governance structure as in the case of Hamilton County Recycling and Solid Waste District.

[32] “Influence” is used to also describe the stakeholder’s “power.”
[33] “Support” is used to describe funding potentials or outreach, such as stakeholder coordinatiors and policy makers.

Furthermore, “interest” refers to the stakeholders’ stated interest in the project and the likelihood of actually influencing the project. Proximity was once again a factor in these rankings. Specific points of interest were recycling, reuse, and zero waste.

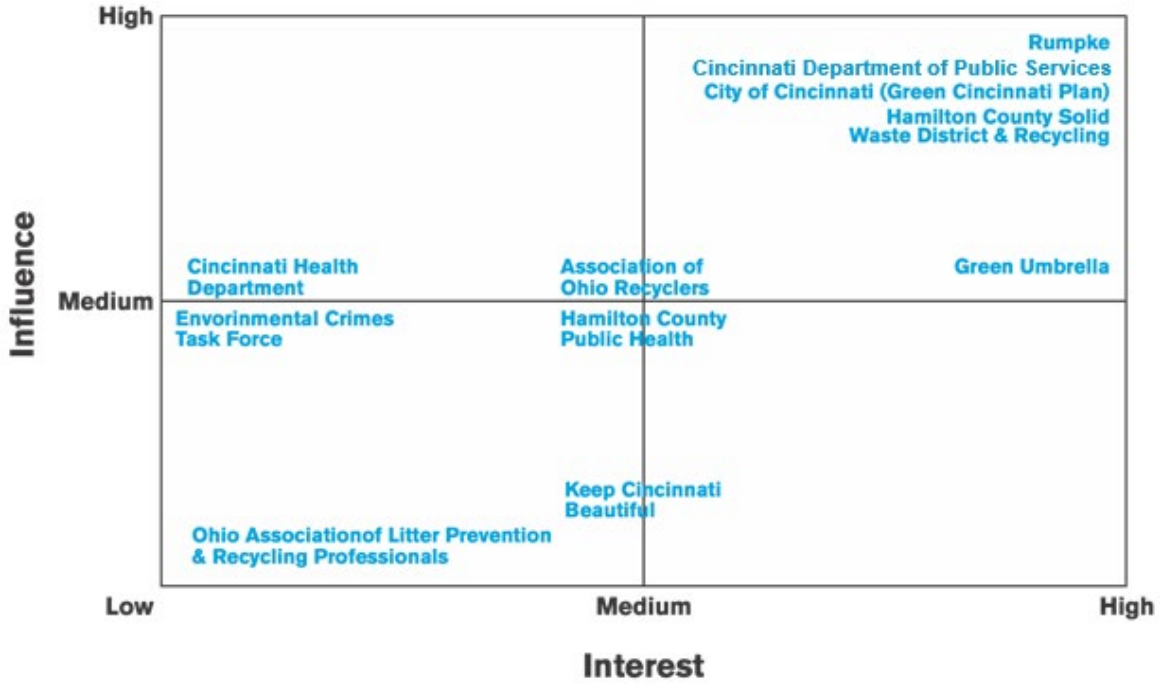


Figure 7: Stakeholder Map

Table 6 provides further analysis and a description of Cincinnati’s stakeholders.

Table 6: Stakeholder Analysis/Description

Stakeholder Name	Analysis/Description
Association of Ohio Recyclers	Composed of more than 50 businesses and organizations, responsible for implementing a plan that promotes waste reduction, reuse, and recycling **Influence: Medium** **Interest: Medium**
Cincinnati Department of Public Services	Contributes to the effective, efficient delivery of quality solid waste collection for Cincinnati Public Services **Influence: High** **Interest: High**
Cincinnati Health Department	Provides a cleaner and healthier city through recycling **Influence: Low** **Interest: Medium**
Environmental Crimes Task Force (and representatives)	Provides plausible solutions to reduce the amount of tires and hazardous waste that is dumped (Solutions may involve engaging the community in legal options.) **Influence: Low** **Interest: Medium**
Cincinnati Office of Environment and Sustainability	Created the Green Cincinnati plan with goals of reducing/zero waste and implementing new sustainable waste management solutions **Influence: High** **Interest: High**
Green Umbrella	Works with more than 200 entities in Cincinnati with the goal of coordinating recycling solutions in all sectors; also has interests in aligning with Beyond 34 for reducing food waste **Influence: Medium** **Interest: High**
Hamilton County Public Health	Promotes increased and proper disposal of waste, particularly special waste disposals (Household hazardous waste, infectious waste, pharmaceuticals, etc.) **Influence: Medium** **Interest: Medium**
Hamilton County Recycling and Solid Waste District	Provides the county in which Cincinnati resides with interest in and dedication to "ethical environmental leadership to equitably promote the public good through innovative and responsible strategies leading to the management of all waste as a resource that leads to a society that generates zero waste"[34] **Influence: High** **Interest: High**
Keep Cincinnati Beautiful	Provides education to Cincinnati on keeping the city green and beautiful and has collected over 60 tons of trash and tires in its first year of operation **Influence: Low** **Interest: Medium**
Ohio Association of Litter Prevention & Recycling Professionals	Interested in educating and creating relationships between its members and local solid waste districts and national organizations **Influence: Low** **Interest: Low**
Rumpke	Provides environmentally friendly waste/recycling options for Cincinnati **Influence: High** **Interest: High**

