Delaware County's Path Toward Zero Waste

NPS/Michael Cuff

Delaware County, Pennsylvania
Municipal Waste Management Plan 2023-2033

Office of Sustainability
Pre-Circulation Draft June 2023

DELCO SUSTAINABILITY

Zero Waste

Table of Contents

Introduction

Delaware County embarked on a planning process to update its Municipal Waste Management Plan in 2021 to coincide with the development of the Sustainability and Climate Action Plan and to comply with Pennsylvania's Municipal Waste Planning, Recycling and Waste Reduction Act (Act 101 of 1988).

The primary goals of the planning process were to:

1. Ensure that the County has sufficient processing and disposal capacity for its municipal waste for the next 10 years.
2. Guide the County's transition to Zero Waste practices by following the Zero Waste Hierarchy.
3. Ensure maximum feasible waste reduction of municipal waste.
4. Assure the effectiveness of the County's recycling programs, including market development, and investigate the feasibility of organics collection and composting methods for inclusion in the plan.
5. Conserve resources and protect the public health, safety, and welfare from the short- and long- term dangers of transportation, processing, treatment, storage, and disposal of municipal waste.
6. Evaluate the plan to see how Zero Waste solutions can help meet other County goals and result in cost-savings and efficiencies across programs.
7. Engage with stakeholders in the county throughout the development of the plan, and provide extensive outreach to obtain feedback from all communities, including consultation with the County's Sustainability Commission to take into consideration County sustainability goals.

Zero Waste is an aspirational goal, like zero accidents on the job site and zero defects in manufacturing. Recognizing that there will continue to be some "legacy materials" that must continue to be landfilled at the end of their useful life (such as treated wood and asbestos), the County's performance measure for Zero Waste is to eliminate incineration and achieve at least 90 percent diversion from landfills. The priority is to focus on strategies that reduce consumption (address waste at the source) while maximizing opportunities for recycling and composting. The ultimate measure of success is in lowering the per capita volume of waste disposal.

Zero Waste

The internationally peer-reviewed definition has been curated by the Zero Waste International Alliance:

> Zero Waste is the conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health.[1]

The Zero Waste hierarchy describes a progression of policies, programs and infrastructure to support the development of a Zero Waste system, from highest and best to lowest use of materials.

The components of the hierarchy are:

- Rethink/Redesign – Design and purchase products/materials from reused, recycled or sustainably-harvested renewable, non-toxic materials to be durable, repairable, reusable, fully recyclable or compostable, and easily disassembled.
- Reduce – Minimize quantity and toxicity of materials used.
- Reuse – Maximize reuse of materials and products.
- Recycle/Compost – Support and expand systems to keep materials in their original production loop and to protect the full usefulness of the materials.
- Materials Recovery – Maximize materials recovery from mixed discards and research purposes after extensive source separation.
- Residuals Management – Examine materials that remain and use this information to refine the systems to rethink, reduce, reuse, and recycle in order to prevent further discards. Biologically stabilize materials prior to landfilling.
- Unacceptable – Incineration and other "waste-to-energy" or "waste-to-fuels" schemes.

[1]Zero Waste International Alliance: https://zwia.org/zero-waste-definition/

Stakeholder Engagement

A key difference between a traditional solid waste management plan and a Zero Waste planning process, is the focus on stakeholder outreach.

Zero Waste requires a change in behavior. Changing behavior requires understanding the barriers and benefits of the proposed actions (reducing waste, recycling and composting more) and developing new or expanded policies and programs to overcome the perceived barriers to take advantage of the potential benefits.

Understanding requires engagement. To ensure that all stakeholders could meaningfully participate in the development of this plan, the County conducted an extensive outreach process led by the Solid Waste Advisory Committee and the members of the Delaware County Sustainability Commission Zero Waste Committee. A list of members is included in Appendix A.

Listening Sessions

20 listening sessions with service providers, municipalities, environmental justice organizations, faith-based groups, schools and universities

Over 140 participants

In-Person Workshops

Three workshops held at the Upper Darby and Norwood Public Libraries and at Chester City Hall

Addressing:

- Guiding Principles
- Zero Waste Initiatives
- Implementation

Online Workshops

Presented online via Zoom and designed to coincide with the in-person meetings and covering the same topics

Nearly 200 stakeholders participated in either the online or in-person meetings

Advisory Committee

Five meetings of the Solid Waste Advisory Committee (with representatives from municipalities, community organizations, and service providers) and the Sustainability Commission's Zero Waste Committee

Guiding Principles

The focus of the first workshop series was to develop the Guiding Principles of the plan - the guidelines that help decision-making that reflect the values of the community. The Guiding Principles were drafted by the Advisory Committee and refined and updated through the public workshops. These Guiding Principles reflect the values that informed the development of the plan and will guide the implementation of Zero Waste policies, programs and infrastructure in Delaware County.

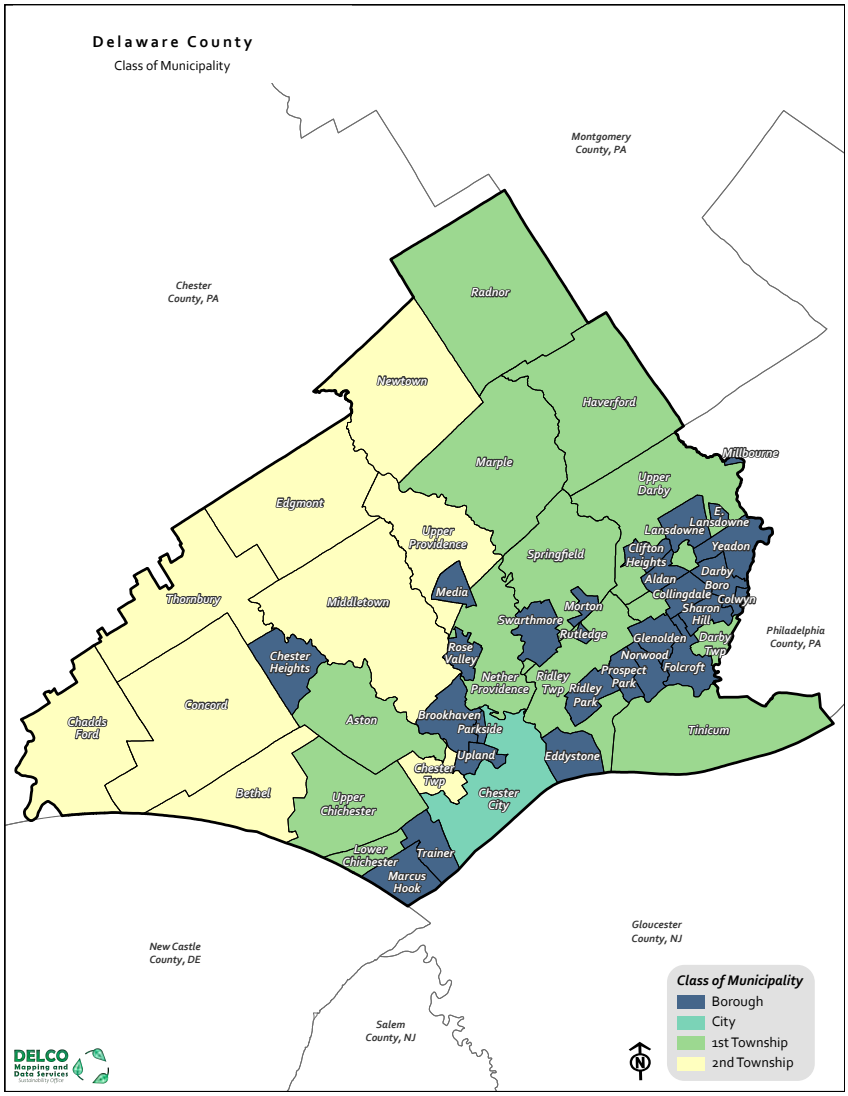
1. **Center environmental justice**
   by keeping pollution out of Environmental Justice communities
2. **Protect public health and the environment**
   by reducing discharges to air, water, and land
3. **Reduce waste**
   by enacting policies, providing technical assistance and education, and developing partnerships with County municipalities, businesses, residents, and institutions
4. **Foster a Zero Waste culture**
   through education and programs that reinforce the concept of Zero Waste and make it easier to take actions that follow the Zero Waste Hierarchy
5. **Strengthen Zero Waste jobs in the local economy**
   by supporting existing local and regional Zero Waste businesses and attracting new ones, and spurring innovation
6. **Improve transparency, communication, and accountability between all parties** - *as it relates to actions, roles, impacts, and costs*
7. **Support municipalities**
   by providing Zero Waste resources and services
8. **Hold producers of waste responsible**
   by identifying problem products and materials and supporting policies to address them
9. **Use science and data**
   to guide decisions
10. **Equitably fund programs and infrastructure**
    by identifying appropriate revenue sources

1. Description of the Waste

Overview of Current Municipal Solid Waste System

There are 49 municipalities in Delaware County that are classified based on population and governance structure:

- 27 Boroughs
- 12 First Class Townships
- 9 Second Class Townships
- 1 Third Class City



The municipal systems summary is included in Appendix B.

Trash

Destination: Municipalities in Delaware County have adopted ordinances that commit all municipal solid waste to be delivered to facilities owned and operated by the Delaware County Solid Waste Authority (Authority). The ordinances were renewed in January of 2017 with a 25-year commitment.

The Authority is an independent government agency formed to accept and handle approximately 400-500,000 tons of residential and commercial trash annually generated in the county. The board of directors of the Authority is appointed by the County Council.

Approximately, two-thirds of the trash generated in the county is delivered to one of two transfer stations owned by the Authority and operated by Waste Management – Transfer Station #1 in Chester Township and Transfer Station #3 in Marple Township.

Trash from the transfer stations is delivered to the Delaware Valley Resource Recovery Facility, a municipal waste incinerator in the City of Chester. The Delaware Valley Resource Recovery Facility is owned and operated by Covanta, a company that was acquired by EQT Infrastructure V fund, a private Swedish investment firm. About one-third of the trash is delivered directly to Covanta, bypassing the transfer stations. Ash from Covanta is disposed of at the Authority-owned Rolling Hills Landfill in Earl Township, Berks County.

Cost: As of January, 2023, the fee charged by the Authority to municipalities is $83 per ton at the transfer stations or $78 per ton if brought directly to Covanta.

Residential Collection System: In addition to the tip fees paid to the Authority, each municipality (or resident in the case of subscription service) is responsible for coordinating and paying for the collection of waste and its delivery to the transfer stations or directly to Covanta. That cost is determined by the method of collection the municipality uses.

There are several methods a municipality can use to collect trash and recycling from customers.

Municipal collection - Operated with municipal staff and equipment owned by the municipality.

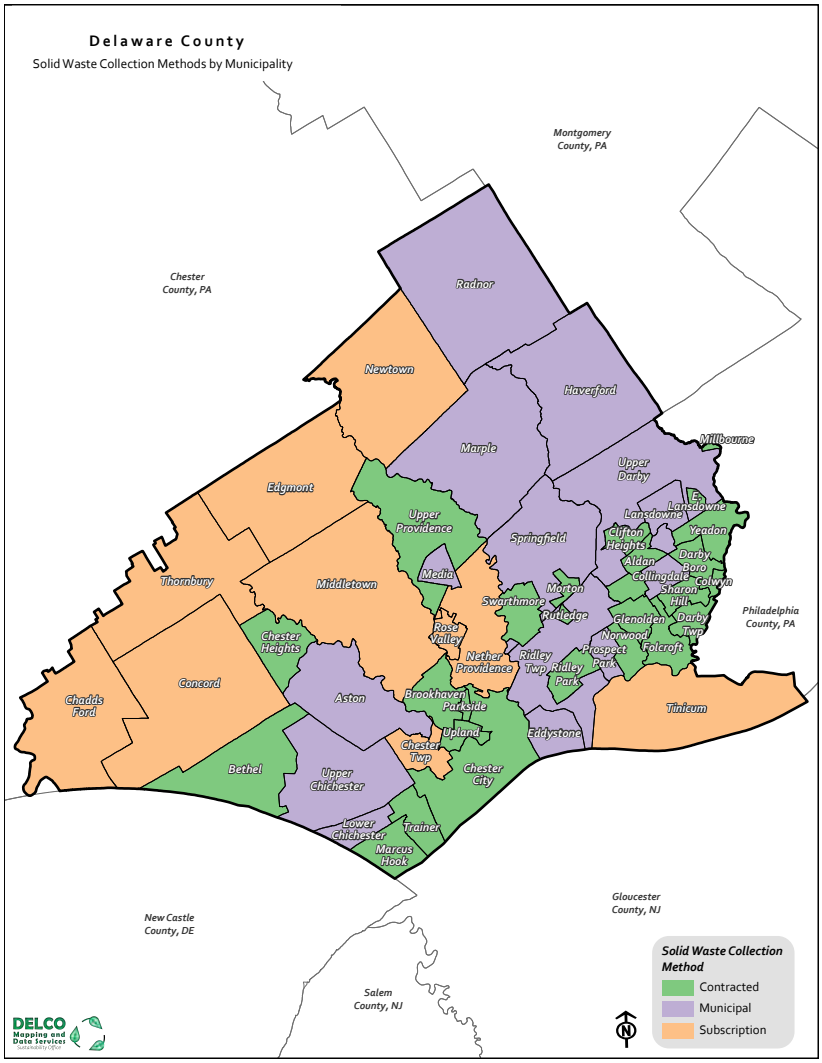
Contracted collection - The municipality contracts with a hauler that provides service to the resident.

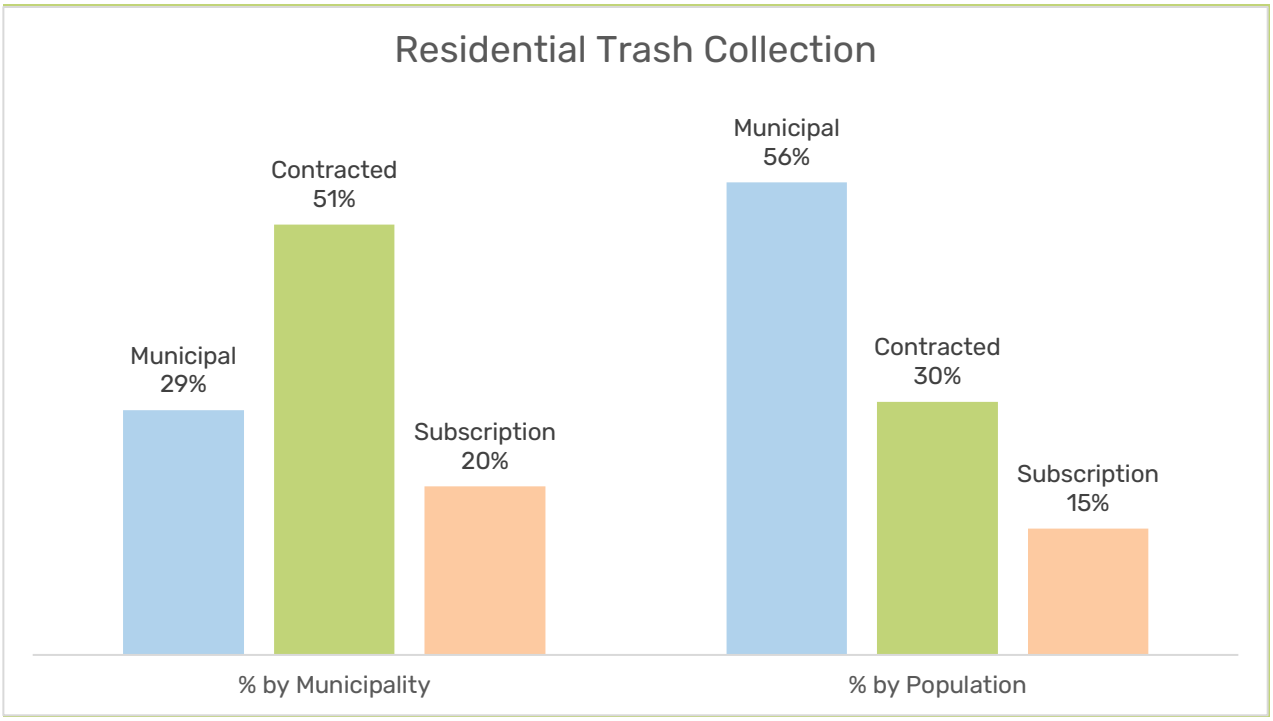
Subscription collection - The resident chooses from a list of licensed haulers to contract with directly.

Thirty-nine out of the 49 municipalities representing 85% of the population of Delaware County have municipality-provided trash collection, either from municipal owned and operated trucks, or through contracted services with a private hauling company that services every household. The remainder of residents contract directly with a private hauler themselves, as required under municipal ordinance. The Authority does not accept municipal waste "self-hauled" by residents. Even though the majority of

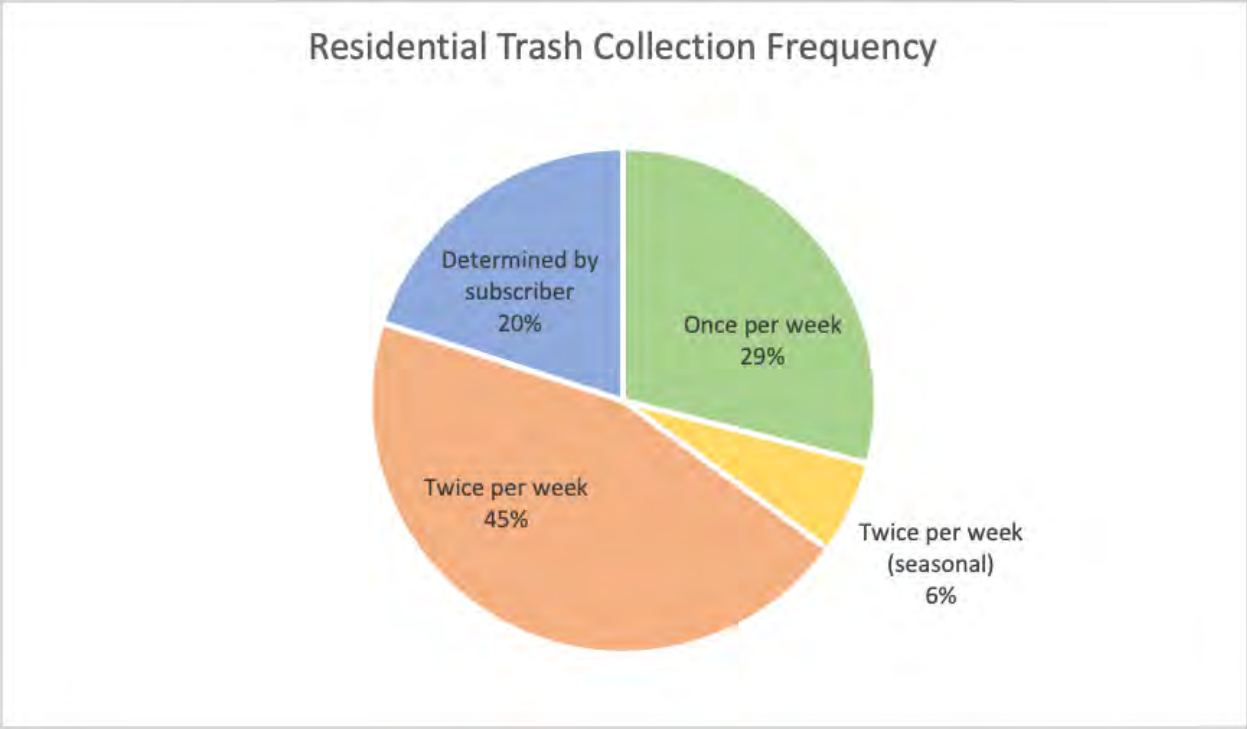
municipalities utilize contract services for trash collection, the majority of residents in Delaware County are serviced through municipal collections.

Eight out of the 12 First Class Townships have municipal collection, while only six out of the 28 Boroughs, and none of the nine Second Class Townships or the Third Class City of Chester have municipal collections. This is likely because the municipalities with the largest populations tend to get the most economic benefit due to economies of scale in operating their own municipal fleets. Smaller populations make it more difficult to capitalize the cost of a collection fleet and sustain the labor needed. The following chart shows the breakdown of collection systems by municipality and population in Delaware County.





Collection Frequency: Currently, 22 municipalities have twice per week trash collection, 3 have twice per week trash collection in the summer only, and 14 municipalities have once per week trash collection. The remaining 10 municipalities rely on subscription services that typically allow each household to choose their desired level of service.



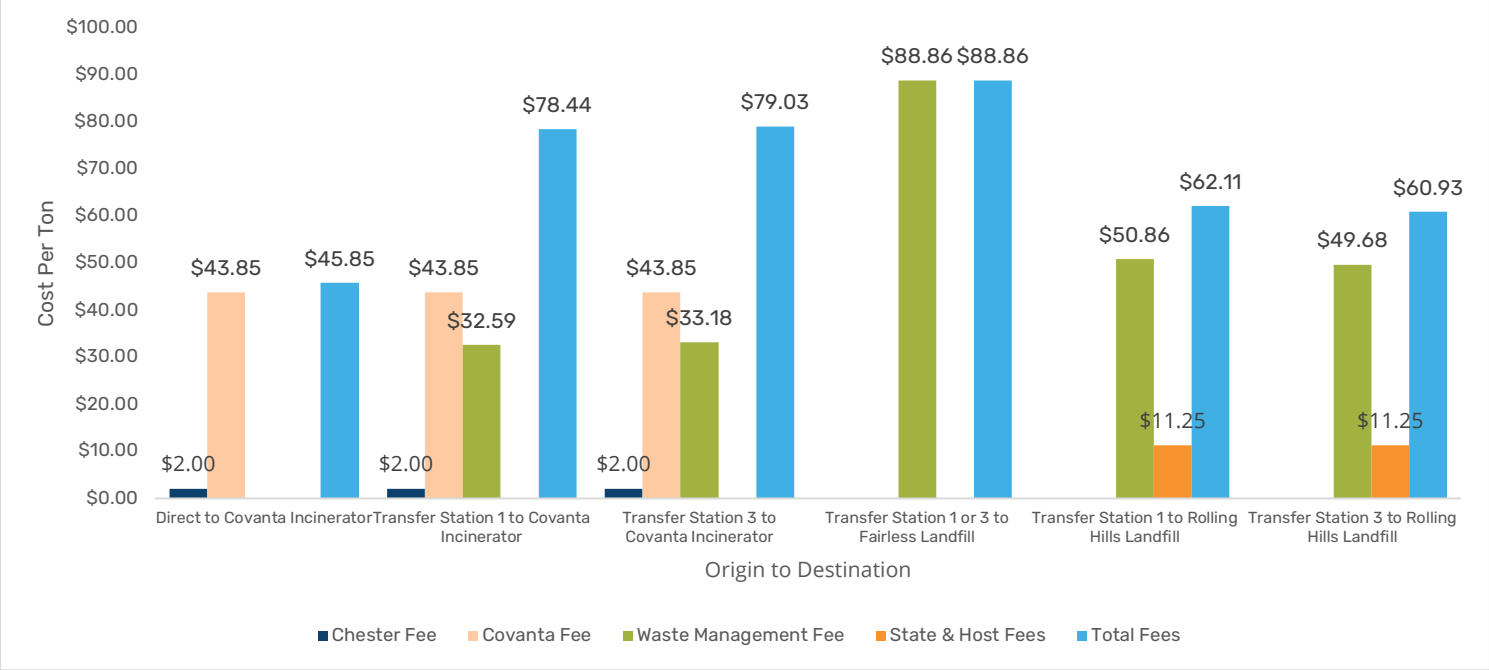
Many municipalities provide bulky item and white goods collections periodically with trash pickup. In addition, some municipalities offer "back-door" collection where the collector walks from the truck to collect waste from the top of the driveway or back door of the house.

Commercial Collection System: Some of the municipalities provide trash collection services to some commercial customers. Most commercial customers (including businesses, institutions and large multifamily buildings) subscribe to collection services from a list of haulers licensed by the Authority. A complete list of licensed haulers is included in Appendix C.

Commercial waste comprises approximately 40% of the waste received by the Authority each year. Commercial waste is not regulated to the extent that municipal waste is in Delaware County. There is no requirement that haulers collecting commercial waste in Delaware County deliver that waste to Authority facilities or Covanta.

Cost: Tipping fees at Authority facilities for licensed haulers providing collection for businesses and institutions increased to $83 per ton in 2023.

The following chart describes the net cost for transferring waste to available facilities.



Source: Authority October 2022 Board Packet

Special Handling Waste

Special handling wastes include: infectious, pathological and chemotherapeutic wastes (known as "regulated medical waste"), incinerator ash residue, sewage, septic, and water sludge and does not meet the definition of residual or hazardous waste.

Regulated medical waste is generated at hospitals, clinics, nursing homes, commercial laboratories, and doctors and dental offices. Regulated medical waste can only be picked up or delivered commercially in Pennsylvania by an infectious and chemotherapeutic waste transporter licensed by the Pennsylvania Department of Environmental Protection and must be delivered to an approved medical waste disposal facility. In 2022, 428 tons of regulated medical waste were treated and disposed in landfills in the region permitted to accept processed medical waste.

Delaware County Processed Medical Waste Disposal (2022)

Disposal Facility	Processed Regulated Medical Waste (Tons)
Pioneer Crossing Landfill	397
Conestoga Landfill	31
Total	428

Ash from the Covanta Delaware Valley municipal incinerator located in the City of Chester, is generated from processing waste from Delaware County (approximately one-third of the total) and New Jersey, New York, Philadelphia and other sources (about two-thirds of the total). A total of 369,227 tons of ash was created from 1,192,887 tons of waste.

Delaware County Ash Disposal (2022)

Disposal Facility	Ash Disposal (Tons)
Conestoga Landfill	5,792
Delaware County Solid Waste Authority Rolling Hills Landfill	363,435
Total	369,227

Sewage sludge or biosolids are generated through the treatment of municipal waste water. Sewage is collected from sewer systems and the waste water is processed by water pollution control plants, creating sewage sludge or biosolids. Septage is produced in onsite septic tanks and hauled to water pollution control plants where it is treated.

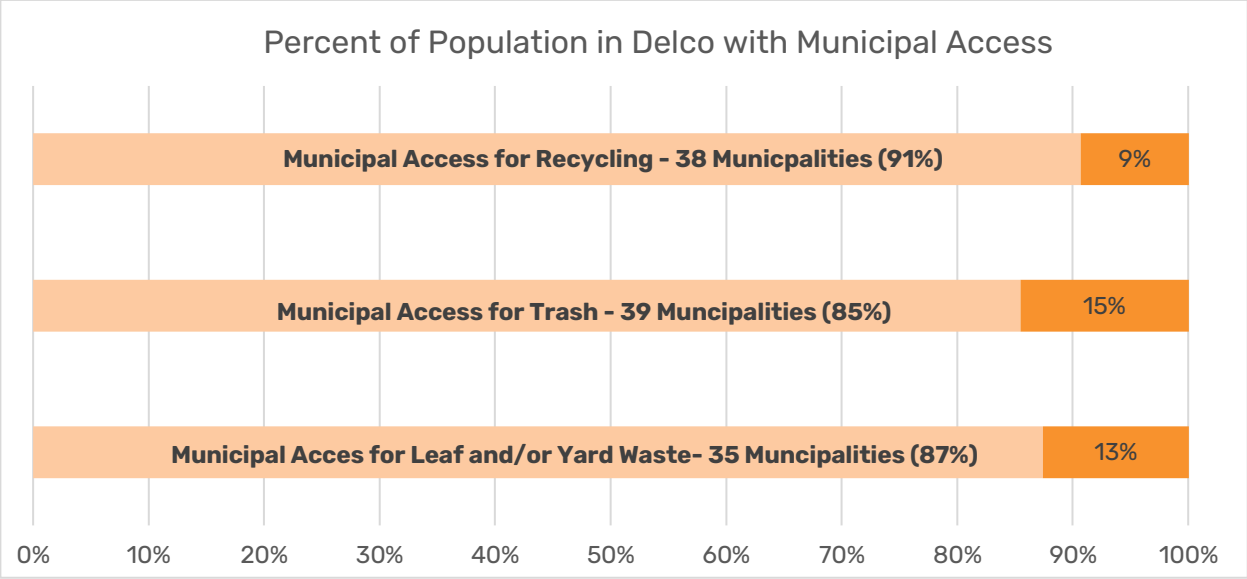
The Delaware County Regional Water Quality Control Authority (DELCORA), located in the City of Chester, produces "sludge" that is incinerator ash containing sludge incinerator residue from the DELCORA facility as well as from the Concord Waste Water Treatment Plant, Media Waste Water Treatment Plant, Tinicum Waste Water Treatment Plant, Thornbury Waste Water Treatment Plant and two waste water treatment plants in Chadds Ford. Southwest Delaware County Municipal Authority (SWDCMA) also generates sludge that they process on site for land disposal. In 2022, 2861 tons of sewage sludge was generated in Delaware County and disposed in landfills in the region permitted to accept processed medical waste.

Delaware County Sewage Sludge Disposal (2022)

Disposal Facility	Sewage Sludge Disposal (Tons)
Pioneer Crossing Landfill	1,37
Conestoga Landfill	1,482
Total	2,861

Overall Municipal Access

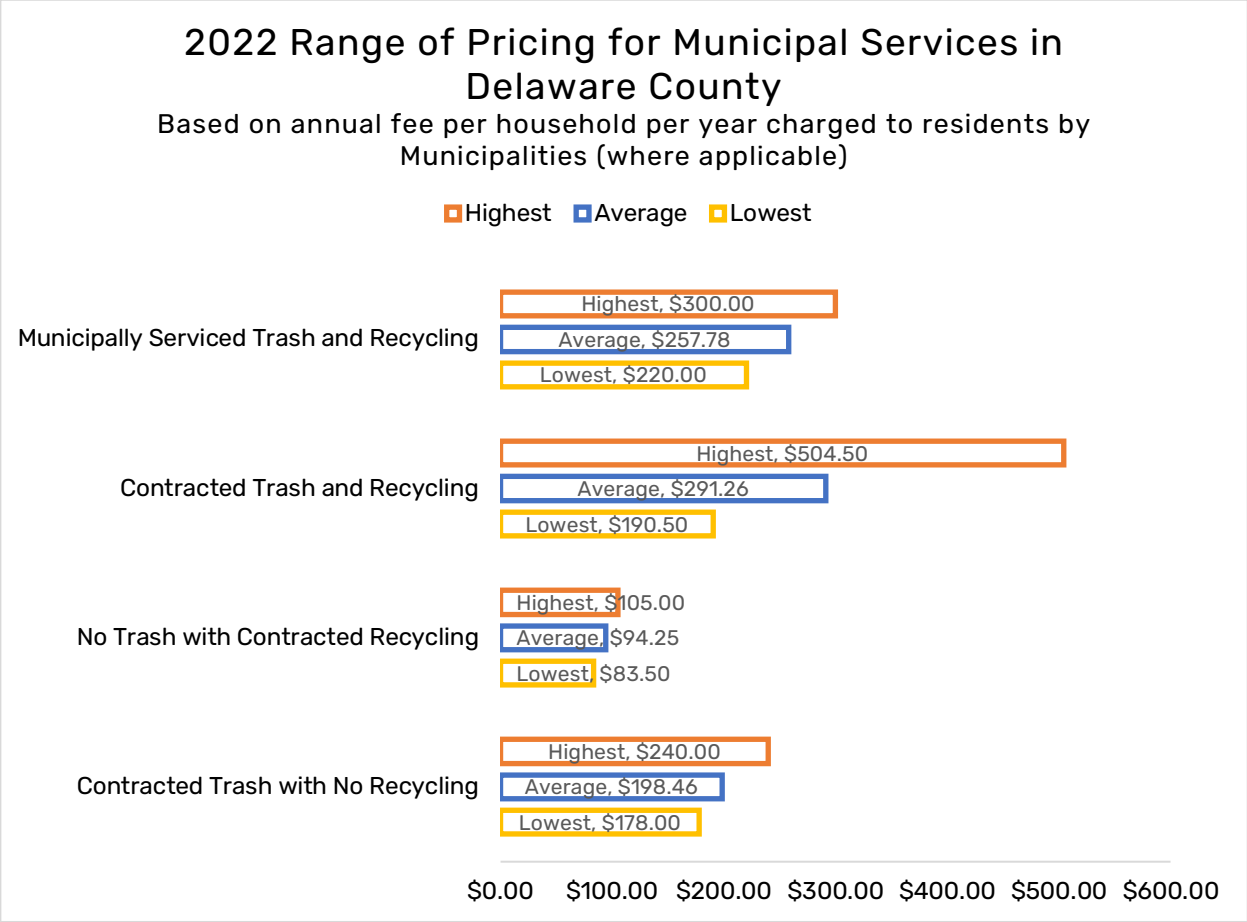
Overall, most Delaware County residents have services that are automatically provided by the municipality, either through municipal or contract collection. Ninety-two percent of all residents have recycling services provided by the municipality, 85% have trash service provided by the municipality and 87% have leaf and/or yard waste collection provided by the municipality. The remaining residential customers contract for their own service directly with a hauler. A complete list of municipal programs is included in Appendix B.



Source: Annual Municipal Surveys conducted by the Authority

Cost

Based on reviews of annual budgets and fees charged to residents, it's clear that costs to municipalities vary greatly, even when service levels are similar. The average fees per household based on the data available was $271.56 per year, however, fees ranged from as low as $105 per year for communities with just contract recycling to over $500 per year for municipalities with trash, recycling and yard trimmings collection. For municipalities that don't provide municipal trash service, residents pay an additional fee directly to the hauler as a subscription. Annual costs per household depend mostly on the level of services provided (trash, recycling, yard trimmings), the frequency of services (number of collections per week or month), the size of the community and when the contract was last renewed. Some municipally-operated programs also provide service to the commercial sector, likely making it more cost effective for residential collections.



Findings

These findings are based on comments received from the listening sessions and public workshops, along with analysis of the current municipal waste systems in Delaware County. The associated Zero Waste initiatives are listed here, with details provided in Section 4.

Opportunity for Economies of Scale: Most municipalities in Delaware County are small. Nineteen of the 49 municipalities (39%) have fewer than 2,000 households and only five municipalities have more than 10,000 households. Increasing the pool of households bidding on services can attract more competition and typically results in better rates for the municipalities. This can be achieved through various strategies, including collaborating across municipalities on bids, having a franchise/opt-in contract with a private company organized by the County or the Authority, or having the County or the Authority provide services directly.

See associated Zero Waste initiative: 18. Recyclables Processing.

Need for Technical Assistance: Many municipalities have limited staffing and lack the expertise to evaluate the best systems for waste, recycling and organics collection and implement strategies to increase diversion. There is inconsistency in data collection. Model ordinances, standardized reporting, and staffing available for technical assistance could be provided by the County or Authority.

See associated zero waste initiatives: 4. Universal Recycling/Composting (model ordinance), 8. Outreach, Education and Technical assistance, 12. Universal Recycling/Composting Collection (for all generators).

Challenge of Education: Since there are 49 municipalities each with different rules and regulations for recycling and organics, opportunities for regional education are limited and it can be confusing to have a different system than neighboring municipalities. Rules for what can be included in recycling can be achieved by agreeing on a standard set of items to promote countywide. This can also be accomplished by having a County or Authority-run recycling processing facility (either through public operation or by contracting with a private company and accepting material for transfer).

See associated Zero Waste initiative: 8. Outreach, Education and Technical Assistance.

Lack of Competition and Service Providers/Options: Many municipalities report a lack of competition in responses to Requests for Proposals for collection services. In addition, cost-effective organics processing is difficult to secure, especially for food scraps. The Authority could support municipalities by accepting recycling and organics at the transfer stations, allowing municipalities to opt into contracts negotiated by the Authority or the County, or by increasing processing capacity through Authority-run facilities.

See associated zero waste initiatives: 8. Outreach, education and technical assistance, 18. Recyclables Processing.

Lack of Transparency: Municipalities have a difficult time with reporting, or understanding what happens to recycling after it leaves the curb. With the given press attention to the problems with plastic recycling, it's important for communities to be confident in their program. The section on economies of scale above include solutions that would allow for more accountability and demand for transparency in recycling and composting contracts.

See associated Zero Waste initiatives: 4. Universal Recycling/Composting (model ordinance), 8. Outreach, Education and Technical Assistance, 12. Universal Recycling/Composting Collection (for all generators).

Environmental Justice Concerns: The 2022 American Lung Association "State of the Air" report gave Delaware County a passing grade overall, but a D for both ozone pollution and particle pollution. They estimate that the people at risk number nearly 60,000 for youth and adult asthma, 31,280 for COPD and 43,202 for cardiovascular disease related to poor air quality. Rates of asthma and chronic COPD are higher in Delaware County than the state average and rising. The asthma rate overall is 7%, while according to EJScreen the average rate in the target communities is 13%, with rates in some census tracts in the City of Chester (where the incinerator is located) as high as 15%. EJ Screen indicators confirm the target communities in the corridor fall in the 80th-100th percentiles for Air Toxics Cancer Risk and Air Toxics Respiratory Hazard in the US. The City of Chester ranks in the 86th -97th percentile for all 12 of the EPA EJ Indexes, and both Darby and Trainer boroughs are above the 86th percentile for 10 of the 12.

Covanta is operating under grandfathered emission rules and a new incinerator would not be permitted today with these emissions standards. Communities like Chester City have been fighting environmental justice battles for decades. "Dirty" industrial uses along the Delaware River are deemed essential to the regional economy and unlikely to move operations anytime soon, and have resulted in population loss, low property values and large amounts of abandoned housing and main street businesses. Reducing the amount of garbage burned at Covanta would reduce airborne contamination and the vehicle traffic to and from the site.

In addition, there have been concerns in the racial disparity around host fees. Delaware County pays twice as much per ton in host fees to the white community that hosts the landfill than it does to the majority black community that hosts the incinerator. Delaware County pays half as much per ton to Chester as the City of Philadelphia and New York City pay to Chester in host fees.

See Section 14 Lifecycle Analysis.

Disposal Marketplace Analysis: Pennsylvania's waste disposal costs are likely to increase dramatically in the 10- to 20-year time frame. Landfill space is an important and precious public asset and for many years, this space has been given

away to other counties and states, risking that Delaware County municipalities will face skyrocketing costs once Rolling Hills Landfill runs out of capacity. Delaware County's near-term choices will determine whether costs can be kept low long-term. There are two main ways to preserve landfill space other than through incineration:

1. Zero Waste policies and programs to reduce, reuse, recycle, and compost materials.
2. Stop filling the county's landfill with waste from other counties.

Unlike Delaware County, most counties that own their own landfills preserve their space for their own use. The value of Rolling Hills Landfill's airspace in 10-20 years will be worth much more than the current marketplace. It is worth considering how Delaware County could work with Authority to create an economic path forward that allows the authority to be financially stable without filling the county's landfill with incinerator ash or other out-of-county wastes.

Composition of Municipal Solid Waste

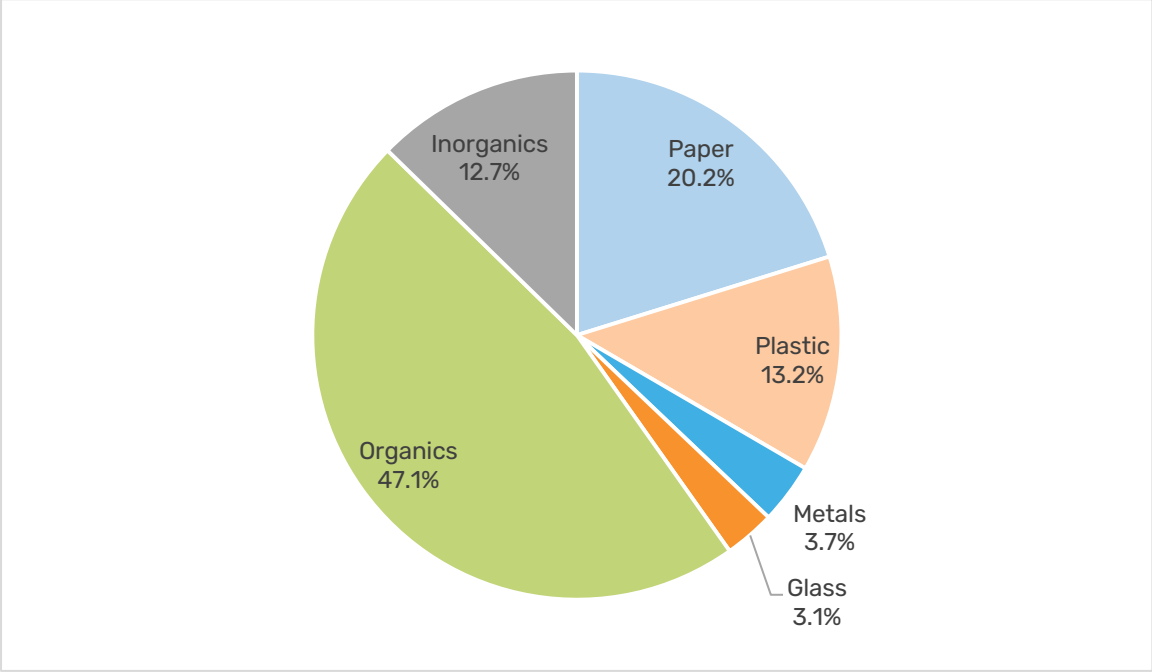
The Pennsylvania Department of Environmental Protection commissioned a statewide waste characterization study conducted by MSW Consultants in 2021.[2] This study was designed to evaluate the changes in the waste and recycling streams since the previous statewide Waste Characterization Study in 2003 and Recycling Composition Study (2005).

The study was conducted over four seasons with sorting at 13 disposal facilities within six planning regions in Pennsylvania (Northwest, Northcentral, Northeast, Southwest, Southcentral, Southeast). The Southeast region encompassed five counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia.