The five most influential stakeholders identified are the Cincinnati's Office of Environment and Sustainability, Hamilton County Solid Waste District and Recycling, Rumpke, Cincinnati Department of Public Services , and Green Umbrella.

The Cincinnati Office of Environment and Sustainability[35] (OES), which is responsible for building a sustainable, equitable, and resilient future for Cincinnati, designed the Green Cincinnati Plan. The GCP was created by a steering committee of 30 mayor-appointed representatives from government, corporate, academic, and nonprofit sectors. The GCP identifies eight major focus areas: built environment, education and outreach, energy, food, natural systems, resilience, transportation, and waste. For the purpose of this analysis, waste and food are the primary focus. However, many of the other six focus areas play a role in Cincinnati's solid waste management goals. The OES is considered the most influential stakeholder for achieving the goals of Beyond 34 for two reasons: because the GCP secured support from the mayor and council, and because the objectives of the GCP directly align with that of Beyond 34. Due to the nature of the OES and GCP, which involves nearly all elements and systems of the city, OES affects all roles discussed in the waste value chain map in Figure 6.

Rumpke[36] corporation provides recycling, collection, and landfill services to the residents and businesses of Cincinnati. Rumpke is the primary residential curbside recycling collector for Cincinnati and operates the main material recovery facility (MRF) and landfill in the Cincinnati Metropolitan Statistical Area. The MRF services more than 200,000 homes in the greater Cincinnati area and separates more than 100,000 tons of recyclables each year. The recyclable materials include paper, plastics, metals, and glass, all separated and sold to vendors who are primarily domestic. Rumpke also provides collection for large disposal projects and yard waste in some communities and currently accepts yard waste collected by Cincinnati into its composting facility. Rumpke is considered the second most important stakeholder because of its direct relationship with recycling and waste management in Cincinnati. Rumpke is also involved in many community education and recycling events within the city.

The Hamilton County Recycling and Solid Waste District (HCSW) establishes many of the protocols, policies, and objectives for waste management in the county. The organization's objectives are as follows:

[34] Hamilton County Solid Waste District: http://www.hamiltoncountyrecycles.org/
[35] Cincinnati Office of Environment and Sustainability: https://www.cincinnati-oh.gov/oes/
[36] Rumpke: https://www.rumpke.com/

> *[HCSW is] a County organization, established by State law, responsible for ensuring that the County achieves State-mandated goals for recycling and waste reduction. The District achieves these goals through the implementation of waste reduction programs targeted to residents, communities, businesses, and schools.*[37]

Hamilton County Recycling and Solid Waste District provides governance to the City of Cincinnati for its solid waste and recycling policies. The HCSW has a committee of nine members tasked with determining recycling policies for the county. HCSW is a highly valuable and important stakeholder for two main reasons. First, HCSW and Beyond 34 share a vision that increased recycling and diversion from the landfill can generate economic growth in Hamilton County while providing its citizens with a healthier community. Secondly, Hamilton County Recycling and Solid Waste District can share the Beyond 34 blueprint built for Cincinnati to help improve recycling and diversion in other cities and towns in the county once the project in Cincinnati is completed.

Cincinnati Department of Public Services[38] is in many ways similar to HCSW. However, Cincinnati Department of Public Services is responsible for the collection of solid waste, recycling, and yard waste. Cincinnati Department of Public Services is also responsible for governing which wastes are to be recycled and scheduling collection for all neighborhoods, as well as establishing and meeting waste and recycling goals for the city. As such, Cincinnati Department of Public Services is considered a vital stakeholder because of this governance role, its 2035 zero waste goal, and its ability to generate revenue and economic growth for the city.

Green Umbrella[39] is a nongovernmental organization (NGO) whose goal is to facilitate measurable sustainable improvements through collaborations with 200 nonprofits, businesses, educational institutions, and governmental entities. Green Umbrella operates around the Collective Impact Model, which is an idea that actors from a variety of sectors can coordinate together to make small changes that will have a very large impact when combined. Green Umbrella is a vital stakeholder to Beyond 34 because it is the backbone organization for a substantial number of organizations and smaller stakeholders within Cincinnati. Through collaboration with Green Umbrella, recycling solutions that require coordination between all sectors of Cincinnati become more feasible. Similarly, Green Umbrella has goals that align with Beyond 34.

[37] Hamilton County Recycling and Solid Waste District: http://www.hamiltoncountyrecycles.org/about_us
[38] Cincinnati Public Services: https://www.cincinnati-oh.gov/public-services/
[39] Green Umbrella: https://greenumbrella.org/

2.3 Other Facilities in Cincinnati

In addition to the stakeholders' institutions, programs, and facilities, other facilities in Cincinnati offer potential opportunities for the city to increase its diversion rate. Three of these facilities are listed in Table 7.

Table 7: Other Facilities—Cincinnati

Facilities	Location	Facility Type
Donco Recycling Solutions	Cincinnati, Ohio	Non-wood fiber recycler (carton recycler)
Hanna Paper Recycling	Cincinnati, Ohio	Paper recyclers
Hafner and Sons Inc.	Cincinnati, Ohio	Construction and demolition debris recycling

2.4 Facilities Near Cincinnati

Table 8 depicts an analysis of 14 recycling facilities and waste-to-resource processors within a 6.5-hour driving distance from Cincinnati. These companies are considered logistically viable due to their relatively close proximity to Cincinnati and could be potentially beneficial in meeting diversion goals through partnerships and/or contracts. A map of some of these facilities is provided in Appendix A4.

Table 8: Facilities—Outside of Cincinnati

Facilities	Location	Facility Type	Distance From Cincinnati (Miles)	Time From Cincinnati (Hours)
Renergy Inc.	Marengo, Ohio	Anaerobic digester (AD) stand-alone (SA)	139.0	2.17
Dovetail Energy	Fairborn, Ohio	AD SA	67.7	1.10
Haviland Energy	Haviland, Ohio	AD SA	162.0	2.67
Buckeye Biogas LLC	Independence, Ohio	AD SA	246.0	3.77
Energy Cooperative	Zanesville, Ohio	AD SA	161.0	2.52
Waste No Energy LLC	Monticello, Indiana	AD SA	200.0	3.27
Struthers Waste Water Treatment Plant	Struthers, Ohio	AD water resource recovery facilities (WRRFs)	284.0	4.43
Wooster Wastewater Treatment Plant	Wooster, Ohio	AD WRRF	202.0	3.13
West Lafayette WWRF	West Lafayette, Indiana	AD WRRF	181.0	2.90
Pratt Industries	Valparaiso, Indiana	Paper Recycler	265.0	4.12
Vadxx Energy	Cleveland, Ohio	Plastic to oil	249.0	3.82
Barnes Nursery	Huron, Ohio	Composting facility	223.0	2.82
Paygro	South Charleston, Ohio	Composting facility	80.4	1.37
Auriga Polymers Inc.	Spartanburg, SC	Plastic recyclers	423.0	6.58

Table 8 includes the following type of recyclers and waste-to-resource processors:

Anaerobic Digesters

Anaerobic digester (AD) is a facility where wastewater solids are digested in an anaerobic (no-oxygen) process. It is the natural process with which microorganisms break down organic materials. Methane, a renewable energy source, is produced throughout the anaerobic digestion process. Two types of AD technology include the following:

A. Stand-alone (SA) anaerobic digesters process one or more sources of feedstock for a tipping fee.[40] The primary feedstock for SA digesters is food waste. However, these can also process/co-digest other organic materials, such

[40] Types of anerobic digesters: Environmental Protection Agency https://www.epa.gov/anaerobic-digestion/types-anaerobic-digesters#StandAloneAD

as yard waste, manure, and wastewater solids. Some SA digesters are built to process industry-specific wastes. This is common in the food and beverage industry. These digesters are typically co-located at processing plants and are designed to process a certain kind of material. These units typically do not accept other feedstocks from offsite sources.

B. Water resource recovery facilities (WRRFs) are facilities that process wastewater into clean waste. While this clean water is typically not considered potable, it is used to support rivers, agriculture, and recreational uses.[41] The biosolids in the water can be processed in an anaerobic digester in liquid form, and the digestate and methane are also captured. As such, it is typical to use anaerobic digesters attached to WRRFs. Another important note is that the potential for energy creation from wastewater treatment is up to five times greater than the energy required to process the water.[42]

Further analysis of AD potential will be completed within the Opportunity Analysis and Economic Impact Assessment.

Paper Recyclers

Paper recyclers convert waste paper into new paper products. Recycling paper has several important benefits besides saving trees and forests. Recycled paper is less energy and water-intensive than paper made from wood pulp. Paper products in landfills can break down over time and produce methane in the process.