Municipal waste samples were collected and sorted from residential, and institutional, commercial and industrial sources and sorted them into six major categories and 58 subcategories. Results for the Southeast region were used in evaluating the diversion potential of the Zero Waste initiatives (Section 4) and the life cycle analysis (Section 14).

[2] Pennsylvania Department of Environmental Protection, Waste Characterization Study, MSW Consultants, September 2022. https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2022/PA_DEP_Report_FINAL_10-04-2022.pdf

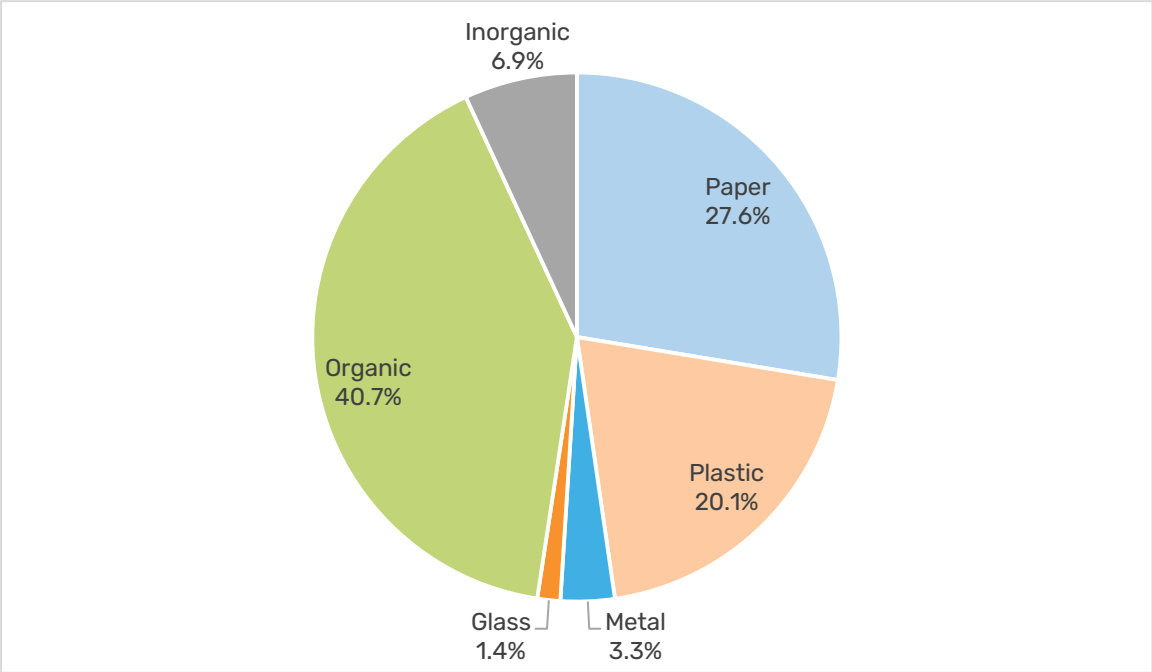
Southeast Regional Residential Waste Composition by Major Category



Southeast Regional Residential Waste Composition Top 5 Subcategories

Subcategory	Percent
Food Waste	14.8%
Compostable Paper	7.5%
Textiles and Leather	6.8%
Yard Waste	5.6%
All Other Film	5.5%
Total	40.2%

Southeast Regional Institutional-Commercial-Industrial
Waste Composition by Major Category



Southeast Regional Institutional-Commercial-Industrial
Waste Composition Top 5 Subcategries

Subcategory	Percent
Food Waste	22.8%
All Other Film	7.9%
Compostable Paper	6.1%
Unpainted Wood	6.0%
Mixed Recyclable Paper	5.5%
Total	48.3%

2. Description of Facilities

Overview of Municipal Solid Waste Facilities

Background

The Delaware County Solid Waste Authority (Authority) was established originally as the Delaware County Incinerator Authority in 1954. Three incinerators were constructed in the late 1950s and operated until 1979 when they were closed. Two of the incinerators were converted to Transfer Stations to accept and handle approximately 400,000 to 500,000 tons of commercial and residential trash disposed annually in Delaware County.

In 1984 the Delaware County Council adopted a resolution requesting that the Delaware County Incinerator Authority acquire the Rolling Hills Landfill (formerly Colebrookdale Landfill) in Earl Township, Berks County. The majority of all County trash had been disposed of at Rolling Hills Landfill for years prior to the proposed acquisition. The purchase of the Landfill was completed in 1985 and the name of Delaware County Incinerator Authority was changed to the Delaware County Solid Waste Authority.

All of the solid waste processed through the two Transfer Stations continued to be shipped to Rolling Hills until 1992 when the Delaware Valley Resource Recovery Facility (Covanta), a municipal waste incinerator, opened in the City of Chester.

Approximately 400,000 to 500,000 tons of commercial and residential trash annually generated in Delaware County is processed at Covanta with the ash residue shipped to Rolling Hills Landfill. This arrangement is defined by contract between the Authority and Covanta. Each pays a per ton fee to the other for the tons delivered and processed or landfilled.

Current Municipal Solid Waste Facility System

Approximately 70% of municipal solid waste from municipalities and haulers throughout Delaware County is delivered to the Delaware County Solid Waste Authority transfer stations.

- Transfer Station #1 in Chester Township (receives about 40%)
- Transfer Station #3 in Marple Township (receives about 30%)

The transfer stations are owned by the Authority and operated by Waste Management of Pennsylvania, Inc.

Waste Management transfers municipal waste to:

- Delaware Valley Resource Recovery Facility (Covanta) in City of Chester (Delaware County), owned by EQT Infrastructure V fund, a private Swedish investment firm

- Rolling Hills Landfill in Earl Township (Berks County), owned and operated by the Authority
- Fairless Landfill in Morrisville (Bucks County), owned and operated by Waste Management

In 2021, Delaware County embarked on a planning process to move beyond incineration as a primary strategy for managing municipal solid waste. The Pennsylvania Department of Environmental Protection approved an expansion of the Rolling Hills Landfill in 2021.

In April 2022, the Authority extended the term of its agreement with Covanta and began transition planning to upgrade the Authority's Transfer Stations to make them suitable for longer haul transporting municipal solid waste to the Rolling Hills Landfill instead of the shorter haul to Covanta. Note that any changes made to the permitted area of the transfer stations may require at a minimum a permit amendment or modifications.

Delaware County Solid Waste Authority System Tons (2022)

Disposal Facility	Tons
Delaware Valley Resource Recovery Facility (Covanta)	374,645
Rolling Hills Landfill (Delaware County tons)	1,576
Fairless Landfill	5,569
Delaware County Subtotal	381,790
Rolling Hills Landfill	
Ash (from Covanta)	412,838
Berks County	52,661
Montgomery County	97,501
Other	10,524
Rolling Hills Landfill Subtotal	573,524
Total Delaware County Solid Waste Authority System Tons	955,314

Source: Authority 2022 Annual Report, May 2023, Pennsylvania Department of Environmental Protection, Bureau of Waste Management Disposal Information, June 2023

Transfer Stations

Transfer Station #1 and #3

Approximately 400,000 to 500,000 tons per year are managed through the Authority's Delaware County system. In 2021, 281,880 tons were managed through the transfer stations and 123,300 tons were delivered directly to Covanta.

Delaware County Tons Delivered to Transfer Stations and Covanta

Facility	2017	2018	2019	2020	2021
Transfer Station #1	186,320	141,550	116,480	156,950	165,390
Transfer Station # 3	141,480	152,760	149,170	135,330	116,490
Direct Haul to Covanta	37,680	82,520	112,470	111,980	123,300
Total	365,480	376,830	378,120	404,250	405,180

Source: Authority Correspondence 1-14-22

In 2018 the Authority began to charge $5 less per ton for loads delivered directly to Covanta (as the Authority does not incur the costs of transfer for tons delivered directly to Covanta). This increased the amount of materials delivered to Covanta from 10% (134.57 tons per day) in 2017 to 30% (440.36 tons per day) in 2021.

The Authority and Waste Management have made minor upgrades and repairs to the transfer stations in recent years. However, both transfer stations need replacement and expansions could include more reuse, recycling and composting activities. A Request for Proposals for an engineering firm was released in 2023 with expected construction to be completed by 2025 or 2026 at the latest.

Transfer Station #1 is a fifty-five-acre facility located at 2300 Concord Road in Chester Township. The permitted capacity is 1,200 tons per operating day.

Transfer Station #3 is a twenty-five-acre facility located at Sussex Boulevard and Marpit Drive in Marple Township. The permitted capacity is 1,200 tons per day.

Landfills

Rolling Hills Landfill

Rolling Hills Landfill, located at 583 Longview Road, Boyertown, Earl Township, Berks County has been in existence since 1952 as a municipal solid waste facility. The Delaware County Solid Waste Authority purchased Rolling Hills Landfill in 1985. Rolling Hills Landfill presently comprises approximately 680 acres. Of that total acreage, 240 acres are permitted by the Pennsylvania Department of Environmental Protection for use as disposal area and support facilities; 234 acres are woodlands; and 206 acres are considered buffer zones and 115 acres contain waste. The landfill is permitted to receive a maximum daily volume of 3,200 tons per day as averaged over operating days in a quarter, or up to 3,840 tons in a given day.

The expansion approved in 2021 allows the landfill to add 8.8 million cubic yards of disposal volume and more than 10 years of waste disposal capacity to the landfill. Without the expansion, the landfill was expected to reach capacity by 2023. The expansion will not increase the currently permitted maximum elevation, disposal area footprint, property boundary or daily volumes of waste accepted.

Fairless Landfill

Waste Management owns and operates the Fairless Landfill, located at 1000 Bordentown Road, Morrisville, Falls Township, Bucks County. The landfill is permitted to receive a maximum daily volume of 18,333 tons per day as averaged over operating days in a quarter, or up to 20,000 tons in a given day.

As of January 1, 2021, the landfill had 28,010,947 cubic yards of airspace or about 6.4 years of capacity remaining. In 2022, Waste Management purchased 64 acres at the former U.S. Steel site in Fairless Hills and is planning a roughly $100 million project to expand the landfill (which will add an additional five years of capacity according to Waste Management).

The Authority's transfer station and disposal agreement with Waste Management has been extended through 2030. It provides for disposal at the Fairless Landfill and includes a volume discount of $1 per ton for tons delivered in excess of 70,000 per year.

Municipal Waste Incinerator

Delaware Valley Resource Recovery Facility

The Delaware Valley Resource Recovery Facility (Covanta), a municipal waste incinerator, receives municipal solid waste and industrial waste from throughout the region (approximately 1.2 million tons in 2022, including 374,645 tons from Delaware County) and uses a mass-burn technology to convert the municipal waste to ash and air emissions. Under the agreement with the Authority, most of the ash from the facility is delivered to the Rolling Hills Landfill (363,435 tons in 2022), including the two-thirds of ash generated by waste delivered from New Jersey, New York, and Philadelphia.

In April 2022, the Authority entered into a short-term agreement with Covanta for processing municipal solid waste at the incinerator and disposing of ash at the Rolling Hills Landfill. The initial term of the agreement is for three years with the option to extend the agreement for another two years. There is no "put or pay" requirement (e.g., no requirement to deliver a minimum number of tons to the facility), and contains a connected agreement to accept an equivalent tonnage of ash from Covanta's Chester and Plymouth incinerators with one-year renewals every six months in October and April, essentially requiring a six-month notice to end disposal of ash at the landfill.

Municipal Solid Waste Facility Status

Facility	Status
Transfer Stations #1 and #3	Planned replacement and potential expansion
Rolling Hills Landfill	Approved expansion of 8.8 million cubic yards 10.8 million cubic yards remaining as of January 2023 Estimated to have 15-20 years of remaining capacity
Fairless Landfill	Contract through 2030
Covanta	Contract through 2025 with potential to extend to April 30, 2027

3. Estimated Future Capacity

During the planning period (2023-2033), Delaware County will rely on two primary disposal facilities that will be used to manage approximately 400,000 to 500,000 tons of municipal solid waste. The first facility is Covanta located in Delaware County. The Authority has an agreement with Covanta until April 30th, 2025 (with options to extend to 2027) that allows for delivery up to 375,000 tons per year. The second facility is the Rolling Hills Landfill, located in Berks County and owned by the Delaware County Solid Waste Authority. The Rolling Hills Landfill has a permit that allows for 3,200 tons per day on a quarterly average and has received an expansion permit for 8.8 million cubic years of capacity. The landfill had 10.8 million cubic yards remaining as of January 2023, which is expected to last 15-20 years. Finally, a third facility, the Fairless Landfill, located in Bucks County, should be considered a secondary facility that may receive some Delaware County municipal solid waste as the Authority has a disposal agreement with Waste Management (owner of the landfill) that runs through 2030.

As the planning period progresses, Delaware County will transition its municipal solid waste from Covanta to the Rolling Hills Landfill. It is understood that replacing the two transfer stations will play a key role in the transition, as the distance and time is considerably longer to the landfill and more waste retention space will be required at the transfer stations to ensure that the retention time limit of 24 hours is not exceeded.

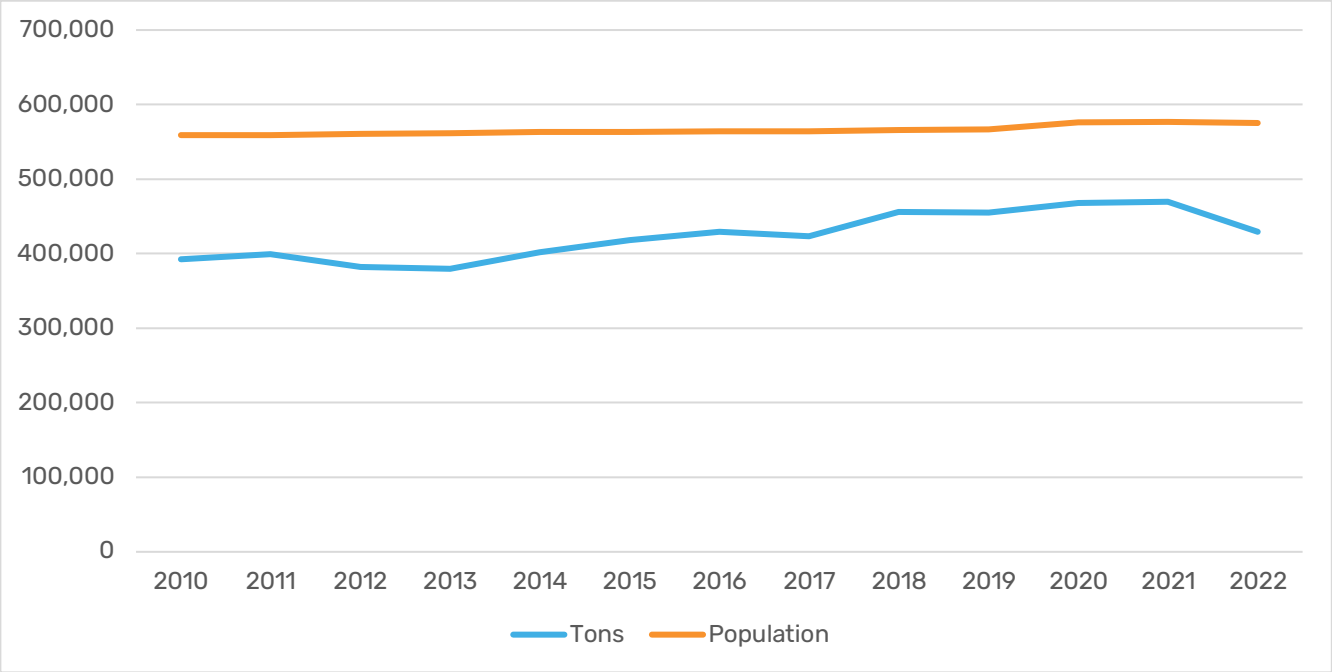
Rolling Hills Landfill currently receives the ash generated from trash delivered to Covanta, about 380,000 tons per year. Delaware County represents about one-third of this material. As less and less waste is delivered to Covanta from Delaware County a similar reduction schedule of ash into the landfill will be implemented by the Authority (as codified in the April 2022 agreement between the Authority and Covanta). Thus the average tons per day into the Rolling Hills Landfill will remain fairly constant at about 1,450 to 1,500 tons per day based on 260 delivery days per year.

Rolling Hills Landfill also provides disposal service to haulers serving Berks County and Montgomery County. These arrangements are contracted for a maximum of one year. The volume from these contracts averages about 150,000 tons per year or about 580 tons per day based on 260 delivery days per year. A range of 560 to 600 tons per day is assumed for the planning period.

Based on the above arrangements, the Rolling Hills Landfill will receive between 2,010 and 2,100 tons per day. Using 260 delivery days at 2,100 tons per day, 546,000 tons will be received in an average year. Using a density of 1 ton per cubic yard (trash is 0.8 tons per cubic yard while ash is 1.2 tons per cubic yard), the space consumption will be 546,000 cubic yards per year. With the expansion of 8.8 million cubic yards, and an annual usage of 546,000 cubic yards, the landfill will last 16 years.

Note that Delaware County's population has increased by an average of one percent per year and disposal tons have increased by the same amount. The county is built out and is not anticipating significant population growth over the next 10 years. Thus, the capacity available through Covanta (in the short-term) and the Rolling Hills Landfill (in the long-term) will more than adequately serve the needs of the county for over 10 years.

Delaware County Population and Disposal Tons by Year



Environmental Justice

Title VI of the Civil Rights Act of 1964 forbids recipients of federal funds (including Delaware County) from taking official actions that have discriminatory effects on racial minorities – regardless of intent.[3] Waste management decisions are not excluded, putting an affirmative obligation on the county to evaluate decisions as to ensure no such discriminatory effects.

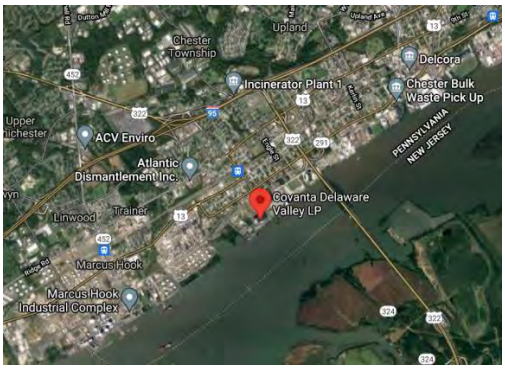
Population and Demographics within Two Miles of the
Four Major Waste Disposal Facilities Used by Delaware County Generators

	Covanta Delaware Valley	Rolling Hills Landfill	Covanta Plymouth	Fairless Landfill*
Asian	0.5%	0.1%	6.9%	
Black	64.1%	0.7%	8.9%	
Hispanic	11.2%	1.3%	7.9%	
Multi-Racial	7.2%	2.8%	6.5%	
White	20.4%	95.2%	72.4%	63%*
Population	17,143	1,555	19,968	100-300*
Medium Household Income	$26,434	$77,321	$83,361	$86,000*

* No one lives within nearly two miles of Fairless Landfill. A Census analysis shows no one within two miles because the middle of the landfill doesn't come within two miles of the central point of a Census tract. However, from the edges of the landfill, the two-mile radius touches about 100-300 people who live in Falls Township, Pennsylvania and in Fieldsboro, New Jersey. The demographics within that zone are about 63% white (higher than the national average) and have a median household income of about $86,000.

Satellite maps of the two major facilities in question make it clear how much more urban the community is around the Covanta Delaware Valley incinerator vs. the rural Rolling Hills Landfill location. Also, since incinerator emissions are released from a tall smokestack, the impacts are spread across a wider geography, impacting far more people than the two-mile radius used in the chart above.

[3] Mike Ewall, "Legal Tools for Environmental Equity vs. Environmental Justice," Sustainable Development Law & Policy Journal, Vol. XIII, Issue 1, 2012-2013.
http://www.ejnet.org/ej/SDLP_Ewall_Article.pdf



← Covanta Delaware Valley incinerator

Rolling Hills Landfill →

The term "environmental racism" was coined in response to the siting of hazardous waste facilities in communities of color.[4] Studies have shown that race is more of a factor than class, which is why the focus of the environmental justice movement is on the pattern of racial discrimination.[5]

The trash incineration industry in the U.S. has been found to have a disproportionate impact on people of color. While 67% of the nation's 68 remaining trash incinerators are located in majority white communities, the industry has a strong and disproportionate impact on people of color because the largest are located in communities of color that tend to be more populated. Fifteen of the 20 largest trash incinerators (75%) are located in communities of color.[6] Landfills, on the other hand, tend to be in more rural communities, impacting fewer people. Pennsylvania's landfills are located in communities that are whiter than average – and are wealthier, on average, than communities hosting incinerators in the state.