Plastic Recyclers

Plastic recyclers recover scrap or waste plastic and reprocess the material into useful products. Plastic recyclers sort the plastics based on the type of plastic, such as PET or HDPE. Once sorted, the plastics are typically shredded and cleaned. Once clean, the plastics are melted into small balls called “nurdles,” and in this state, they are ready to be used in the construction of new plastic objects.[43]

Composting Facility

A composting facility is a structure or device that uses controlled aerobic decomposition to transform organic waste material into a biologically stable product that can be used

[41] Water resource recovery facilities: Renewable Water Resources https://rewaonline.org/about/our-facilities/water-resource-recovery-facilities/
[42] Getting the waste out of wastewater: R. Smith and D. Barnes https://www.ysi.com/ysi-blog/water-blogged-blog/2017/09/wastewater-or-water-resource-recovery-getting-the-waste-out-of-wastewater
[43] How does recycling plastic work: T. Johnson https://www.thoughtco.com/recycling-plastics-820356

as a soil amendment. Compost can be produced from many raw organic materials, such as leaves, manures, food scraps, wet/soiled papers, and certified compostable products.

Plastic-to-Oil Facility

These facilities use an advanced thermal process called “pyrolysis” on plastic waste that is turned into naphthalene (to produce plastic resin) or diesel as a fuel.

3. Economic Considerations

The current costs and benefits within the waste and recycling streams are assessed in the section below While the China Ban has impacted recycling efforts across the United States in general, Rumpke and Cincinnati have been less impacted.

3.1 Effects of China’s “National Sword” Policy

Until 2017, many countries, including the United States, sent their waste recyclable materials to China because their contamination standard was low and their pricing was very competitive. In July 2017, China banned the import of foreign garbage in an effort to halt a deluge of soiled and contaminated materials that was overwhelming Chinese processing facilities.

In January 2018, China enacted the “National Sword” policy, banning the import of most plastics and other materials. The enactment of this policy left U.S. municipalities and recycling processors scrambling to find new markets. Communities from Douglas County, Oregon, to Hancock, Maine, have curtailed collections or halted their recycling programs entirely. Some places like Philadelphia are now burning the bulk of their recyclables at an incineration facility, which raises concerns about air pollution.

Since the majority of Rumpke’s buyers for recyclable materials are located within the U.S., Rumpke remains relatively unaffected by China’s ban, and Cincinnati’s solid waste facilities have not experienced detrimental economic setbacks. However, this may change in the coming years as these contracts come up for renewal.

3.2 Revenues and Fees

The average tipping fee in Ohio is roughly $44.50 per ton of waste to a landfill.[44] The Midwest, in general, has some of the lowest tipping fees in the nation. When creating the GCP, the authors recognized the challenge that low tipping fees create for the

[44]Flourish: https://public.flourish.studio/visualisation/86521/

financial viability of composting or anaerobic digestion facilities or other technologies. Additionally, the availability of feedstock creates concern for investors regarding a return on investment for any waste diversion technologies looking to locate to the area.

When conducting the Beyond 34 analysis of Cincinnati, Portland was used as a benchmark. For comparison, the current tipping fee in Portland is $97.45 per ton, plus a $10.00 transaction fee for a total fee of $107.45, making recycling facilities in Portland financially viable. Consequently, Portland reported a 54% diversion rate in 2017 and diverted a total of 403,000 tons of recycling and 151,100 tons of yard waste. Further analysis of the factors that affect the financial viability of diversion programs will be conducted in the Economic Impact Assessment and Opportunity Analysis.

In early August 2019, Rumpke received approval from the Ohio Environmental Protection Agency for a 240-acre landfill expansion. This project would increase Rumpke's sanitary landfill from 597 to 939 acres through a vertical and lateral expansion and will increase the capacity of the landfill from 20 to 25 years. Prior to the expansion approval, the landfill had less than four years of capacity left. Rumpke anticipated a 20% hike in service cost unless it received the expansion approval. Further analysis will be conducted in the Economic Impact Assessment and Opportunity Analysis.

4. Summary of Findings

Cincinnati proved the best fit for the next Beyond 34 city based on 36 criteria, which ranged from zero waste goals to recycling participation rates and waste hauling. The current diversion rates of the five most populated cities in Hamilton County show that Cincinnati is ranked first. Furthermore, of the five most populated counties in Ohio, Hamilton County is ranked second in recycling rates for residential and commercial as well as third for industrial. These rankings establish that Cincinnati and its surrounding areas have made significant efforts to prioritize recycling. In combination with these efforts, the 2018 Green Cincinnati Plan proposes 10 recommendations that can aid in achieving the GCP's goal of citywide Zero Waste by 2035. Additionally, Rumpke, a primary waste collector and operator of the only MRF in Cincinnati, and partner to the city is uniquely situated in the current recycling environment because many buyers of its recycled material are located regionally and domestically, allowing the company to mitigate some of the harmful effects of the China Ban and continue business as usual.

When examining the waste categorization for Cincinnati, there are high capture rates for materials such as plastic, although there is also notable room for improvement in high-impact areas such as paper and compostable waste. Cincinnati began tracking city-

wide diversion rates in 2007 and calculated a 10% diversion rate. Through the additions of infrastructure, policies, and programs, the 2018 diversion rate rose to 22.25%. This level of diversion over the years has been achieved through collaboration with many stakeholders within Cincinnati. These stakeholders include government offices and departments within Hamilton County and Cincinnati and recyclers and NGOs that provide coordination or services.

While the purpose of this Current State Assessment is not to develop scenarios or recommendations, an initial introduction to some future possibilities is relevant.

To establish a basis for circular systems in Cincinnati, several different factors, such as urban farming initiatives, waste collection, yard waste, and infrastructure, were evaluated to demonstrate their interconnectivity. Independently, some of these factors could be counterproductive to other goals highlighted in the GCP. However, when analyzed holistically, there is a greater net benefit than could be achieved otherwise. In this section, ideas for potential coordination with Cincinnati, policies, and other notable recycling efforts are discussed.

4.1 Green Cincinnati Plan: Coordination Within Cincinnati

Many interrelated plans and recommendations occur within each of the GCP key focus areas. As the goals for food and waste begin implementation, several opportunities and considerations have been identified that could occur between these key focus areas, helping to create a more circular system based on the GCP's waste goals. Additionally, further opportunities likely will arise within each key focus area.

4.1.1 Possible Increase in Food Waste Resulting From GCP-Driven Tripling Urban Food Production Acreage

One of the GCP's food system goals is a plan to triple the acreage of urban food production. Cincinnati can accomplish this through mechanisms such as creating policies to encourage urban agriculture, improving support and distribution for local food system entrepreneurs, and increasing land used for local food production. While the tripling of acreage for urban food production will create a net benefit for Cincinnati, it is also foreseeable that there might be a greater volume of food waste, which could negatively impact the city's diversion goals, if not properly managed. A coordinated approach would have the following potential benefits:

- A greater volume of food waste could serve as feedstock for an anaerobic digester, helping improve the financial viability of investments.

- If a greater percentage of the food waste is diverted to an anaerobic digester, this will increase overall diversion rates.

4.1.2 Possible Increase in Yard Waste Resulting From GCP-Driven Tree Canopy Increase

One goal within the GCP states a minimum of 30% canopy cover for all residential neighborhoods in Cincinnati. While it is unclear exactly how much total tree canopy cover will be created, of the roughly 50 neighborhoods accounted for, six are below 20% canopy cover and nine are below the desired 30% canopy cover. A coordinated approach would have the following potential outcomes:

- The extent of coordinated management could positively or negatively impact Cincinnati's diversion goals.
- Increased yard waste further supports a city-owned compost facility owned by the City Parks Department, which could provide the department itself as well as urban farmers with compost.

4.2 Recycling Opportunities

In conducting the Current State Assessment, additional opportunities were identified with regard to recycling and diversion in Cincinnati.

A hypothetical scenario has been evaluated with the purpose of establishing how quickly potential infrastructure and policy changes can lead to substantial increases in diversion rates. If Cincinnati can recycle or divert 50% of the recyclable paper and compostable waste from the current waste stream, the city's diversion rate would increase 23% from the current 24.58% to 47.58%. Some early success could be achieved through a cardboard ban. Assuming all cardboard that is currently in the waste stream is diverted from the landfill, the cardboard ban would increase diversion roughly 7%. Similarly, providing additional infrastructure, such as a city composting facility or anaerobic digester, could provide an opportunity to divert compostable material while also providing an economic benefit to the city.

In addition, a small adjustment could be made to Cincinnati's current recycling system. At this time, residents must request a recycling cart in order to take part in recycling. Potential benefits to diversion could occur if Cincinnati initially enrolls all residents while offering an opt-out program if necessary. This opportunity would likely increase operational costs.

4.3 Beyond 34 Goals and Future Analyses in Support of Long-Term Sustainable Diversion

The four main goals of Beyond 34 are the following:

1. Demonstrate scalable processes for improving recycling, recovery, and reuse rates in a selected U.S. region.
2. Provide a blueprint demonstrating how companies and communities can successfully recover materials to keep them flowing in continuous, profitable, and sustainable loops that can be replicated in other communities.
3. Develop strategic partnerships across the value chain that help shift the U.S. toward a more circular economy.
4. Raise awareness of the barriers and opportunities for transition to the circular economy in the U.S. and share learnings from Beyond 34 efforts so others can better address challenges for materials recovery.