[4] Environmental Justice & Environmental Racism, http://www.ejnet.org/ej

[5] "Toxic Wastes and Race at Twenty: 1987-2007," United Church of Christ, March 2007. http://www.ejnet.org/ej/twart.pdf

[6] "Incineration and Environmental Racism," http://www.energyjustice.net/incineration/ej

4. Description of Recycling Program

Current Recycling System

Recycling

Residential Recycling: Thirty-eight municipalities in Delaware County provide municipal recycling service to residents. Municipalities are mandated to recycle under Act 101 if they have a population of 10,000 or more people or with a population of more than 5,000 but fewer than 10,000 people with a population density of more than 300 people per square mile. Currently, 11 municipalities in Delaware County do not provide municipal recycling services to residents. Of these, three require by ordinance that residents subscribe to service. None of remaining 8 municipalities without recycling collection services are required to provide it under state law. Details about the status of each municipality's recycling program are included in Appendix B.

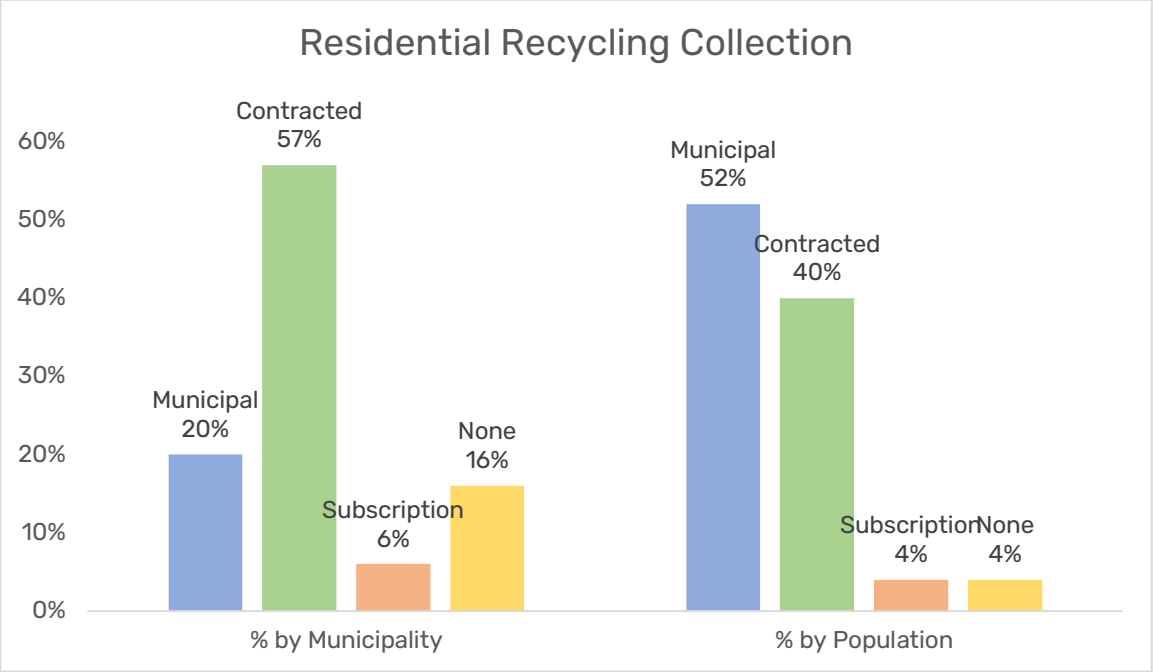
There are two main approaches that most municipalities use to provide recycling to residents.

- Municipalities contract with a hauler that delivers the recyclables to a facility of the hauler's choice. In this case, municipalities pay a single fee to the hauler, based on the number of households serviced.
- Municipalities directly contract with a recycling facility and either deliver material themselves or contract with a private hauler for collection. In this case, the collection cost (per household) is separate from the processing fee (per ton) and the municipality may get a commodity rebate based on market conditions.

Recycling is typically collected either weekly or every other week. The predominant form of collection for recycling is through a "Single Stream" program, where all recyclable materials are mixed together in a single bin for collection. Single stream recycling programs have slight variations but in Delaware County they all include; cardboard, mixed paper, aluminum and steel cans, plastic bottles and tubs, and glass bottles.

There are five primary facilities (known as Material Recovery Facilities or "MRF") that accept single stream recycling from Delaware County municipalities.

- Republic Services MRF - King of Prussia, Pennsylvania
- Republic Services MRF – Wilmington, Delaware
- Waste Management MRF - Philadelphia, Pennsylvania
- Mascaro Total Recycle - Birdsboro, Pennsylvania (Bridgeport transfer)
- Omni Recycling (acquired by Salt Creek Capital in 2022) - Pitman, New Jersey (Philadelphia transfer at a Waste Management facility)



Ten municipalities, representing 52% of Delaware County population, provide recycling collection through a municipally-owned fleet and staff. This is similar to trash collection where the larger municipalities are better able to benefit from municipal collections. More than half the First Class Townships have municipal recycling. Twenty-eight municipalities, representing 40% of the county population, provide contract services where one private hauler collects recycling from every household. Three municipalities, representing 4% of the county population, have an ordinance requiring every household to contract for recycling service directly with a private hauler. The remaining 8 municipalities, representing 4% of Delaware county's population, provide no recycling service to residents and don't require residents to recycle.

Commercial Recycling: All municipalities covered under Act 101 must create municipal waste management programs that include recycling. Under the law, commercial, municipal and institutional establishments (including schools, hospitals, government buildings, churches, retailers, offices, non-profits, and others) must recycle according to the mandatory recycling ordinance the municipality has enacted. Most municipalities in Delaware County require commercial establishments (including businesses, institutions and large multifamily buildings) to arrange for recycling collection if it is not provided by the municipality. Act 101 requires commercial, institutional, and municipal establishments located in Pennsylvania's mandated municipalities to recycle high-grade office paper, corrugated paper, aluminum, and leaf waste and submit this information annually to the municipality.

Organics

Seventy-one percent of municipalities, representing 87% of the county population, offer yard trimmings collection and/or leaf pick up. Most municipalities offer leaf waste collection seasonally and some offer yard trimmings collection throughout the summer. Yard trimmings and leaves are either composted at a municipal site, or brought directly to a private facility by the municipality or hauler the municipality contracts with. Only one municipality, Media Borough, currently offers food scraps collection to all households. Residents in other municipalities may opt into food scraps composting programs from several private companies at their own additional expense.

Food Scraps Collection Providers operating in Delaware County include:

- Back to Earth Compost Crew
- EZ Compost
- Kitchen Harvest, Inc.
- Media Township
- Mother Compost

The list of public and provide yard trimming and food scraps collectors and processors is included in Appendix D.

Additional Programs

Drop-offs: Many communities have municipally-hosted or private drop-offs that accept paper, cardboard, bottles and cans, textiles, electronics, yard waste and more. The Authority recently transitioned to providing front-load single stream dumpster service for drop off locations at 18 sites throughout the county. Materials accepted include: clear, green, brown glass office paper, junk mail, newspapers, cardboard boxes, clean flattened, plastic bottles, rinsed and lids off, metal and aluminum cans, rinsed. A complete list of drop-off locations is included in Appendix E.

Special Collection Events: The County and Authority promote and help coordinate events throughout the county, with nonprofits such as Pennsylvania Resources Council. These include hazardous waste collections, electronics collections, shredding events and hard to recycle collections. Some communities have agreements with a private on-demand pick up service (such as Retrievr) for textiles and electronics.

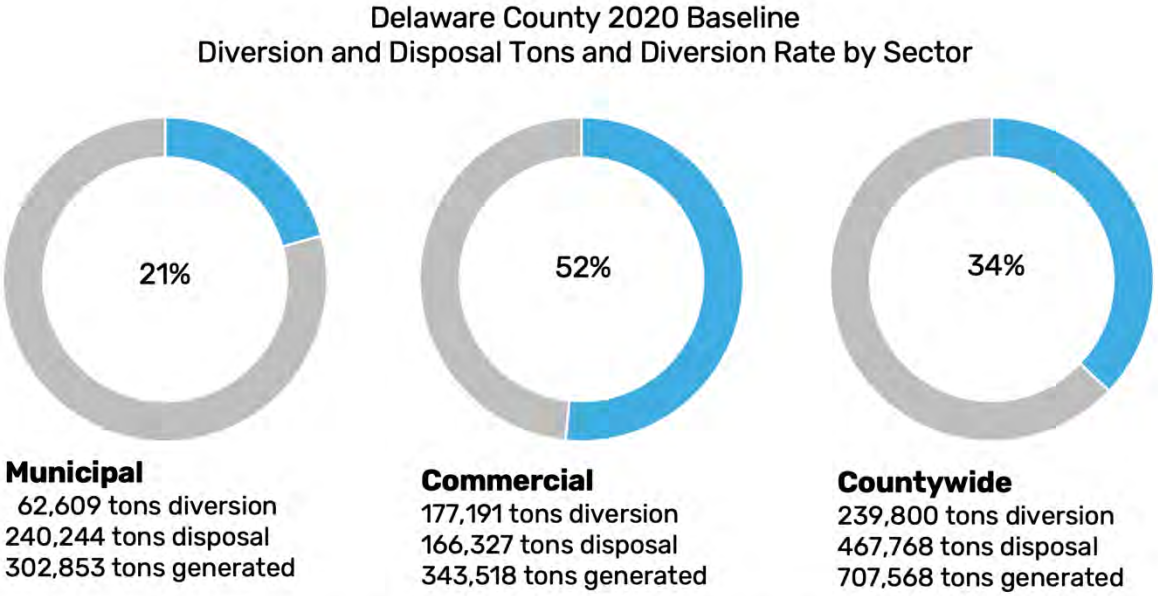
Countywide Diversion Rate

Diversion rates are typically expressed as the percentage of materials diverted from disposal in landfills and incinerators using the following formula:

Generation = Diversion + Disposal
Diversion Rate (%) = Diversion (tons) /Generation (tons)

The Authority conducts an annual survey of Delaware County municipalities and documents diversion and disposal tonnages by municipal (primarily residential) and commercial tonnages.

In 2020, the baseline year for this plan, the countywide diversion rate was 34 percent. This is based on 239,800 tons of diversion (recycling and composting) and 467,768 tons of disposal (landfill and incineration). This baseline estimate includes the materials handled by each municipality, the tons delivered to Authority facilities by municipalities and licensed haulers, and an additional 61,196 tons of municipal solid waste from Delaware County delivered to landfills and incinerators outside of the Authority's disposal system.



Note: Countywide disposal includes 61,196 tons disposed at facilities outside of the Authority's disposal system

It is important to also consider overall discards in the context of diversion rate. The upstream impacts of consumption, including extraction, manufacturing and transportation of consumption are significant compared to disposal.

Zero Waste Initiatives

A major focus of the planning process was to identify the policies, programs and infrastructure needed to transition Delaware County's municipal solid waste management system to a Zero Waste System.

Twenty-one Zero Waste initiatives were identified for implementation over the 10-year planning period (2023 to 2033). The initiatives are categorized based on the Zero Waste Hierarchy of Highest and Best Use, curated by the Zero Waste International Alliance (https://zwia.org/zwh/). The Zero Waste Hierarchy describes a progression of policies, programs and infrastructure to support the

development of a Zero Waste system, from highest and best to lowest use of materials.

Delaware County Zero Waste Initiatives

	Policies	Programs	Infrastructure
Rethink/ Redesign	▪ Product policies ▪ Lead by example	▪ Reduce frequency of trash collection	
Reduce/ Reuse	▪ Deconstruction	▪ Outreach, education and technical assistance ▪ Reuse collection ▪ Edible food donation ▪ Reuse and repair	▪ Refillable stations ▪ Zero packaging stores ▪ Building materials reuse centers
Recycle/ Compost	▪ Universal recycling/ composting (model ordinance) ▪ Save-as-you-throw ▪ Construction & demolition recycling requirements	▪ Universal recycling/ composting collection (for all generators)	▪ Center for Hard to Recycle Materials ▪ Recyclables processing ▪ Organics processing
Materials recovery			▪ Biological stabilization
Residuals Management		▪ Materials characterization	▪ 10-year landfill capacity

These Zero Waste initiatives were discussed by the Advisory Committee, refined through the public outreach process, and evaluated for inclusion in the plan.

Initiative Descriptions

1. Product policies

Bans, fees or take-back requirements for problem products, such as plastic bags and single-use plastic foodware.

2. Lead by example

Model waste reduction, recycling and composting at County and municipal buildings, parks and events.

3. Deconstruction

Require selective dismantling of building components, specifically for reuse, repurposing, and recycling.

4. Universal recycling/composting (model ordinance)

Develop model ordinance for municipalities to adopt which requires recycling and composting for all generators and supplements the existing Act. 101 requirements.

5. Save-as-you-throw

Volume based collection fees paid by the customer.

6. Construction & demolition recycling requirements

Require recycling of building materials from construction and demolition projects.

7. Reduce frequency of trash collection

Transition from twice per week trash collection to weekly collection and consider every-other-week trash collection along with weekly organics collection.

8. Outreach, education and technical assistance

Countywide program to support all generators to reduce waste, recycle and compost.

9. Reuse collection

Quarterly collection of reusable goods, textiles and furniture.

10. Edible food donation

Expand surplus edible food recovery from grocery stores and restaurants to food pantries and soup kitchens.

11. Reuse and repair

Quarterly or monthly repair fairs, tool lending library, promote material exchange.

12. Universal recycling/composting collection (for all generators)

Expansion of recycling and composting collection programs for single-family, multifamily, commercial, and schools/institutions.

13. Materials characterization

Data collection and research on recycling, composting and trash composition and quantities by sector.

14. Refillable stations

Expand refill stations at grocery stores, reusable foodware at schools, water stations in public buildings and parks.

15. Zero packaging stores

Support expansion of zero packaging stores throughout the County.

16. Building Materials Reuse Centers

Site facility for surplus building materials and materials salvaged from deconstruction.

17. Center for Hard to Recycle Materials

Drop-off facility for materials that are not suitable for curbside collection (textiles, mattresses, electronics).

18. Recyclables processing

Contract with recyclables processors, provide transfer, and expand County recyclables processing.

19. Organics processing

Contract with compost facilities, provide transfer, and expand County compost capacity.

20. Biological stabilization

Process mixed waste to stabilize organics prior to landfill.

21. 10-year destructive disposal capacity

Expand County landfill and transition from incineration.

Full descriptions of each of the initiatives is included in Appendix F.

Estimating Impact

Each of the Zero Waste initiatives within each category in the hierarchy has the potential to increase the countywide diversion rate. Estimates were made using conservative assumptions for capture rates by material type for what can be accomplished by implementing Zero Waste initiatives over the 10-year planning period (and assume full implementation of each initiative).

For each initiative, the following impacts have been identified and estimated:

- Capture rate – the percent diverted from total disposal
- Potential landfill diversion tons - annual

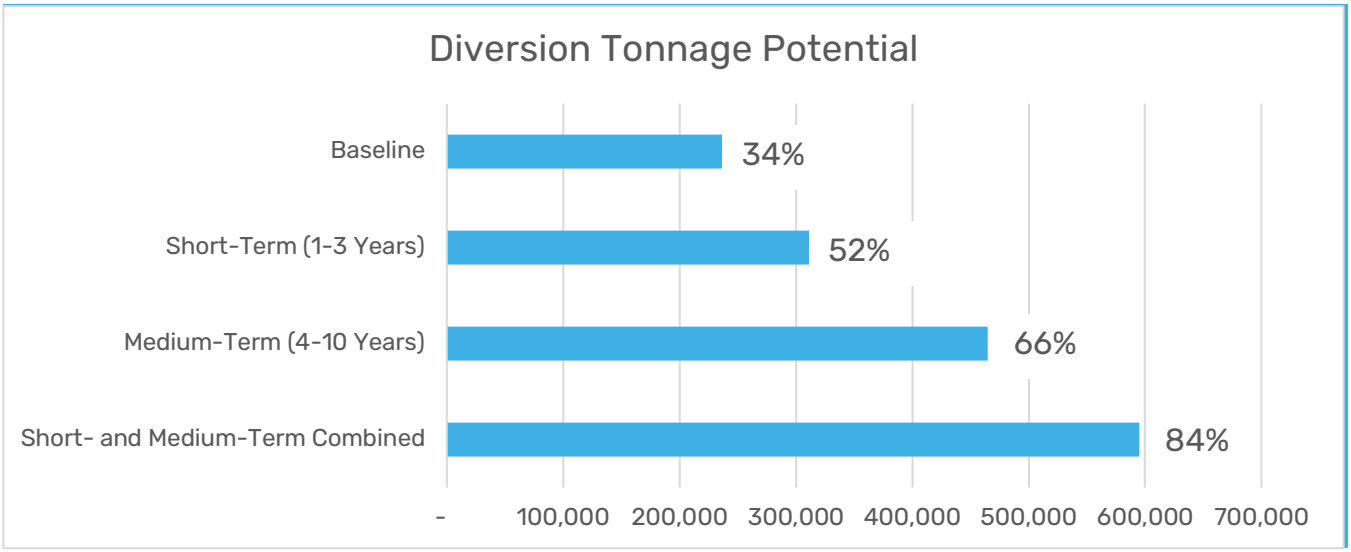
The assumptions and methodology are included in Appendix G.

	Initiatives	Capture Rate %	Diversion Potential (Tons)
1	Product Policies	1.0%	4,732
2	Lead by Example	3.2%	15,032
3	Deconstruction	2.2%	10,110
4	Universal Recycling & Composting (Model Ordinance)	12.6%	58,980
5	Save-As-You-Throw	4.3%	19,994
6	Construction & Demolition Requirement	3.4%	16,096
7	Reduce Frequency of Trash Collection	1.3%	6,082
8	Outreach, Education, and Technical Assistance	22.4%	104,868
9	Reuse Collection Program	1.8%	8,241
10	Edible Food Donation Program	1.1%	5,159
11	Reuse & Repair Programs	0.7%	3,415
12	Universal Recycling & Composting Collection (all generators)	12.6%	58,980
14	Refillable Stations Program	0.2%	1,082
15	Zero Packaging Store Program	0.4%	1,989
16	Building Material Reuse Center	1.7%	8,087
17	Center for Hard to Recycling Materials (CHaRM)	1.0%	4,671
18	Material Recovery Facility (MRF)	1.3%	6,248
19	Organics Processing	4.6%	21,374
20	Biological Stabilization	Not applicable	
21	10-year destructive disposal capacity	Not applicable	
	Total	**76%**	**355,140**

The Zero Waste initiatives will be phased in over the 10-year planning period during the short-term (1-3 years) and medium-term (4-10 years). Some initiatives will be initiated in the short-term and then fully implemented in the medium-term. Implementing the Zero Waste initiatives is estimated to increase the countywide diversion rate from 34 percent in 2020 to 84 percent over the 10-year planning period (2023-2033).

Diversion Potential	Baseline	Short-Term (Years 1-3)	Medium-Term (Years 4-10)	Short- and Medium-Term Combined
Disposal Tons	467,769	337,621	242,777	112,629
Diversion Tons	239,800	369,947	464,791	594,939
Generated Tons	707,569	707,568	707,568	707,568
Diversion Rate	34%	52%	66%	84%

Note: This analysis is based on total tons disposed in 2020, including tons disposed outside of the Authority's disposal system.



Implementation Plan

Implementation of the Zero Waste Initiatives will require dedicated staff support at the County or Authority level to develop countywide programs and infrastructure and support the municipalities in implementing new policies and programs at the local level. The Zero Waste initiatives were grouped according to appropriate staff positions to estimate the level of effort for implementation. The chart below shows the four primary staff positions proposed as a first step in the implementation process. These positions will play a critical role in project managing

implementation and delivery of services, as outlined in the "Time Action Schedule" included in the following section.

Leadership, Education & Inspiration

- Product Policies
- Lead by Example
- Outreach, Education & Technical Assistance
- Reuse Collection
- Edible Food Donation
- Reuse & Repair
- Refillable Stations
- Zero Packaging Stores

Zero Waste Infrastructure

- Center for Hard to Recycle Materials
- Materials recovery facility
- Recyclables Transfer
- Mini-MRF
- Organics processing

Universal Collection

- Model Ordinance/County Technical Assistance
- Universal Recycling & Composting Collection for all Generators (Residential, Commercial, Institutional)
- Save-As-You-Throw
- Reducing Frequency of Trash Collection

Building Materials Reuse & Recycling

- Deconstruction
- Construction & Demolition Recycling Requirements
- Building Materials Reuse Centers

Leadership, Education & Inspiration

Position Scope: This is a dedicated County staff position to oversee initiatives related to Leadership, Education & Inspiration

Position Description: Dedicated County-level staff support is needed to develop countywide product policies, demonstrate leadership in Zero Waste at County facilities, conduct outreach, and technical assistance activities throughout the county. This position can also support the reuse collection initiative, expand edible food donation, promote reuse and repair, and promote the development of refillable stations and zero packaging stores in the county.