The various components of the Current State Assessment provide the foundation not only for the in-depth and complete analysis of Cincinnati's opportunities for increasing diversion and achieving its zero waste goals but also for strong support in achieving Beyond 34's broad goals. The findings presented herein will require more in-depth research and further analysis, which is occurring in the following Beyond 34 work products:

1. The *Economic Impact Assessment* will identify and quantify the economic impact of waste diversion options for the currently recycled and additionally recoverable tons of plastic, glass, metals, and paper in the City of Cincinnati's municipal waste stream.
2. The *Opportunity Analysis* will be completed with the objective of providing diversion improvement scenarios segmented by the highest diversion potential and estimated costs that include a predicted ROI for stakeholders.
3. The *Institutional Analysis* will incorporate personal communication with key local stakeholders to best understand the formal and informal "rules of play" within stakeholder groups, and will provide greater insights to opportunities and challenges that are embedded in the larger waste and recycling system.
4. The *Roadmap and Implementation Plan* is the final deliverable and will be developed using the input and information gathered from local stakeholders. An initial draft will detail prioritized projects, costs, ROI, and identified partners. This roadmap will provide stakeholders and funders with the ability to see the larger zero waste vision of the region. It will clearly state what data are used to measure progress, the diversion impacts by project, and how the region will continue

working collaboratively on increasing recycling in the short and long terms after the Beyond 34 efforts are completed.

When all these additional analyses are completed and viewed holistically with this Current State Assessment, the findings presented in this report will eventually tie directly to Beyond 34's goals. At the project's completion, Cincinnati will be able to better understand and develop scalable processes for their waste diversion programs, provide blueprints for material recovery, identify impactful partnerships, and broadly raise awareness for the potential for a circular economy.

5. Appendix

A1: Counties in Ohio (Population vs. Recycling Rate)

Scale			
County	**Population**	**Recycling Rates (Residential/Commercial)**	**Recycling Rates (Industrial)**
Adam-Clermont	230,092	39.30%	81.10%
ACHMSU[45]	322,060	26.30%	76.30%
Ashland	53,299	21.00%	76.50%
Ashtabula	98.622	17.30%	8.90%
Athens-Hocking	94,110	24.70%	41.30%
Augaize	45,778	42.40%	88.80%
Belmont-Jefferson	136,238	3.20%	1.30%
Brown	43,799	26.20%	97.60%
Butler	375,702	17.60%	49.90%
CCH[46]	147,806	9.90%	35.20%
CFLP[47]	3944,789	26.00%	89.10%
Clark	135,520	41.40%	92.70%
Clinton	41,869	31.70%	95.40%
Crawford	42,231	33.30%	95.80%
Cuyahoga	1,257,401	29.00%	75.20%
Darke	51,919	22.80%	88.00%
DFPW[48]	136,619	33.30%	63.00%
DKMM[49]	354,387	21.90%	87.50%
Erie	75,369	27.10%	78.10%
FHPR[50]	177,106	25.20%	87.50%
Franklin	1,253,507	46.20%	75.10%
Geauga-Trumbu	297,236	28.00%	55.20%
GJMV[51]	99,203	12.00%	1.00%
GMMMNW[52]	214,955	9.90%	6.50%
Greene	164,825	35.00%	89.90%
Hamilton	882,149	33.10%	73.10%
Hancock	75,508	24.90%	61.20%

[45] ACHMSU: Allen-Champaign-Hardin-Madison-Shelby-Union
[46] CCH: Carroll-Columbiana-Harrison
[47] CFLP:Coshocton-Fairfield-Licking-Perry
[48] DFPW: Defiance-Fulton-Paulding-Williams
[49] DKMM: Delaware-Knox-Marion-Morrow
[50] FHPR: Fayette-Highland-Pickaway-Ross
[51] GJMV: Gallia-Jackson-Meigs-Vinton
[52] GMMMNW: Guernsey-Monroe-Morgan-Muskingum-Noble-Washington

Henry	27,463	43.30%	79.90%
Holmes	43,808	5.30%	89.90%
Huron	58,497	22.00%	92.20%
Lake	229,701	17.30%	84.00%
Lawrence-Scioto	229,701	16.80%	73.20%
Logan	45,323	51.40%	93.60%
Lorain	305,405	26.20%	64.90%
Lucas	433,404	52.80%	92.10%
Mahoning	231,857	29.60%	58.40%
Medina	176,362	22.20%	64.20%
Mercer	40,723	22.60%	96.40%
Miami	104,081	32.50%	84.10%
Montgomery	531,987	21.90%	85.10%
OSS[53]	155,877	24.30%	81.50%
Pike	28,291	5.30%	42.60%
Portage	162,080	27.80%	7.70%
Preble	41,328	13.60%	85.80%
Putnam	34,037	48.70%	99.00%
Richland	121,533	25.10%	64.90%
STW[54]	582,719	23.40%	67.50%
Summit	541,318	27.80%	47.70%
Van Wert	28,262	23.80%	76.30%
Warren	223,868	21.60%	75.10%
Wood	129,504	23.30%	95.70%
Wyandot	22,190	42.00%	70.40%

[53] OSS: Ottawa-Sandusky-Sences
[54] STW: Stark-Tuscarawas-Wayne

A2: Hamilton County Recycling Rates vs. Population

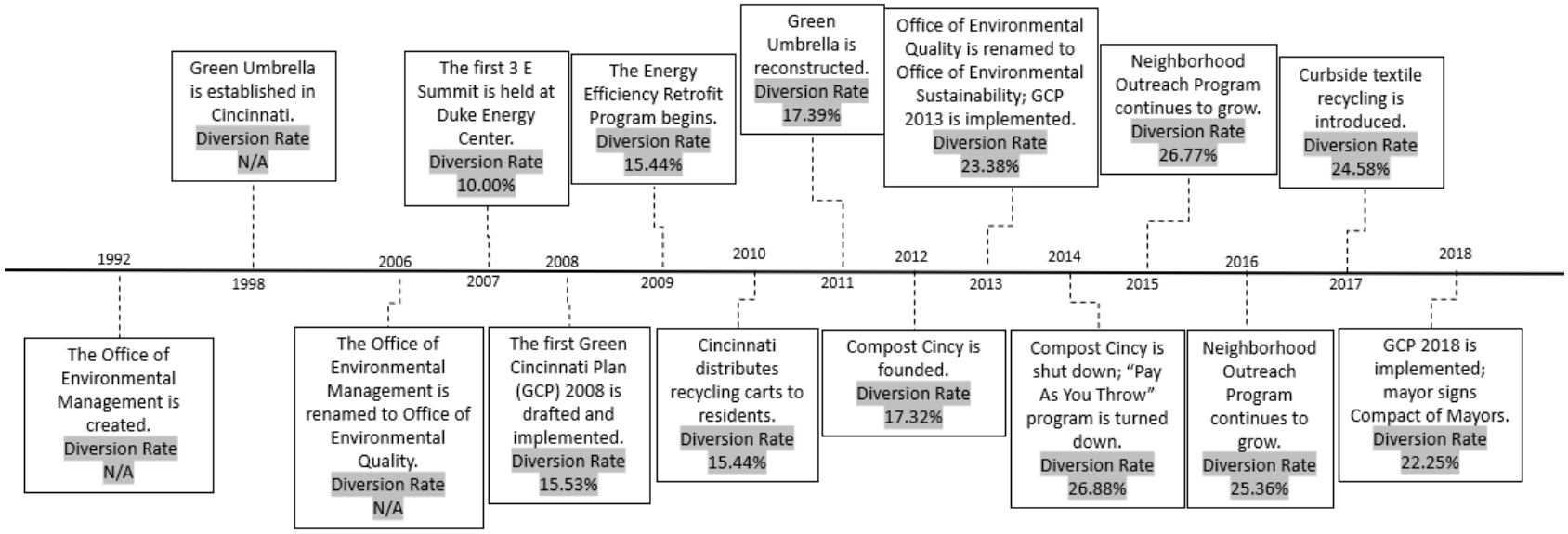
Scale	First	Second	Third
Cities	**Population**	**Recycling Rates**	
Addyston	938	2.38%	
Amberley Village	3,778	53.09%	
Anderson	43,969	16.47%	
Arlington Heights	740	0.00%	
Blue Ash	12,199	28.29%	
Cheviot	8,292	1.88%	
Cincinnati	301,301	22.25%	
Cleves	3,422	2.84%	
Colerain	59,217	13.62%	
Columbia	6,241	18.85%	
Crosby	2,808	4.95%	
Deer Park	5,679	24.74%	
Delhi Township	29,686	7.31%	
Elmwood Place	2,194	0.45%	
Evendale	2,864	30.45%	
Fairfax	1,707	13.38%	
Forest Park	18,690	14.39%	
Glendale	2,180	31.75%	
Golf Manor	3,532	7.18%	
Green Township	59,042	10.52%	
Greenhills	3,597	17.26%	
Harrison City	11,300	7.71%	
Harrison Township	22,346	14.79%	
Indian Hill	5,874	33.53%	
Lincoln Heights	3,286	6.92%	
Lockland	3,462	2.48%	
Loveland	12,770	17.42%	
Maderia	9,149	27.89%	
Mariemont	3,433	58.03%	
Miami Township	50,572	8.85%	
Montgomery	10,746	40.13%	
Mount Healthy	6,063	7.57%	
Newton	4,547	12.18%	
North Bend	867	10.17%	
North College Hill	9,309	7.17%	
Norwood	19,870	8.49%	
Reading	10,260	7.59%	
Sharonville	11,376	15.86%	

Silverton	4,753	8.98%
Springdale	11,213	16.20%
Springfield	59,208	15.94%
St. Bernard	4,363	15.95%
Sycamore	830	24.87%
Symmes	14,876	14.19%
Terrace Park	2,289	47.07%
Whitewater	5,477	2.39%
Woodlawn	3,298	10.36%
Wyoming	8,536	40.22%

A3: Historical Recycling Efforts

Based on information available, the historical analysis discussed herein goes back to 1992, with a more in-depth analysis of historical efforts that occurred in the past decade.