Product policies - Present research on potential model ordinances to stakeholders and community and get their input on bans, fees, take-back and RFP for reusable takeout services. Ordinances can be directed at large institutional waste generators, such as cafeterias, that can provide anchor tons to develop county wide facilities for such things as organics composting. Conduct further research on details. Draft ordinances and RFP. Engage with stakeholders and community to review draft ordinances and RFP. Revise ordinances and RFP. Adopt ordinances and RFP. Support municipalities in adopting model ordinances at the local level. Several Delaware County municipalities have proposed or recently implemented bag bans

and packaging ordinances, including Haverford Township, Media Borough and Swarthmore Borough.

Lead by Example - Develop model waste reduction, recycling and composting systems at County and municipal buildings, parks and events. Provide technical assistance to municipalities and schools and encourage adoption of the County program. Adopt and implement environmentally preferable procurement (EPP) policy that provides incentives for recovered products to be reused, made of recycled content or compost products, and to be reusable, recyclable or compostable at the end of their useful life. Implement reuse, recycling, and composting programs in events (e.g., with adoption of a Zero Waste Events Ordinance). The County recently established an interdepartmental Green Team to help implement and promote reuse, recycling, and composting programs in County buildings and operations, starting with the County Courthouse and Government Center buildings.

Outreach, Education & Technical Assistance - Provide comprehensive outreach, education and technical assistance to support all generators countywide to reduce waste, recycle and compost. Outreach and education will be directed at all sectors: residential, institutional, commercial, industrial, self-haul, and construction and demolition. Zero Waste policies and programs will be accepted and integrated better when there is outreach and education to ensure a more successful rollout of Zero Waste initiatives.

Reuse Collection - Create a curbside residential program for the collection of durable goods and non-durable textiles to be collected for reuse and/or recycling. This program can be created by the County in collaboration with nonprofit and for-profit organizations that specialize in the reuse and recycling of durable goods and nondurable textiles.

Edible Food Donation - Expand surplus edible food recovery from grocery stores and restaurants to food pantries and soup kitchens. Partner with current food recovery efforts and build on their success and established systems. These systems could be expanded to accommodate the additional edible food that could be rescued.

Provide grants to food banks and food rescue operations to support their expansion (e.g. providing refrigerated storage facilities, refrigerated trucks and mobile storage containers for collecting and distributing edible food).

Reuse & Repair - Organize Fixit Clinics and Repair Cafés at Delaware County libraries and other municipal buildings. These events would repair and prolong the life of the items and there are model events throughout the world that can be replicated locally. These events can be held regularly to help create the culture change in Delaware County around resource conservation. Develop a reuse, repair, and share online directory. This directory would offer information on where to divert materials for reuse, list local repair shops, list local reuse stores, and/or list

tool-lending libraries. These resources can be created by the Delaware County government or could be created in conjunction with a community partner.

Refillable Stations - Expand refill stations at grocery stores, reusable foodware at schools, water stations in public buildings and parks. Develop a mini-grant program to help fund refillable stations as models for different industries and applications/types of materials.

Zero Packaging Stores - Support the growth of zero packaging stores across Delaware County. Initiate a Zero Packaging Consortium to mobilize retailers interested in offering zero packaging options. Use the County's procurement power to purchase zero packaging options at a rate that consortium members can benefit from and keep prices affordable.

Leadership, Education & Inspiration County-Level Staff Actions	Estimated Impacts FTE = Full Time Equivalent $ = Hauler/Contractor/ Consultant Support	
	FTE	$
Develop and oversee implementation of County ordinance and draft model municipal ordinances addressing: single use plastics, plastic shopping bags and other product policies	0.1	
Develop model programs for waste reduction, recycling and composting at County buildings, parks and events and provide technical assistance to municipalities and schools	0.2	$125,000
Provide comprehensive outreach, education and technical assistance to support all generators countywide to reduce waste, recycle and compost	0.3	$250,000
Partner with local non-profit organizations to create a curbside residential program for the collection of durable goods and non-durable textiles to be collected for reuse and/or recycling	0.1	
Partner with community organizations and County libraries to sponsor Fixit Clinics and Repair Cafés	0.1	$25,000
Create and maintain an online reuse and repair directory and promote repair and reuse businesses	0.1	
Develop a mini-grant program and provide support for edible food donation, refill stations and Zero packaging stores, and other community-led projects	0.1	$100,000
Annual Impact	1.0 FTE	$500,000

Universal Collection

Position Scope: This is a dedicated County staff position to oversee initiatives related to collecting waste, recyclables and organics in Delaware County's residential and commercial sectors.

Position Description: A dedicated County staff would support the initiatives related to collecting waste, recyclables and organics in Delaware County's residential and commercial sectors.

An early task (years 1-3) would be for the County staff to survey cities within Delaware County to determine if they would like to pursue any of these initiatives by themselves, or with assistance from Delaware County, and to determine which of these initiatives is of greatest interest. These 4 initiatives could be implemented together, or independently. The development of one or more of these initiatives could be started in one municipality interested in piloting this effort in the county. County staff would coordinate the development process through engagement with City staff, the existing hauler(s), and local existing or potential diversion service providers. County staff would draft the model Universal Collection ordinance and then provide support to other municipalities in Delaware County to adopt the ordinance (years 4-10).

A similar process and timeline would be followed to develop and implement Universal recycling and composting collection programs. In both cases, the timing of policy implementation must take into consideration the availability of services and infrastructure to support the requirements of the policy.

Special care would need to be taken to design the Universal collection Ordinance or Program to stimulate competition. That might be facilitated by Delaware County applying for federal infrastructure funding to support these initiatives, particularly in disadvantaged communities. Private haulers would be interested in getting such "free" money to implement programs and would be willing to think outside of the current boxes that define collection systems within the County.

Save-As-You-Throw and Reducing Frequency of Trash Collection could be designed into existing contracts with haulers, or included as part of a Universal Collection Ordinance or Program.

County staff would provide municipalities with ongoing technical support. Other County staff activities are included below.

Universal Collection County-Level Staff Actions	Estimated Impacts FTE = Full Time Equivalent $ = Hauler/Contractor/ Consultant Support	
	FTE	$
Collaborate with municipalities	0.1[1]	35,000[1]
Develop Universal collection ordinance	0.4	50,000
Develop Universal collection pilot program	0.4	50,000
Expand Universal collection program countywide	0.2	50,000
Include Save As You Throw	0.1[1]	20,000[1]
Include Every Other Week	0.1[1]	20,000[1]
Support competition	0.1[1]	0
Apply for grants	0.1[1]	10,000[1]
Annual Impact	1.0 FTE	$150,000
[1]One-Time Cost	0.5 FTE	$85,000

Building Material Reuse & Recycling

Position Scope: This is a dedicated County staff position to oversee initiatives related to reducing waste in Delaware County's building sector.

Position Description: A dedicated County staff would support the expansion of diversion activities identified in the initiatives related to the building sector, which include deconstruction, construction & demolition recycling requirements, and building material reuse centers.

An early task (years 1-3) would be for the County staff to provide technical assistance to Delaware County municipalities in developing a model deconstruction ordinance for inclusion in local building codes. This task could be initiated in one municipality interested in piloting this effort in the county. The County staff would coordinate the development process through engagement with City staff, local building industry stakeholders, and local existing or potential diversion service providers. The County staff would support the adoption of the model deconstruction ordinance and then provide support to other municipalities in Delaware County to adopt the ordinance (years 4-10).

A similar process and timeline would be followed to develop and implement model construction & demolition recycling requirements. In both cases, the timing of policy implementation must take into consideration the availability of services and infrastructure to support the requirements of the policy.

The County staff would work with the workforce development and diversion service provider communities to develop a grant program for enterprise development to support the growth of Delaware County's deconstruction service

and building material reuse sectors (years 2-4). Grants would cover workforce development for deconstruction crews and building material reuse infrastructure. The County staff would then administer and oversee the grant program as needed (years 4-10).

The County staff would provide municipalities with ongoing technical support. Other County staff activities are included below.

Building Material Reuse & Recycling County-Level Staff Actions	Estimated Impacts FTE = Full Time Equivalent $ = Hauler/Contractor/ Consultant Support	
	FTE	$
Develop a deconstruction ordinance	0.1	50,000[1]
Support the growth of Delaware County's deconstruction sector	0.1	0
Establish a grant or loan program	0.1	50,000
Adopt a landfill ban for construction & demolition debris	0.1	50,000[1]
Adopt a construction & demolition debris diversion ordinance	0.1	50,000[1]
Support the growth of Delaware County's construction & demolition diversion sector	0.1	0
Assist with planning for a County-owned or Authority-owned building material recovery yard	0.1	0
Look for a site, including at local big box home stores (e.g. Home Depot or Lowe's) for a building material reuse center.	0.1	0
Assess municipally-owned properties to determine if a suitable site for development of a building material reuse center exists	0.1	0
Support the establishment of building material reuse centers in Delaware County	0.1	0
Annual Impact	1.0 FTE	$50,000
[1]One-Time Cost		$150,000

Zero Waste Infrastructure

Position Scope: This is a dedicated County staff position to oversee initiatives related to Zero Waste infrastructure development.

An important part of moving towards Zero Waste is ensuring that there is adequate infrastructure in place for municipalities to cost effectively and conveniently increase diversion rates. Several of the Zero Waste initiatives identified for the plan relate to infrastructure, including increasing recycling and composting processing and drop-off options and building capacity for reuse. The Delaware County Solid Waste Authority is in a prime position to leverage its existing investments in waste

disposal to build out capacity in Delaware County. The County as well can invest in infrastructure through public-private partnerships that support the work existing private businesses are already doing in the County.

There is currently a strong climate for infrastructure investments with funding opportunities and a recognition of the importance of the role in reducing waste.

The **Department of Environmental Protection** recently came out with recommendations to update Act 101.[7] These include:

- Diversion of organic waste from landfills by funding composting and anaerobic digestion projects
- Support smaller, dual-stream and commingled waste recycling facilities
- Fund regional public Material Recovery Facilities (MRFs) to create competition and increase stability in the cost of processing recyclables.
- Expand access to recycling through convenience centers. Ensure all Pennsylvanians have convenient access to all recycling options.

State Funding: There are several grant programs accessible to the County through Act 101 and other legislation. These include:

- 901 Planning Grants: Planning grants are awarded to counties for 80% of approved costs for preparing municipal waste management plans, as required by Act 101, for carrying out related studies, surveys, investigations, inquiries, research and analysis, including those related to siting, environmental mediation, education programs on pollution prevention and household hazardous waste (HHW) and providing technical assistance to small businesses for pollution prevention
- 902 Development and Implementation Grants: Recycling program development and implementation grants. 90% funding of approved recycling program costs (100% for financially distressed municipalities). Examples of eligible projects include operating leaf compost facilities, developing web-based programs on recycling for consumers, expanding recycling processing facilities, installing data collection systems on recycling vehicles, continuing and creating curbside recycling programs, and developing educational materials to encourage residents to properly recycle.
- 903 Grants provide a 50% reimbursement for County Recycling Coordinators' salary and expenses. This grant is only available to Pennsylvania county governments.
- 904 Grants: Recycling Program Performance Grants are available to all Pennsylvania local governments with recycling programs. Twenty-six of the

[7] PA Environment Digest Blog, David E. Hess.
http://paenvironmentdaily.blogspot.com/2021/12/dep-to-outline-recommendations-for_15.html

49 municipalities in Delaware County received grants in 2019 (latest available), totaling over $700,000 in grants. The average grant per municipality was $28,000. The average grant per household for the municipalities that received grants was $5.97 per household. If all municipalities performed as well and submitted grant applications, the county would bring in an additional $450,000 per year.

- Technical Assistance Grants: Recycling technical assistance, up to a value of $7,500, is available free of charge to Pennsylvania local governments selected to participate. The purpose of the program is to upgrade recycling programs to maximize material recovery and ensure program sustainability.

Federal Infrastructure Funding: With the passage of the Bipartisan Infrastructure Act, $325 million is now flowing from the U.S. Environmental Protection Agency (EPA) into local communities, $250 million for development of facilities and $75 million for development of outreach and education programs. Other Federal agencies also are funding the growth of recycling infrastructure, including the U.S. Department of Energy, U.S. Department of Labor, and the U.S. Department of Agriculture. There are other federal funding sources for local economic development that have been used to fund recycling infrastructure in other locations.

Industry Funding: Industry has supported significant efforts to increase resident access to high quality recycling programs. These include the Closed Loop Fund, Recycling Partnership, and various coalitions such as the American Beverage Association, PET coalition, Polypropylene Coalition, Glass Recycling Coalition, Food Packaging Institute, and carton council. These are all groups actively looking for projects to fund and potential sources for capital investments

The following sections provide recommendations for implementation steps and planning level costs.

Recycling: As described in the municipal systems summary, each of the 49 municipalities in Delaware County currently contract on their own for recycling (either directly with the processor or indirectly through a contract with the waste hauler). Costs for services vary greatly between municipalities and each of the four primary MRFs utilized by municipalities have slightly different rules for how recycling is sorted, making regional education difficult. Many municipalities have difficulty getting answers on what happens to their recycling and where it ends up.

While the regional private marketplace is currently handling the recycling generated in Delaware County, no material recovery facilities or processors are located within the county. The County and/or the Authority can take an enhanced role in providing services and infrastructure that increase capacity to support Delaware County's growing needs while providing economic development and workforce development benefits to the County. The work can be done in phases

that would provide municipalities increasing support throughout the implementation stages, as described below.

Technical Assistance: With a median size of 2,640 households, municipalities in Delaware County have limited staffing and typically lack the funding to pay for the expertise needed to negotiate the most cost-effective contracts. The County can assist municipalities in designing the program and developing and evaluating bid documents with a goal of increasing competition and lower costs to residents. Many counties provide this service through their state grant-supported recycling coordinator position.

Multi-Municipal Contracts: The County can take technical assistance one step further and support the development of multi-municipal bids that can result in lower costs due to economies of scale and provide consistency in education and recycling rules between neighboring municipalities. The listening sessions conducted for the planning process indicated that there is interest in this and precedent in terms of sharing services such as fire, police and 911 services. Municipalities can work together through contracts with private companies, or in the case of municipally run services, work together to create more efficiencies for everyone.

Increase Transfer Capacity at the Authority: The Authority could begin to accept recycling at the transfer stations relatively quickly (1-3 years) by leveraging the planned investments in the Authority transfer stations. There may be opportunities to dedicate tip floor space to begin transferring through the existing transfer stations to existing MRFs. This would be limited by the current layout of the facilities and may require modifications to the existing permits. The Authority is already planning on investing in replacing the transfer stations, the inclusion of additional bays for recycling transfer could be incorporated. Most of the cost for operating the transfer station are in the site, staff, equipment used for loading trucks and truck weigh scale that are all needed for the primary trash function of the transfer stations regardless of additional streams.

Providing transfer options for additional diversion streams allows the Authority to negotiate pricing for larger quantities of materials, taking advantage of quantities of scale. And this could also help the County attract local markets for recyclable materials. Contracts with revenue sharing result in the lowest costs to municipalities over time since they share the value of recycling as the markets shift while providing the processor consistent fees to cover the processing costs. Revenue share agreements typically require a minimum number of tons and a level of technical expertise that many of the small municipalities in Delaware County don't have.

Municipalities would benefit from shorter drive distances to the centrally located transfer stations, rather than to the recycling facilities which are all located outside of Delaware County. Recycling would be transported from the transfer stations in larger loads that result in lower transportation emissions per ton. In addition, it

would set a standard for how materials are sorted for recycling, allowing for regional education efforts. Additionally, the Authority would provide transparency, accurate reporting, and accountability to ensure that items residents put at the curb are truly being recycled.

Since there is no guarantee of municipal recycling flowing through the transfer stations, the Authority would have to first understand the demand and potential tons of material available before taking the next step in developing a MRF. And the additional material will bring in additional tip fee revenue to support the Authority's operations.

Build a Delaware County Material Recovery Facility (MRF): A Materials Recovery Facility, or MRF, is where recyclables are processed and prepared for sale to manufacturers as raw materials for new products. MRFs are important links in the recycling system chain as they provide communities a place for recyclable material to go after collection. They can be public, private, or operated through public/private partnerships. There are four primary MRFs operating within the region or with access to a regional transfer station, however none are located in Delaware County. Currently each MRF servicing municipalities in Delaware County accepts slightly different materials with different rules for recycling. By providing centralized recycling processing, rules could be uniformly applied across the county. In addition, processing material locally reduces transportation costs and emissions, a factor exacerbated during times of high fuel and capital costs, like we're currently experiencing.

A County or Authority run MRF increases accountability and transparency for recycling beyond that of the transfer model. Control of how the system operates increases the ability for material collected for recycling to be used for its highest and best use and directed to local market development initiatives for use as feedstock. A MRF brings in new revenue streams from tipping fees and materials sales and provides job creation and workforce development opportunities for people returning from incarceration and other populations.

Planning, development, and implementation of a MRF in Delaware County is likely a 3 to 5-year process that could include developing and issuing an RFP for qualified vendors to design, build, and possibly operate the facility. Costs for a new MRF can range from $2.5 million to $40 million, based on the automation of sorting and number of tons the system can process per hour. Careful consideration should be given to the existing private capacity and the potential for additional recovery in Delaware County to determine what will best serve the county. Currently, residents and businesses in Delaware County recycle 77,000 tons per year. Based on waste characterization analysis, an additional 150,000 tons are potentially available for processing.

Mini-MRF: A new class of small, modular MRF systems are being designed to process about 5-7 tons of single stream per hour, or 15,000 tons per year on one shift. These systems can have minimal equipment costs of approximately $2.5

million dollars that allow for sorting of material on a small footprint. These systems would likely fit well into the footprint of either of the transfer stations and allow for scaling up to 30,000 tons with two shifts – or expansion to both transfer stations and up to 60,000 tons per year for a $5 million investment in equipment. As the technology for these systems is relatively new, it is recommended to watch the progress of these systems over the next several years.

Small MRF: A small MRF system from a turn-key equipment manufacturer such as Machinex can be designed to process 15 tons per hour, or about 30,000 tons per year on one shift. These systems may cost in the range of roughly $6 to $8 million dollars and include advanced automation such as optics, screens and robots that separate out different types of materials in single stream recycling.

In Ann Arbor Michigan, the city recently re-capitalized a shuttered MRF through a public private partnership with Recycle Ann Arbor (RAA). The MRF launched at the end of 2021. RAA operates the MRF and the city provided a ground lease for the 40,000 square foot building along with a 10-year contract for recycling. The equipment, purchased from Machinex, costs around $6,000,000 but RAA was able to utilize some of the old existing equipment which lowered the costs. There were additional building modification costs during the 18-month installation project. While the city has approximately 14,000 tons of recycling per year, the facility will process 30,000 tons and deliver a host fee rebate to the city for all 3rd party tons. The sorting staff is unionized, and they are working with people returning from incarceration on workforce development.

Full Scale MRF: A full scale MRF can process 100,000-200,000 tons or more per year, operating at 30-50 tons/hour. These systems can range from $20 million and up depending on the level of sorting desired. To achieve this level of throughput, the facilities require a larger footprint and more sophisticated equipment that further automates the sorting process.

Rumpke recently announced the development of a 200,000 square foot MRF being developed on 25 acres in Columbus, Ohio, set to open in 2024. The facility will cost $50 million and process 50 tons of recycling per hour. They plan to incorporate career development, research and education into the facility, including a partnership with Ohio State University.

Expected Operating Costs: The significant cost of the capital highlights the importance of right-sizing the system. Operating a system without enough tons to support the capital increases costs significantly. An optimized system running at capacity can range in operating costs (including capital) from $80/ton to $160/ton with the lower costs coming from the larger systems. These costs are highly dependent on labor costs, occupancy expenses and energy costs. The market value of the materials in single stream, once they are sorted, can be worth more than $100/ton in average market conditions, resulting in a net cost of $-20/ton to $50/ton under current market conditions.

There are various ways the facility could be constructed and operated. In Centre County, PA, the waste authority owns and operates a MRF (and fleet of trucks). There are many other examples of a county or municipality contracting with a private company to build and/or operate the facility for them, either at a fixed cost or per ton basis. Some contracts allow for the private operator to solicit additional tons from other communities and provide a host fee or other incentive to the county owner.

Composting: An organics processing/compost facility is where compostable materials such as yard trimmings, food scraps, and compostable paper are converted into a nutrient-rich soil amendment. They can be public, private, or operated through public/private partnerships. Currently in PA, there is a stricter permitting process for food scraps than yard waste, resulting in limited capacity for food scraps. The Authority previously operated yard trimmings composting at both transfer stations but has since stopped providing those services and currently does not accept yard waste or food scraps for composting. There are several private facilities that accept yard waste operating within Delaware County, as well as municipally operating yard waste and leaf waste composting operations. However, there is only one composting facility that accepts food scraps in Delaware County, making food scrap composting extremely limited.

Organic material and food scraps represent over a third of what is left in the garbage. Increasing access to cost-effective options will be critical for municipalities to significantly reduce their waste streams. The County is fortunate to have a passionate and dedicated contingent of composting providers that service subscription customers throughout the county. The County and Authority should work together with this group, through a task force or other mechanism, as plans for additional processing capacity are developed. This will ensure the local expertise and community are engaged in the process moving forward. As processing capacity is identified, the Authority should play a role in determining if it makes sense to have operations located at or provide acceptance at the transfer stations.