The Cincinnati Recycling Program Timeline, shown below, visually presents the steps Cincinnati has taken toward improving waste recycling programs and increasing its diversion rate.[55]



[55] A Cincinnati Farming and Food History: A. Wight and J. Metz https://greenumbrella.org/page-1075475

In 1992, Cincinnati created the Office of Environmental Management, directed by Bonnie Phillips.

In 1998, Green Umbrella was established to focus on the conservation of green space for social, economic, and environmental vitality within the region of Ohio, Indiana, and Kentucky. Green Umbrella has since become known as a regional sustainability alliance in the Ohio-Kentucky-Indiana area that focuses on healthy food policies, local food promotion, and green space conservation.

In 2006, the Office of Environmental Management was renamed the Office of Environmental Quality, directed by Larry Falkin. In 2007, Larry Falkin, Bonnie Phillips, and Ginnell Schiller hosted the first-ever 3 E Summit.[56] In addition, the city had started tracking the citywide diversion rates during this year, and the diversion rate for 2007 was 10.00%.

In 2008, this team established the first Green Cincinnati Plan (GCP), focusing on reducing greenhouse gas emissions to improve public health, reduce the city's contributions to global warming, strengthen the local economy, and improve air and water quality.[57] By 2008, the citywide diversion rate increased to 15.53%.

In 2009, the Energy Efficiency Retrofit Program began. This program focused on engaging residents on energy conservation to reduce Cincinnati's energy consumption. The citywide diversion rate was reduced to 15.44%.

In 2010, Cincinnati distributed recycling carts to residents to promote recycling, and the citywide diversion rate increased to 15.44%.

In 2011, Green Umbrella restructured and partnered with Agenda 360 and Vision 2015 (now Skyward). Agenda 360 and Vision 2015 were then the leading regional planning initiatives. The new Green Umbrella worked to improve Cincinnati residents' quality of life and economic vitality by targeting and supporting citizens and organizations that were focused on environmental sustainability. The citywide diversion rate decreased to 17.39%.

[56] The 3 E Summit was an event that targeted city employees to help learn about Environment, Energy, and Economy (3 E) initiatives related to sustainability.
[57] GCP 2008: https://www.cincinnati-oh.gov/oes/citywide-efforts/climate-protection-green-cincinnati-plan/climate-protection-action-plan/

In 2012, the first commercial composting facility in Cincinnati, Compost Cincy, was founded by Grant Gibson. This program was established to coordinate with local restaurants and grocers to divert waste to the Compost Cincy facility. The citywide diversion rate decreased to 17.32%.

In 2013, the Office of Environmental Quality was renamed the Office of Environment and Sustainability. The Cincinnati Department of Public Services department distributed trash carts to all residential customers, though business structures were no longer eligible for city trash services. The citywide diversion rate increased to 23.38%. A large portion of this increase was due to Compost Cincy and the city's change in calculating diversion rates versus recycling rates.

In 2014, Compost Cincy was shut down due to odor complaints. The odor problem could be tied to the facility's insufficient capacity and to the community's high participation. The program was originally designed to handle only 20,000 tons of organic material per year, but at its peak, the facility accumulated 80,000 tons of organic material. Also, the "Pay As You Throw" program, recommended by the GCP 2013, was not passed by the city council.[58] Despite these impacts, the citywide diversion rate increased to 26.88%.

In 2015 and 2016, Cincinnati's Neighborhood Outreach Program continued to grow, but no new environment and sustainability policies or programs were developed. In 2015, the citywide diversion rate decreased to 26.77%. In 2016, the citywide diversion rate further decreased to 25.36%.

In 2017, Cincinnati introduced curbside textile recycling, allowing residents to recycle clothing, textiles, fabrics, and houseware (collected and processed by Simply Recycling for no cost). The citywide diversion rate decreased to 24.58%.

In 2018, Mayor John Cranley signed the Compact of Mayors, a global agreement of 648 cities to measure emissions and climate risk and publicly report findings. Cincinnati drafted and implemented a new GCP 2018. The GCP 2018 "*presents a comprehensive set of recommendations to advance the sustainability, equity, and resilience*" of Cincinnati.[59] This includes focused recommendations and opportunities that the city could take in order to move toward its goal of Zero Waste by 2035.[59] The citywide diversion rate decreased to 22.25%.

[58] Charter Amendment: https://www.sos.state.oh.us/globalassets/elections/2009/gen/misc.pdf
[59] GCP 2018: https://www.cincinnati-oh.gov/oes/assets/File/2018%20Draft%20Green%20Cincinnati%20Plan%20180511.pdf

A4: Other Facilities Map