There are various paths the County can take to support food waste composting. Within a Zero Waste framework, the Institute for Local Self Reliance (ILSR)[8] published a Food Waste Hierarchy of strategies from reduction to processing options. These include reduction, food donation and backyard composting at the top of the hierarchy. Communities such as Haverford have robust backyard composting programs that can serve as a model. However, more accessible solutions will be needed to further reduce organics from the waste stream. ILSR highlights small scale, decentralized solutions. Media Borough currently provides municipal collection of food scraps and brings it to a private company, Kitchen Harvest at Linvilla, for composting. Additionally, there is a growing and robust

[8] Food Waste Hierarchy, Institute for Local Self-Reliance: https://ilsr.org/food-waste-hierarchy/

network of small-scale composters throughout the Delaware County and Philadelphia regions actively looking to expand access to composting to residents and businesses.

The County should prioritize the exploration of existing opportunities to commingle food waste with existing yard waste facilities, expand on-farm composting and explore permitting for non on-farm traditional composting options.

Drop-offs for Recyclables and Hard to Recycle Materials: As of June 2022, the Authority provides single stream dumpsters for municipal drop off programs, currently at 18 locations. Some communities have additional streams at their drop offs such as textiles. Appendix E includes a list of drop-off recycling locations. Some divertible materials are not accepted in curbside recycling collection programs or at drop-off recycling centers. Those materials are often "hard to recycle" because they may contain hazardous materials or their end markets may be more difficult to secure than typical household recyclable commodities such as paper, cardboard, bottles, and cans.

A Center for Hard to Recycle Materials, or CHaRM, is a kind of drop-off facility that provides an opportunity for community members to divert more types of materials from disposal. CHaRM facilities are known to accept household appliances, tires, scrap metal, books, textiles, electronics, mattresses, hard to recycle plastics, ceramics, concrete, and other materials based on availability of local markets. CHaRM facilities collect these items, may deconstruct or process some items such as electronics, and market the materials for recycling, repurposing, or reuse. CHaRM facilities create jobs through collection, processing, deconstruction, and marketing. Having established drop off locations for hard to dispose of items, like tires, can reduce problems with illegal dumping.

The Authority has an opportunity to expand their transfer stations to allow residents to include a CHaRM. As the Authority has already expressed their intention to rebuild the facilities, designing space for a CHaRM would likely not require significant additional costs. Revenue from a gate fee for residents would cover the disposal and labor costs, potentially bringing in additional revenue to support the Authority.

Boulder, CO is home to the nation's first CHaRM facility, operated by the non-profit EcoCycle.[9] This mostly outdoor drive-through facility provides drop-off bins in covered areas where visitors can recycle electronics, hard-to-recycle plastics, appliances, mattresses & box springs, bicycles & parts, books & manuals, cooking oil, porcelain toilets, sinks & urinals, concrete, fire extinguishers, shredded paper, yoga mats, and textiles. The facility also includes a small hardback book processing room and a 6,000 square foot warehouse that houses e-waste processing, an

[9] Center for Hard to Recycle Materials, Ecocycle. https://www.ecocycle.org/charm

expanded polystyrene densifier, and office space. The EcoCycle CHaRM facility keeps functional items in use locally and they also accept traditional recyclables and compostables. Each vehicle is charged a $3 facility use fee. Additional charges apply for some items. This CHaRM facility is also funded in part by the City of Boulder trash tax dollars.

Zero Waste Infrastructure County-Level or Authority-Level Staff Actions	Estimated Impacts FTE = Full Time Equivalent $ = Hauler/Contractor/ Consultant Support	
	FTE	$
Develop relationships with municipalities to document needs for processing and technical support	0.2	
Work to find short- and long-term solutions to increase capacity to transfer additional streams, including recycling, organics and expanded drop off at Authority transfer stations	0.1	$35,0001
Negotiate contracts to transload organics and recycling for processing at existing facilities	0.1	$15,0001
Enter into municipal and commercial contracts to receive organics and recycling at transfer stations	0.1	$25,0001
Identify technology and systems available to process organics and recycling	0.1	$25,0001
Feasibility study on siting a MRF or organics processing solution at the transfer station locations	0.1	$50,0001
Develop budgets and solicit approval from appropriate parties	0.1	
Secure grants and funding opportunities	0.1	
Project manage financing and development of MRF and composting infrastructure	0.1	$150,0001
Annual Impact	1.0 FTE	
10ne-Time Cost		$300,000

Time-Action Schedule - Phase 1 and Phase 2

County-Level Staff Actions Phase 1 (Years 1-3)	FTE	One-Time FTE	Annual Costs	One-Time Costs	Annual Diversion Potential (tons)	Annual GHG Reduction Potential (MTCO2e)
Leadership, Education & Inspiration						
Develop and oversee implementation of County ordinance and draft model municipal ordinances addressing: single use plastics, plastic shopping bags and other product policies	0.1				3,812	-1,974
Develop model programs for waste reduction, recycling and composting at County buildings, parks and events and provide technical assistance to municipalities and schools	0.2		$125,000		3,326	-4,008
Provide comprehensive outreach, education and technical assistance to support all generators countywide to reduce waste, recycle and compost	0.3		$125,000		22,603	-28,638
Leadership, Education & Inspiration Total	0.6	0	$250,000	0	29,741	-34,620
Universal Collection						
Collaborate with municipalities		0.1		$35,000		
Develop Universal collection ordinance	0.4		$50,000		11,780	-16,055
Develop Universal collection pilot program	0.4		$50,000			
Expand Universal collection program countywide	0.2		$50,000		11,780	-16,055
Include Save As You Throw		0.1		$20,000	3,736	-6,362
Include Every Other Week						
Support competition		0.1				
Apply for grants		0.1		$10,000		
Universal Collection Total	1	0.4	$150,000	$65,000	27,296	-38,472

County-Level Staff Actions Phase 1 (Years 1-3)	FTE	One-Time FTE	Annual Costs	One-Time Costs	Annual Diversion Potential (tons)	Annual GHG Reduction Potential (MTCO2e)
Building Material Reuse & Recycling						
Develop a deconstruction ordinance	0.1			$50,000	2,779	-5,602
Support the growth of Delaware County's deconstruction sector	0.1					
Establish a grant or loan program	0.1		$50,000			
Adopt a landfill ban for construction & demolition debris	0.1			$50,000		
Support the growth of Delaware County's construction & demolition diversion sector	0.1					
Building Material Reuse & Recycling Total	0.5		$50,000	$100,000	2,779	-5,602
Zero Waste Infrastructure						
Develop relationships with municipalities to document needs for processing and technical support	0.2					
Work to find short- and long-term solutions to increase capacity to transfer additional streams, including recycling, organics and expanded drop off at Authority transfer stations	0.1			$35,000		
Negotiate contracts to transload organics and recycling for processing at existing facilities	0.1			$15,000		
Enter into municipal and commercial contracts to receive organics and recycling at transfer stations	0.1			$25,000		
Identify technology and systems available to process organics and recycling	0.1			$25,000		
Feasibility study on siting a MRF or organics processing solution at the transfer station locations	0.1			$50,000		
Develop budgets and solicit approval from appropriate parties	0.1					
Secure grants and funding opportunities	0.1					
Project manage financing and development of MRF and composting infrastructure	0.1			$150,000		
Zero Waste Infrastructure Total	1	0	$0.00	$300,000	0	0
Total Phase 1 (Years 1-3)	3.1	0.4	$450,000	$465,000	59,816	-78,694

County-Level Staff Actions Phase 2 (Years 4-10)	FTE	One-Time FTE	Annual Costs	One-Time Costs	Annual Diversion Potential (tons)	Annual GHG Reduction Potential (MTCO2e)
Leadership, Education & Inspiration						
Develop and oversee implementation of County ordinance and draft model municipal ordinances addressing: single use plastics, plastic shopping bags and other product policies	0.1				11,437	-5,922
Develop model programs for waste reduction, recycling and composting at County buildings, parks and events and provide technical assistance to municipalities and schools	0.2		$125,000		16,127	-19,836
Provide comprehensive outreach, education and technical assistance to support all generators countywide to reduce waste, recycle and compost	0.3		$250,000		68,467	-85,940
Partner with local non-profit organizations to create a curbside residential program for the collection of durable goods and non-durable textiles to be collected for reuse and/or recycling	0.1				2,113	-5,481
Partner with community organizations and County libraries to sponsor Fixit Clinics and Repair Cafés	0.1		$25,000		1,542	-3,976
Create and maintain an online reuse and repair directory and promote repair and reuse businesses	0.1				1,542	-3,976
Develop a mini-grant program and provide support for edible food donation, refill stations and Zero packaging stores, and other community-led projects	0.1		$100,000			
- Edible Food Donation					4,955	-18,722
- Refillable Stations Program					3,812	-1,974
-Zero Packaging Store Program					5,359	-14,695
Leadership, Education & Inspiration Total	1	0	$500,000.0	0	115,354	-160,521

County-Level Staff Actions Phase 2 (Years 4-10)	FTE	One-Time FTE	Annual Costs	One-Time Costs	Annual Diversion Potential (tons)	Annual GHG Reduction Potential (MTCO2e)
Universal Collection						
Collaborate with municipalities						
Develop Universal collection ordinance	0.4		$50,000		35,616	-45,450
Develop Universal collection pilot program	0.4		$50,000			
Expand Universal collection program countywide	0.2		$50,000		35,616	-45,450
Include Save As You Throw					15,398	-20,701
Include Every Other Week		0.1		$20,000	1,717	-2,069
Universal Collection Total	1	0.1	$150,000	$20,000	88,347	-113,670
Building Material Reuse & Recycling						
Develop a deconstruction ordinance	0.1				6,046	-11,634
Support the growth of Delaware County's deconstruction sector	0.1					
Establish a grant or loan program	0.1		$50,000			
Adopt a landfill ban for construction & demolition debris	0.1					
Adopt a construction & demolition debris diversion ordinance	0.1			$50,000	3,831	-11,586
Support the growth of Delaware County's construction & demolition diversion sector	0.1					
Assist with planning for a County-owned or Authority-owned building material recovery yard	0.1					
Look for a site, including at local big box home stores (e.g. Home Depot or Lowe's) for a building material reuse center.	0.1					
Assess municipally-owned properties to determine if a suitable site for development of a building material reuse center exists	0.1					
Support the establishment of building material reuse centers in Delaware County	0.1				2,190	-5,115
Building Material Reuse & Recycling Total	1	0	$50,000	$50,000	12,067	-28,335

County-Level Staff Actions Phase 2 (Years 4-10)	FTE	One-Time FTE	Annual Costs	One-Time Costs	Annual Diversion Potential (tons)	Annual GHG Reduction Potential (MTCO2e)
Zero Waste Infrastructure						
Develop relationships with municipalities to document needs for processing and technical support	0.2					
Work to find short- and long-term solutions to increase capacity to transfer additional streams, including recycling, organics and expanded drop off at Authority transfer stations	0.1					
- Center for Hard to Recycle Materials					10,608	-8,773
- Material Recovery Facility					9,776	-20,787
- Organics Processing					16,406	2,219
Negotiate contracts to transload organics and recycling for processing at existing facilities	0.1					
Enter into municipal and commercial contracts to receive organics and recycling at transfer stations	0.1					
Identify technology and systems available to process organics and recycling	0.1					
Feasibility study on siting a MRF or organics processing solution at the transfer station locations	0.1					
Develop budgets and solicit approval from appropriate parties	0.1					
Secure grants and funding opportunities	0.1					
Project manage financing and development of MRF and composting infrastructure	0.1					
Zero Waste Infrastructure Total	1	0	0	0	36,791	-27,340
Total Phase 2 (Years 4-10)	4	0.1	$700,000	$70,000	252,559	-329,866

5. Selection and Justification of Municipal Waste Management Program

Delaware County, through the Delaware County Solid Waste Authority, has invested in publicly-owned facilities designed to meet needs of the residents and businesses within the 49 municipalities throughout Delaware County.

This Municipal Waste Management Plan update ensures that the County has sufficient processing and disposal capacity for its municipal waste for the next 10 years.

Through the development of the Guiding Principles curated by the Advisory Committee with extensive input from stakeholders in the community, this plan reflects the vision and needs of Delaware County residents and businesses.

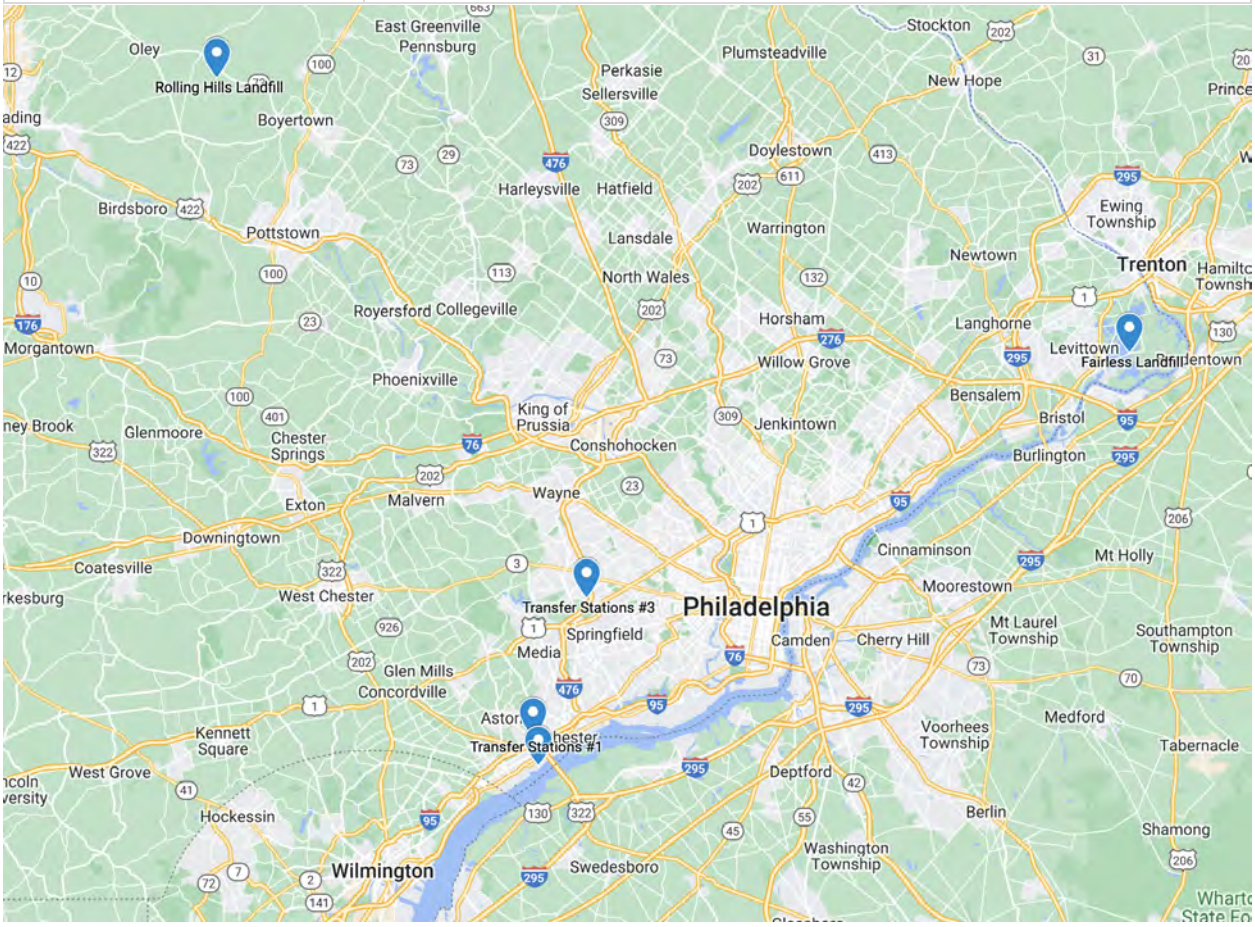
Through identification and analysis of the Zero Waste initiatives, this plan guides the County's transition to a Zero Waste system and ensures maximum feasible waste reduction of municipal waste.

6. Location

The Delaware County Solid Waste Authority's municipal solid waste facilities, publicly-owned and under contract, are identified in the map below.

Municipal Solid Waste Facilities

Facility	Address
Transfer Stations #1	2300 Concord Road, Chester Township, Delaware County
Transfer Stations #3	Sussex Boulevard and Marpit Drive in Marple Township, Delaware County
Rolling Hills Landfill	583 Longview Road, Boyertown, Earl Township, Berks County
Fairless Landfill	1000 Bordentown Road, Morrisville, Falls Township, Bucks County
Delaware Valley Resource Recovery Facility (Covanta)	10 Highland Ave, City of Chester, Delaware County



7. Implementing Entity Identification

Under Act 101 of 1988, counties have a responsibility to develop and implement municipal waste management plans. A key component of a County municipal waste management plan is to "ensure the availability of adequate permitted processing and disposal capacity for the municipal waste which is generated within its boundaries."

This plan also sets Delaware County on the path to Zero Waste and identifies the polices, programs and infrastructure to be developed over the next 10 years that will increase the countywide diversion rate from 34 percent to 84 percent.

Delaware County Council will take primary responsibility for implementing the plan in partnership with:

- Delaware County Solid Waste Authority
- Delaware County Sustainability Commission
- The 49 municipalities within Delaware County
- Private sector service providers
- Non-profit organizations and Zero Waste entrepreneurs

8. Public Function

Delaware County has determined that the publicly-owned facilities managed by the Delaware County Solid Waste Authority are a public function.

The Authority's system includes:

- Transfer Stations #1 and #3 – These facilities have the potential to fill service voids, such as recyclables and organics processing, construction & demolition debris processing, surplus building materials reuse centers, and drop-off centers for hard-to-recycle materials. The Authority contracts with Waste Management (now "WM") to manage the transfer stations.
- Rolling Hills Landfill – The County intends to phase out of incineration as a primary method of disposal and rely on the Rolling Hills Landfill which has been publicly owned since 1985.

Outside of the Authority's system are two major private facilities that the Authority currently contracts with:

- Fairless Landfill – The Authority has a contract with Waste Management through 2030.
- Delaware Valley Resource Recovery Facility (Covanta) – The Authority has a short-term contract with Covanta and intends to phase out of incineration in the short-term.

9. Copies of Ordinances and Resolutions

All forty-nine municipalities in Delaware passed an ordinance which regulates the disposal of all municipal solid waste from the municipality; requiring disposal at approved sites; providing a permit for solid waste collectors; providing for regulations and penalties; and entering into a joint cooperation agreement with Delaware County.

Appendix H contains Upper Darby Township Ordinance #2702, which represents

ordinances that each municipality enacted to direct the flow of municipal waste to the publicly owned sites as provided in the 2013 Delaware County Solid Waste Management Plan, Substantial Revision.

Each ordinance indicates that municipalities have full authority under applicable laws to provide for the management of municipal waste within its boundaries.

Each ordinance indicates that all collectors shall deliver and dispose of all municipal waste collected within the municipality to the solid waste facility designated by the County subject to such reasonable regulations for the operation thereof as may be established by the County and/or Contractor.

Delivery and disposal at any other place shall be a violation of the ordinance and cause for revocation of the collector's permit, except in special circumstances approved in advance by the municipality, the County and/or Contractor. All collectors shall comply with their operation, all applicable laws, ordinances, and regulations pertaining to the collection and transportation of municipal waste.

10. Orderly Extension

This Municipal Waste Management Plan update is consistent with prior Delaware County Solid Waste Management Plans and builds on the Delaware County Municipal Solid Waste Management Plan - 2013 Substantial Revision.

Delaware County has undertaken the development of the Municipal Waste Management Plan update to coincide with the development of the Delaware County Sustainability Plan. The Advisory Committee met with the Zero Waste Committee of the Delaware County Sustainability Commission to coordinate efforts and to inform the contents of each plan.

The Sustainability Plan includes the following Zero Waste and Resource Management Goals which are consistent with the Zero Waste approach included in the Municipal Waste Management Plan update.

- Increase percentage of materials purchased with recycled content
- Reduce waste generated in County properties
- Facilitate local reuse, repair, and recovery of materials
- Support policies and programs to reduce residential and commercial waste generated per capita
- Prevent, reduce, and recover food waste
- End incineration and increase methods of recovery to improve diversion from incineration and landfilling

11. Methods of Disposal Other Than By Contracts

Permits are required for Delaware County municipalities, licensed haulers, and landscapers using either Transfer Station #1, Transfer Station #3, or Delaware County waste entering the Delaware Valley Resource Recovery Facility.

Rolling Hills Landfill accepts waste generated in Berks County without a contract.

12. Non-Interference

This Municipal Waste Management Plan update does not interfere with any existing private facilities. The plan identifies opportunities to fill service voids within the County and will supplement and support private operations.

13. Public Participation

The planning process included extensive public outreach, including:

- 20 listening sessions with service providers, municipalities, environmental justice organizations, faith-based groups, schools and universities.
- Three workshops held at the Upper Darby and Norwood Public Libraries and at Chester City Hall addressing Guiding Principles, Zero Waste Initiatives, and Implementation.
- Online workshops via Zoom designed to coincide with the in-person meetings and covering the same topics.
- Four meetings of the Solid Waste Advisory Committee (with representatives from municipalities, community organizations, and service providers) and the Sustainability Commission's Zero Waste Committee.
- Publicity via a dedicated page on the County website, press releases, newsletter articles and flyers posted at County facilities and libraries.

14. Other Information

Life Cycle Analysis: Incineration vs. Landfilling vs. Zero Waste

The attached report (see Appendix I) details a life cycle analysis (LCA) and monetization of human and environmental health impacts from current diversion and disposal of municipal solid waste (MSW) generated in Delaware County, Pennsylvania in 2020. Similar analysis of projected diversion and disposal levels following implementation of a recommended Zero Waste Plan highlights the substantial human and environmental health benefits of the Zero Waste Plan recommendations. Sound Resource Management Group's LCA tool, Measuring Environmental Benefits Calculator (MEBCalc), provides results. MEBCalc relies on a number of supporting tools, scientific research papers, and reliable data on MSW management systems and facilities, as well as data estimates specific to Delaware County.

MEBCalc outputs cover nine different human and environmental health impacts, ranging from global climate health to local human health. Monetization in terms of environmental economic value (EEV) for each impact enables comparison among impact costs,[10] as well as calculation of a single indicator of overall EEV costs and benefits for MSW disposal and diversion. Global and local EEV benefits in this study flow from avoidance of two aspects of

Major findings…

- Fully implementing the zero-waste approach outlined in this report would result in estimated human health and environmental benefits of $820 million dollars annually.
- Covanta Delaware Valley's human health and environmental costs total $337/ton burned, compared to $144/ton for directly using Rolling Hills Landfill.
- Covanta Delaware Valley's human health costs are 23 times higher than those of Rolling Hills Landfill.
- Covanta Delaware Valley's climate costs are 69% higher than those of Rolling Hills Landfill
- Transportation impacts are insignificant relative to the impacts of incineration or landfilling and do not justify choosing incineration.
- Diverting waste from disposal has benefits (avoided harm to other communities) far greater than the harms of disposal by landfilling or incineration. Recycling and composting 522,126 tons of trash under the Delaware County Zero Waste Plan would avoid emissions of almost 703,000 tons of CO_2 equivalents.

[10] For example, the relative economic cost impact of one ton of greenhouse gas emissions on global climate health versus the economic cost impact of one ton of particulates or nitrogen oxides emissions on local human respiratory health

MSW materials' life cycles:

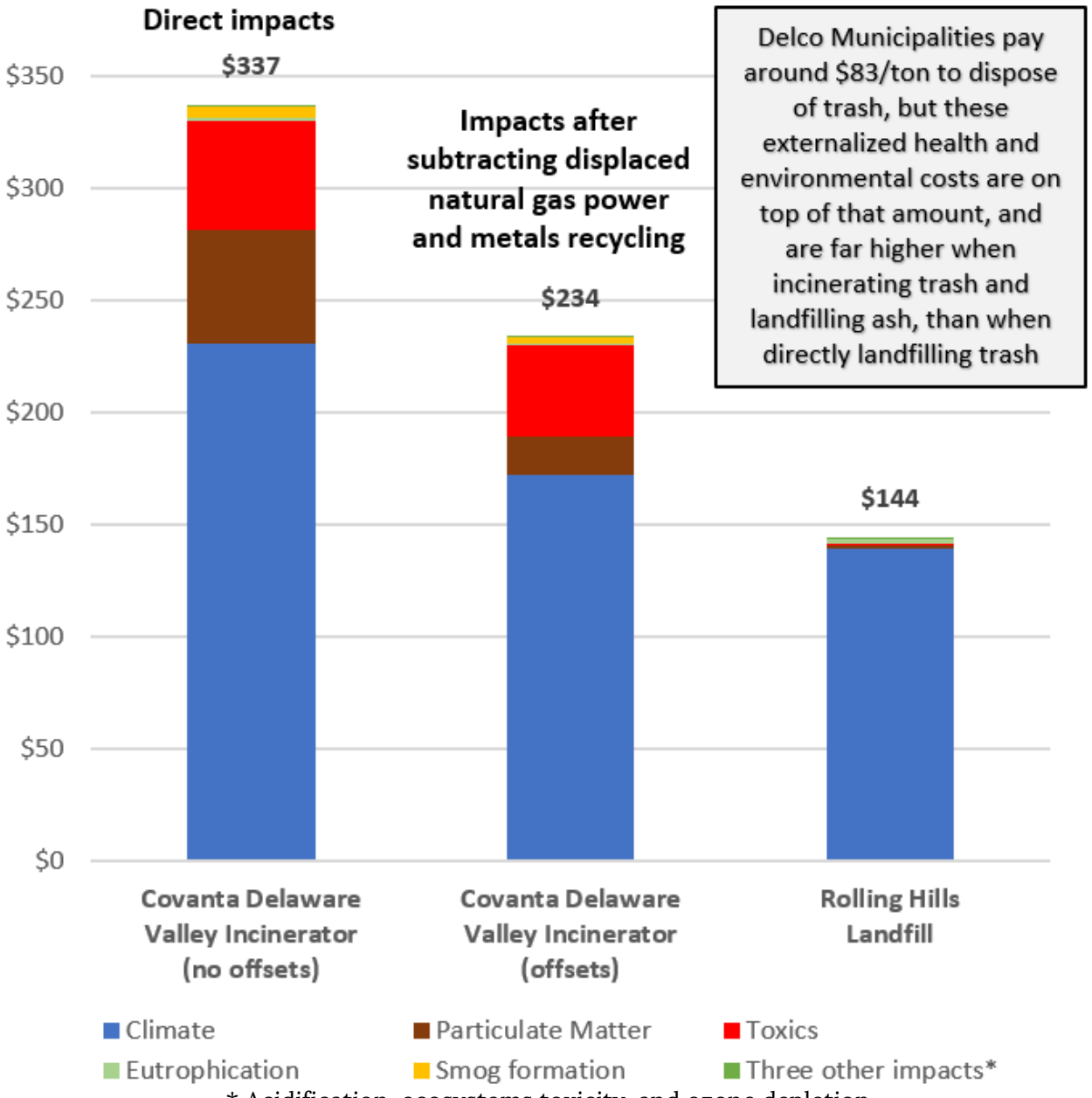
1. Upstream virgin-content manufacturing of materials and products using extracted ecosystem resources, and,
2. Downstream disposal EEV cost impacts when MSW is not reduced, reused, recycled, or composted.

Background

The county's solicitation required the use of a life cycle analysis (LCA) to examine the health and environmental impacts of the current waste system "versus the alternatives of direct use of conventional landfilling and of a Zero Waste approach." It requested that the analysis include "at a minimum, the impacts of global warming pollutants, toxic chemical pollutants (cancer and non-cancer effects), particulate matter emissions, and smog formation from emissions of nitrogen oxides and volatile organic compounds (VOCs) and their impacts on asthma and respiratory health" and that these measures be presented in a standardized way so that they could be evaluated side-by-side.

Health and environmental impacts are typically externalized. This means that they are not paid when purchasing the product or service, but are paid through one's medical bills, through reduced quality of life, through a degraded environment. They are not on the balance sheet, but they have significant impacts on the residents of Delaware County. For example, the Delaware County Solid Waste Authority pays Covanta about $44/ton for the tons that are sent to incinerate waste at the Covanta Facility in Chester. However, according to the analysis conducted, an additional $337/ton in health and environmental costs occur due to Covanta's operation, much of which is felt by residents in and near Chester whose health is most directly impacted.

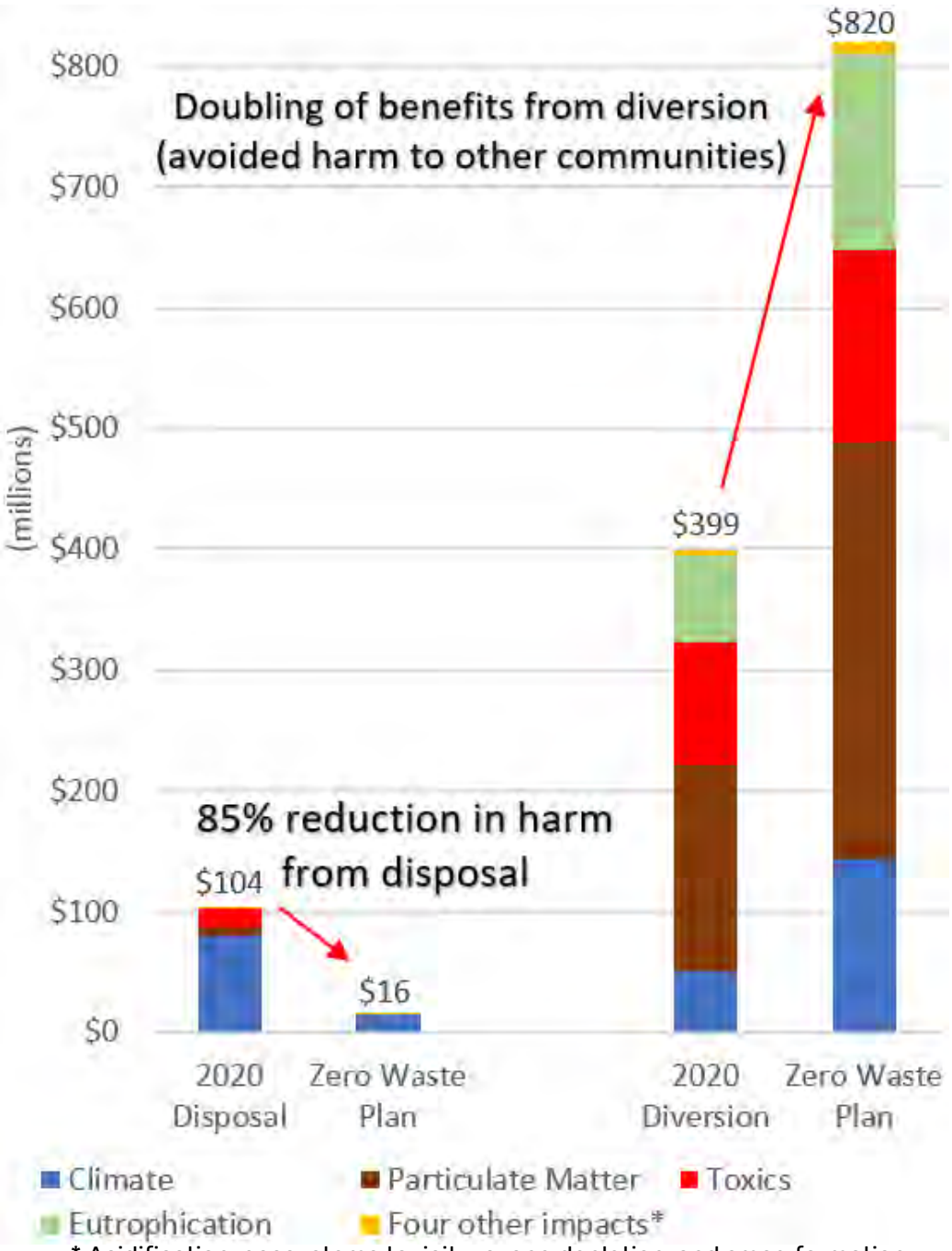
Health & Environmental Impacts per Ton
of Waste Disposed at Covanta Delaware Valley Incinerator vs.
Rolling Hills Landfill



* Acidification, ecosystems toxicity, and ozone depletion

Note: This chart is the same as Figure S2 and Figure 2, but for Rolling Hills Landfill, it shows just the bar calculated with the 20-year impact of methane (which is slightly greater impact than when calculated with methane's 100-year impact). Table A3 provides some of the raw numbers behind this chart.

Annual Health and Environmental Impacts of Implementing Delaware County Zero Waste Plan (2021 dollars)



* Acidification, ecosystems toxicity, ozone depletion, and smog formation

85% reduction of disposal impacts from a combination of diverting materials from disposal, and switching from incineration (and landfilling ash) to direct use of landfilling.

Note: This chart combines Figure S1 / Figure 1 and Figure S4 / Figure 5, but all expressed in positive dollars. Table A1, A2, B1, and B2 provide the raw numbers behind this chart.

The analysis compares the impacts of using the Covanta Delaware Valley trash incinerator in the City of Chester, Delaware County (and landfilling the incinerator ash at the Delaware County Solid Waste Authority's Rolling Hills Landfill in Berks County) to directly sending unburned trash to Rolling Hills Landfill. It also looks at the 2020 baseline – where Delaware County's trash went mostly to Covanta Delaware Valley, but also to Covanta's incinerator in Plymouth Township, Montgomery County, and to Waste Management's Fairless Landfill in Bucks County – and compares it to a scenario where this Zero Waste Plan is implemented, meaning that much of the county's discards are reduced, reused, recycled, and composted instead of being wasted, with any remaining waste directly landfilled instead of incinerating it first.

Extensive data gathering went into the analysis including air emissions data for the incinerators, waste composition data, annual rainfall (affecting landfill gas formation), landfill gas management methods, travel distances from the county's transfer stations to waste facilities, projections on waste reduction, distances to recycling markets, and much more.

Impacts of Zero Waste Strategy

Diversion of 522,126 tons of MSW from disposal to recycling and composting as projected when fully implementing the strategies outlined in this plan would avoid emissions of almost 703,000 tons of carbon dioxide equivalents (eCO_2). This represents an additional 457,000 tons of avoided emissions compared to the current baseline diversion rate. This metric accounts for the climate impacts of collecting recyclables and compostables, MRF processing, composting, and hauling and shipping diverted materials. It also accounts for upstream manufacturing of recycled-content products, as well as displacement of virgin-content manufacturing of the same quantities and types of products. In addition, for biogenic materials diverted to composting, the metric accounts for the upstream displacement of petroleum-based fertilizers and pesticides by soil amendments composted from diverted biogenic materials such as food scraps and yard maintenance debris. The total for avoided carbon dioxide equivalent emissions also includes incremental carbon sequestration due to healthier soils from organic soil supplements enhancing plant growth.

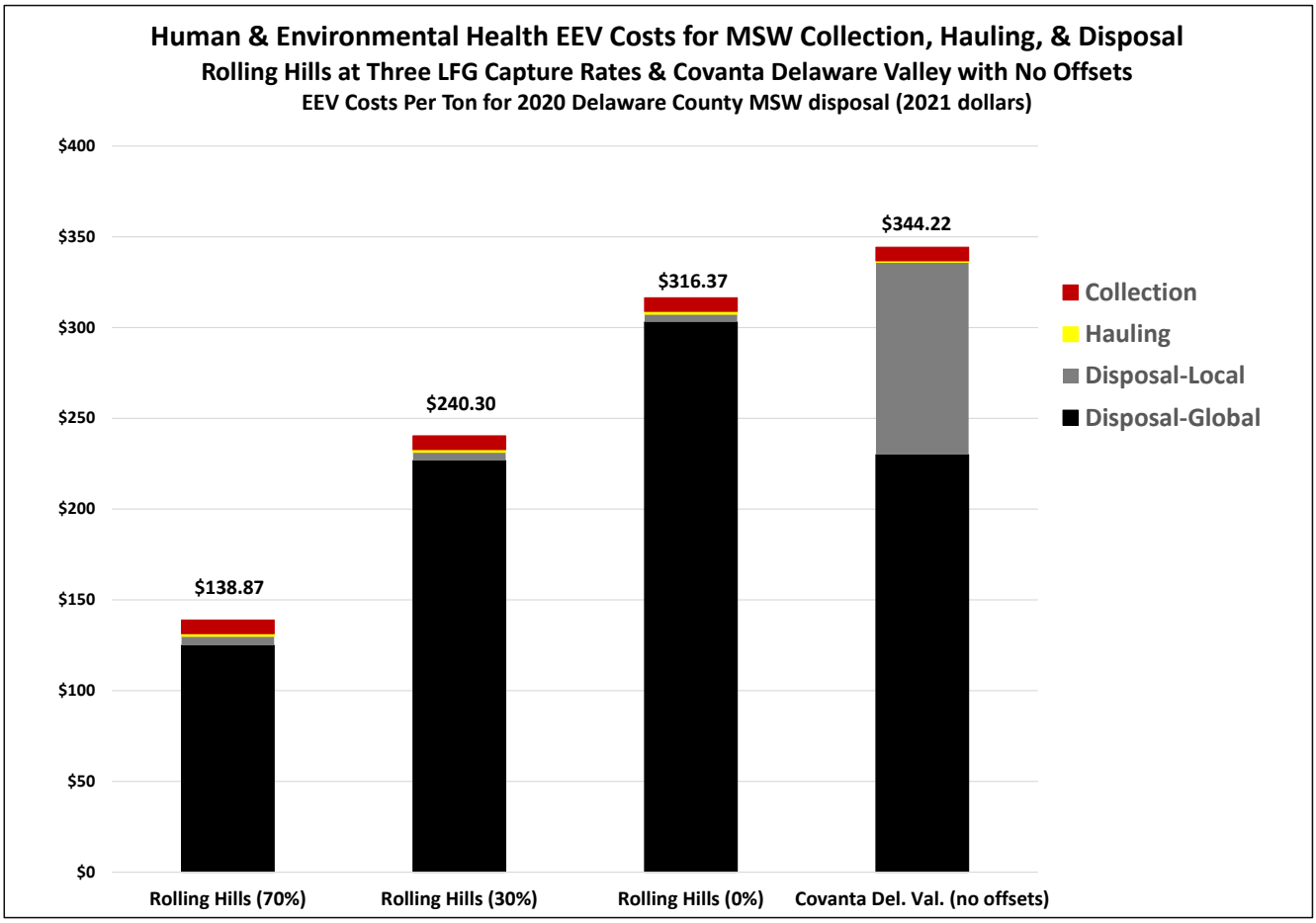
According to EPA, avoidance of 703,000 tons of carbon dioxide equivalent carbon emissions provides the same climate benefit as taking 142,000 gasoline-powered passenger vehicles off the road each year following completion of the Delaware County Zero Waste Plan, or reducing annual miles driven by gasoline-powered passenger cars by 1.6 billion miles.[11]

[11] U.S. EPA, Greenhouse Gas Equivalencies Calculator, available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Trucking Emissions

Trucking trash from the county's transfer stations to Rolling Hills Landfill is five times the distance than trucking to Covanta in Chester. The health and environmental impacts of trucking trash directly to the landfill ($1.52/ton) are twice that of burning it in Chester and hauling ash to the landfill ($0.76/ton). However, the trucking emissions are just 1.1% of the overall impacts of sending trash to Rolling Hills Landfill (first bar in chart below), and 0.2% of the overall impacts of sending trash to be incinerated at Covanta and then trucking ash to the same landfill. The analysis shows that even with these increased emissions from transportation, Rolling Hills Landfill results in significantly lower human and environmental health impacts for trash disposal.

The red and yellow lines in the following chart represent the transportation portion of human and environmental health impacts. Waste collection impacts (red) are the same, representing the smaller trucks picking up trash from residents to deliver to the county's transfer stations or direct to Covanta. Hauling impacts (in yellow) represents larger trucks (transfer trailers) that can handle about three times as much trash, and which haul from the county's transfer stations to either Covanta (and then ash to the landfill) or go directly to the landfill.



Why the different landfill scenarios?

One of the most significant assumptions in this LCA is the percentage of landfill gas that is actually captured and burned in one way or another. Some gas, even in the best systems, leaks out uncaptured. Landfill gas is about half methane and half carbon dioxide, plus trace amounts of various contaminants. The methane is about 82 times more potent as a contributor to climate change than CO_2 over a 20-year time frame. When landfill gas is burned, it converts methane primarily to carbon dioxide and water vapor, so capturing the gas and burning it cuts down the climate impact dramatically. Landfills are generally understood to have a 75% gas capture rate. This LCA conservatively chose to lower that to 70%.

We conducted a sensitivity analysis to see whether a lower landfill gas capture rate for methane and carbon dioxide greenhouse gases and other constituents of landfill gas would flip the results in favor of incineration. For total human and environmental health impacts, and ignoring the incinerator's offsets for beneficial metals recycling from incinerator ash and displacements of natural-gas-fired electricity generation, incineration results in total greater harms than landfilling even if there were no landfill gas capture system. For climate change alone, the landfill's methane and carbon dioxide gas capture rate would have to be lower than about 50% to be worse than incineration, even when the incinerator's offsets are taken into account.

What do the nine impacts mean?

- Climate – global warming impacts
- Particulate matter – human health impacts from breathing small particles, including asthma attacks, heart attacks, stroke, and COPD.
- Toxics (non-cancer) – toxic chemicals that affect health in ways other than cancer, such as learning disabilities, hormonal and immune system dysfunction, birth defects, and much more.
- Toxics (cancer) – carcinogenic impacts of chemicals such as benzene
- Eutrophication – waterways impacted by nitrogen, causing algae blooms and dead zones.
- Acidification – acid gases contributing to acid rain, eye and respiratory irritation.
- Ecosystems toxicity – aquatic systems impacted by pesticide-like chemicals.
- Ozone depletion – chemicals like CFCs that destroy the stratospheric ozone layer, making people more vulnerable to ultraviolet (UV) radiation from the sun.
- Ground level ozone (smog) – nitrogen oxides and volatile organics compounds that contribute to asthma attacks and other respiratory health effects.

Appendices

A. Advisory Committee Members and Sustainability Commission Zero Waste Committee Members
B. Municipal Systems Summary
C. List of Licensed Haulers
D. Yard Trimmings and Food Scrap Collectors and Processors
E. Drop-off Recycling Locations
F. Zero Waste Initiative Descriptions
G. Assumptions and Methodology
H. Municipal Ordinance Granting Flow Control
I. Life Cycle Analysis

Appendix A Advisory Committee and Sustainability Commission Zero Waste Committee

Advisory Committee

First Class Township
Bonnie Hallam - EAC Member, Upper Darby

Second Class Township
Don Vymazal - Town Manager, Upper Providence

Borough
Erica Burman - EAC Member, Media

Citizen Organization
Joan Gunn Broadfield - Chester NAACP

Private Solid Waste Industry
Dominic Fulginiti - Republic Services

Private Recycling Industry
Archie Filshill - Aero-Aggregates

County Recycling Coordinator
Connie Butler - County Recycling Coordinator

Environmental Justice Organization
Chantal Reyes - Delco Student Group (C4-campus coalition concerning Chester)

University Representative
Chris Proctor – Swarthmore College

Reuse Business
Danielle Ruttenberg - Bottle Underground

Recycling Organization
Faran Savitz - PennEnvironment

Composting Organization
Gwenn Nolan - Mother Compost

Recycling Market Development Organization
Robert Anderson - Penn Recycle Market Development Center

Faith Community
Thom Nixon - Phi Beta Sigma Fraternity Inc.

County Staff
Melissa Muroff – Delaware County District Attorney's Office

Delaware County Solid Waste Authority
James F McLaughlin - Board Chair

Department of Environmental Protection
Ann Ryan - SE Regional Office

Sustainability Commission Zero Waste Committee

Joy Baxter
David Director
Mike Ewall
Dale Harris
Chuck Lacy
Alonso Loper
Carol Martsolf
Jaclyn Rhoads
Cephus Richardson
Jennie Saxe
Scott Sidlow
Darren Spielman
Peter Puglionesi
Bob Redfern
Karen Taussig-Lux
Kearni Warren
James Warner

Appendix B Municipal Systems Summary

Delaware County Municipal Information

Municipality	Municipality Class	Population	Housing Units	Trash Collection System
ALDAN BORO	Boroughs	4,244	1,805	B&L Disposal
ASTON TWP	First Class Townships	16,791	6,317	Municipal
BETHEL TWP	Second Class Townships	9,574	3,367	B&L Disposal
BROOKHAVEN BORO	Boroughs	8,300	3,763	B&L Disposal
CHADDS FORD TWP	Second Class Townships	3,972	1,590	Subscription
CHESTER CITY	Cities	32,605	14,023	JP Mascaro
CHESTER HEIGHTS BORO	Boroughs	2,897	1,276	Subscription
CHESTER TWP	Second Class Townships	4,080	1,683	B&L Disposal
CLIFTON HEIGHTS BORO	Boroughs	6,863	2,882	B&L Disposal
COLLINGDALE BORO	Boroughs	8,908	3,515	Municipal
COLWYN BORO	Boroughs	2,474	926	B&L Disposal
CONCORD TWP	Second Class Townships	18,295	7,493	Subscription
DARBY BORO	Boroughs	10,715	3,916	B&L Disposal
DARBY TWP	First Class Townships	9,219	3,891	H&H Disposal Service, Inc.
EAST LANSDOWNE BORO	Boroughs	2,714	1,024	H&H Disposal Service, Inc.
EDDYSTONE BORO	Boroughs	2,459	1,016	Municipal
EDGMONT TWP	Second Class Townships	4,283	1,849	Subscription
FOLCROFT BORO	Boroughs	6,792	2,637	H&H Disposal Service, Inc.
GLENOLDEN BORO	Boroughs	7,223	3,130	B&L Disposal
HAVERFORD TWP	First Class Townships	50,431	18,600	Municipal
LANSDOWNE BORO	Boroughs	11,107	5,030	Municipal
LOWER CHICHESTER TWP	First Class Townships	3,425	1,356	Municipal
MARCUS HOOK BORO	Boroughs	2,454	1,073	B&L Disposal
MARPLE TWP	First Class Townships	24,214	9,201	Municipal
MEDIA BORO	Boroughs	5,901	3,329	Municipal
MIDDLETOWN TWP	Second Class Townships	16,373	6,684	Subscription Trash
MILLBOURNE BORO	Boroughs	1,212	450	J & K Trash Removal
MORTON BORO	Boroughs	2,778	1,227	B&L Disposal

Delaware County Municipal Information

Municipality	Municipality Class	Population	Housing Units	Trash Collection System
NETHER PROVIDENCE TWP	First Class Townships	14,525	5,343	Subscription
NEWTOWN TWP	Second Class Townships	15,002	6,476	Subscription
NORWOOD BORO	Boroughs	5,943	2,422	H&H Disposal Service, Inc.
PARKSIDE BORO	Boroughs	2,321	910	B&L Disposal
PROSPECT PARK BORO	Boroughs	6,427	2,722	Municipal
RADNOR TWP	First Class Townships	33,228	10,923	Municipal
RIDLEY PARK BORO	Boroughs	7,186	3,167	Municipal
RIDLEY TWP	First Class Townships	31,053	12,838	Mascaro
ROSE VALLEY BORO	Boroughs	1,017	397	Subscription
RUTLEDGE BORO	Boroughs	782	294	B&L Disposal
SHARON HILL BORO	Boroughs	6,014	2,279	H&H Disposal Service, Inc.
SPRINGFIELD TWP	First Class Townships	25,070	8,875	Municipal
SWARTHMORE BORO	Boroughs	6,543	2,105	B&L Disposal
THORNBURY TWP	Second Class Townships	6,904	2,255	Subscription
TINICUM TWP	First Class Townships	3,983	1,882	Subscription
TRAINER BORO	Boroughs	1,976	742	B&L Disposal
UPLAND BORO	Boroughs	3,068	1,321	B&L Disposal
UPPER CHICHESTER TWP	First Class Townships	16,898	7,334	Municipal
UPPER DARBY TWP	First Class Townships	85,681	34,508	Municipal
UPPER PROVIDENCE TWP	Second Class Townships	10,852	4,430	A.J. BLOSENKI, INC.
YEADON BORO	Boroughs	12,054	4,932	B&L Disposal

Sources: Delaware County Municipal Data https://www.delcopa.gov/planning/demodata/municipalinfo.html

Municipal Surveys 2020-21

Delaware County Municipal Diversion Programs

Municipality	Recycling Collection System	Recycling Mandated/Non-Mandated (Act 101)	Leaf and/or Yard Trimmings	White Goods
ALDAN BORO	none	Non-Mandated	none	none
ASTON TWP	Municipal	Mandated	yes	yes
BETHEL TWP	B&L Disposal	Mandated	yes	yes
BROOKHAVEN BORO	B&L Disposal	Mandated	yes	yes

Delaware County Municipal Diversion Programs

Municipality	Recycling Collection System	Recycling Mandated/Non-Mandated (Act 101)	Leaf and/or Yard Trimmings	White Goods
CHADDS FORD TWP	None	Non-Mandated	none	none
CHESTER CITY	JP Mascaro	Mandated	none	
CHESTER HEIGHTS BORO	Subscription*	Non-Mandated	none	none
CHESTER TWP	B&L Disposal	Non-Mandated	none	none
CLIFTON HEIGHTS BORO	B&L Disposal	Mandated	yes	none
COLLINGDALE BORO	Municipal	Mandated	yes	none
COLWYN BORO	None	Non-Mandated	none	
CONCORD TWP	Subscription*	Mandated	yes	
DARBY BORO	B&L Disposal	Mandated	yes	none
DARBY TWP	H&H Disposal Service, Inc.	Mandated	yes	yes
EAST LANSDOWNE BORO	None	Non-Mandated	none	
EDDYSTONE BORO	Municipal	Non-Mandated	yes	yes
EDGMONT TWP	Subscription*	Non-Mandated	none	none
FOLCROFT BORO	H&H Disposal Service, Inc.	Mandated	yes	
GLENOLDEN BORO	B&L Disposal	Mandated	yes	None
HAVERFORD TWP	Municipal	Mandated	yes	yes
LANSDOWNE BORO	Mascaro	Mandated	yes	yes
LOWER CHICHESTER TWP	None	Non-Mandated	none	yes
MARCUS HOOK BORO	None	Non-Mandated	yes	yes
MARPLE TWP	Municipal	Mandated	yes	yes
MEDIA BORO	B&L Disposal	Mandated	yes	yes
MIDDLETOWN TWP	A.J. Blosenski	Mandated	yes	none
MILLBOURNE BORO	none	Non-Mandated	none	none
MORTON BORO	none	Non-Mandated	yes	yes
NETHER PROVIDENCE TWP	B&L Disposal	Mandated	yes	none
NEWTOWN TWP	Republic	Mandated	yes	none
NORWOOD BORO	H&H Disposal Service, Inc.	Mandated	yes	
PARKSIDE BORO	B&L Disposal	Mandated	yes	none
PROSPECT PARK BORO	Municipal	Mandated	yes	none

Delaware County Municipal Diversion Programs

Municipality	Recycling Collection System	Recycling Mandated/Non-Mandated (Act 101)	Leaf and/or Yard Trimmings	White Goods
RADNOR TWP	Municipal	Mandated	yes	yes
RIDLEY PARK BORO	Municipal	Mandated	yes	yes
RIDLEY TWP	Mascaro	Mandated	yes	yes
ROSE VALLEY BORO	B&L Disposal	Non-Mandated	none	
RUTLEDGE BORO	B&L Disposal	Non-Mandated	none	yes
SHARON HILL BORO	H&H Disposal Service, Inc.	Mandated	none	
SPRINGFIELD TWP	Municipal	Mandated	yes	yes
SWARTHMORE BORO	B&L Disposal	Mandated	yes	yes
THORNBURY TWP	Opdenaker	Mandated	yes	yes
TINICUM TWP	none	Non-Mandated	yes	
TRAINER BORO	none	Non-Mandated	none	none
UPLAND BORO	B&L Disposal	Non-Mandated	yes	yes
UPPER CHICHESTER TWP	Municipal	Mandated	yes	yes
UPPER DARBY TWP	Municipal	Mandated	yes	yes
UPPER PROVIDENCE TWP	A.J. BLOSENKI, INC.	Mandated	yes	yes
YEADON BORO	B&L Disposal	Mandated	yes	yes

*recycling subscription mandated by municipal ordinance

* residents in communities listed as "none" may opt into subscription, but not mandated by municipality

Source: Municipal Surveys 2020-21

Delaware County Municipal Diversion Programs – Drop Off Sites

Municipality	Drop Off Locations
ALDAN BORO	TV/Radios/Stereos, Computers/Laptops, Cameras, Copiers/Fax machines, cell phones, printers, electronic toys and games, microwaves, and shredders accepted at municipal building
ASTON TWP	Drop off sites: St. Joseph's Church, St. Timothy's Church, Sun Valley High School, Nothley Middle School, Aston Elementary School, Pennell Elementary, and Rick's Tree Service
BETHEL TWP	
BROOKHAVEN BORO	
CHADDS FORD TWP	Drop off at Chadds Ford Township Building

Delaware County Municipal Diversion Programs – Drop Off Sites

Municipality	Drop Off Locations
CHESTER CITY	
CHESTER HEIGHTS BORO	
CHESTER TWP	
CLIFTON HEIGHTS BORO	Municipal parking lot collects clothing and clear/brown glass
COLLINGDALE BORO	
COLWYN BORO	
CONCORD TWP	Township municipal building (for cardboard and paper), public works building (for cellphones, printer cartridges, toner, and batteries), St. John's Episcopal Church (paper and cardboard), Goodwill, and Clayton Park (Igloo for glass, aluminum, bimetallic cans, plastics #1 and #2)
DARBY BORO	Single stream recycling at municipal building
DARBY TWP	Community center for glass and metallic cans and former municipal building
EAST LANSDOWNE BORO	
EDDYSTONE BORO	Eddystone Elementary School drop off for paper and cardboard
EDGMONT TWP	Edgmont reported that the Township has drop off sites at the municipal building for mixed paper/cardboard and aluminum cans/glass (green, brown, clear)/plastics #1&2
FOLCROFT BORO	
GLENOLDEN BORO	Mulch Works, Mulch Express, and Delco Mulch listed as sites to drop off leaf and yard waste -Delco Mulch processes municipally collected leaves
HAVERFORD TWP	Two locations for small electronics recycling at Township Municipal Building and Community Recreation Environmental Center. Drop off at the Township Community Recycling Center for cardboard, paper, cans, plastic 1-7, and bottles.
LANSDOWNE BORO	
LOWER CHICHESTER TWP	
MARCUS HOOK BORO	
MARPLE TWP	Paper recycling drop off at WCP and Malin Rds. There is also a green drop off at Home Depot and clothing drop off box in the rear of Lawrence Park Shopping Center
MEDIA BORO	Green Drop, Goodwill, and Salvation Army listed for textile recycling
MIDDLETOWN TWP	

Delaware County Municipal Diversion Programs – Drop Off Sites

Municipality	Drop Off Locations
MILLBOURNE BORO	
MORTON BORO	
NETHER PROVIDENCE TWP	
NEWTOWN TWP	One-yard waste drop off and one recycling drop off at Public Works Garage at 5 W. Brookhaven Rd for cardboard
NORWOOD BORO	
PARKSIDE BORO	
PROSPECT PARK BORO	Administration building, Elementary school, and Interboro High School for newspaper, paper, and cardboard
RADNOR TWP	Skunk Hollow Yard Waste
RIDLEY PARK BORO	Ridley Public Works - single stream recycling dumpster, trimmings, white goods. Our Lady of Peace- Paper Retriever
RIDLEY TWP	
ROSE VALLEY BORO	
RUTLEDGE BORO	
SHARON HILL BORO	
SPRINGFIELD TWP	1258 Church Rd for Used oil, oil filters, mixed paper/cardboard, and commingled; 50 Powell Rd. for prescription medicines and mixed paper/cardboard; Township library for inkjet/toner cartridges and cell phones
SWARTHMORE BORO	Department of Public Works building - paper, cardboard, aluminum
THORNBURY TWP	Public Works building for paper, cardboard, aluminum, and Igloo materials (plastic #1 and #2)
TINICUM TWP	
TRAINER BORO	Paper recycling at municipal building (USRI)
UPLAND BORO	
UPPER CHICHESTER TWP	Single stream recycling dumpster in town parking lot
UPPER DARBY TWP	
UPPER PROVIDENCE TWP	
YEADON BORO	E-waste collection is held every last working Friday of the month. Residents can bring e-waste such as flat screen tv's, computers, microwaves, etc. to be recycled. They can drop items off at the Public Works Yard between 8am-3pm and stop in the office to show proof of residency-- Southwest Metals provides container and hauling services

Delaware County Municipal Diversion and Disposal Costs and Status Act 101 Grants

Municipality	Annual Fee or Tax to Residents (total recycling, trash, leaf/yard)	Total Budgeted Costs	Budgeted Cost/ Household/ Year	2019 Act 101 409 Grants Awarded	409 Grant/ Household
Aldan	$190.83	$339,400	$188.03	$7,453.89	$4.13
Aston	$260.00	$1,281,285	$202.83		
Bethel	$245.00	$723,700	$214.94	$11,483.82	$3.41
Brookhaven	$261.28	$842,265	$223.83	$43,579.65	$11.58
Chadds Ford				$7,075.54	$4.45
Chester City					
Chester Heights				$7,149.77	$5.60
Chester Township	$300.00			$39,426.87	$23.43
Clifton Heights	$210.00				
Collingdale	$225.00	$1,156,600	$329.05		
Colwyn	$190.50	$176,000	$190.06		
Concord		$19,474	$101.84	$39,426.87	$5.26
Darby Boro	$290.00				
Darby Twp					
East Lansdowne					
Eddystone		$284,024	$279.55		
Edgmont				$7,090.00	$3.83
Folcroft		$413,000	$101.84		
Glenolden	$252.00			$9,536.37	$3.05
Haverford Twp.	$275.00	$5,756,933	$309.51	$82,553.00	$4.44
Lansdowne	$343.00	$1,426,383	$283.58		
Lower Chichester	$595.00				
Marcus Hook				$1,923.48	$1.79
Marple	$300.00	$2,634,137	$286.29	$47,912.15	$5.21
Media Borough		$598,749	$179.86	$23,849.36	$7.16
Middletown	$105.00			$24,834.61	$3.72
Millbourne	$178.00				
Morton	$240.00	$182,950	$149.10		
Nether Providence	$83.50	$342,200	$64.05	$12,377.57	$2.32
Newtown		$536,195	$82.80	$42,140.72	$6.51

Delaware County Municipal Diversion and Disposal Costs and Status Act 101 Grants

Municipality	Annual Fee or Tax to Residents (total recycling, trash, leaf/yard)	Total Budgeted Costs	Budgeted Cost/ Household/ Year	2019 Act 101 409 Grants Awarded	409 Grant/ Household
Norwood					
Parkside	$360.00				
Prospect Park	$225.00			$3,866.83	$1.42
Radnor		$3,289,345	$301.14	$53,246.74	$4.87
Ridley Park Borough	$375.00				
Ridley Twp	$255.00	$2,745,000	$213.82		
Rose Valley		$55,000	$138.54	$1,351.21	$3.40
Rutledge	$504.50	$105,090	$357.45	$1,826.25	$6.21
Sharon Hill	$235.00	$474,380	$208.15		
Springfield	$280.00	$2,184,000	$246.08	$76,256.00	$8.59
Swarthmore	$430.00	$611,947	$290.71	$8,561.46	$4.07
Thornbury		$225,000	$99.78	$11,217.62	$4.97
Tinicum					
Trainer	$185.00	$158,055	$213.01		
Upland	$235.00	$215,000	$162.76		
Upper Chichester	$220.00	$1,757,990	$239.70	$31,373.16	$4.28
Upper Darby	$280.00	$9,814,314	$284.41	$90,763.65	$2.63
Upper Providence	$220.56			$21,763.17	$4.91
Yeadon	$260.00	$1,263,593	$256.20		
AVERAGES	**$271.56**	**$1,402,593**	**$214.67**	**$28,023.43**	**$5.48**
	8,609	***39,612,009***	***6,199***		
			Number of households in municipalities receiving grants		***150,505.00***
			Number of households in remaining municipalities		***78,703.00***
			Money on the table		***$431,675.47***

Sources: Municipal Surveys 2020-21, Pennsylvania Department of Environmental Protection

901 Planning Grants (Act 101)

Grant Summary: Planning grants are awarded to counties for 80% of approved costs for preparing municipal waste management plans, as required by Act 101, for carrying out related studies, surveys, investigations, inquiries, research and analysis, including those related to siting, environmental mediation, education programs on pollution prevention and household hazardous waste (HHW) and providing technical assistance to small businesses for pollution prevention

Eligibility: County Only

https://files.dep.state.pa.us/Waste/Recycling/lib/landrecwaste/recycling/documents/901_PreApplication_Document.pdf

Grantee	Funded	Purpose
Delaware County	$75,000	Updating 10-year annual solid waste management plan.

902 Development and Implementation Grants (Act 101)

Grant Summary: Recycling program development and implementation grants. 90 % funding of approved recycling program costs (100% for financially distressed municipalities). Examples of eligible projects include operating leaf compost facilities, developing web-based programs on recycling for consumers, expanding recycling processing facilities, installing data collection systems on recycling vehicles, continuing and creating curbside recycling programs, and developing educational materials to encourage residents to properly recycle.

Eligibility: Municipalities and County

https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2020/Pre_App_Form_Instructions_Round_60.pdf

Grantee	Funded	Purpose
Delaware County	$10,773	Drop-off Recycling & Educational Programs
Haverford Township	$257,503	Curbside Collection & Leaf Collection Programs
Lansdowne Borough	$174,999	Leaf Waste Collection Program
Newtown Township	$349,142	Leaf Waste Collection and Recycling Education Programs
Ridley Township	$323,803	Leaf Waste Collection Program
Upper Darby Township	$349,875	Leaf Waste Collection & Educational Programs
2020/2021 Countywide Total	**$1,466,095**	
Springfield Township	$116,507	Recycling Collection Program

901 Planning Grants (Act 101)

Marple Township	$171,468	Recycling Collection Program
Haverford Township	$283,068	Recycling and Yard Waste Collection Programs
Folcroft Borough	$50,100	Curbside Collection and Leaf Waste Processing Program
2022/2023 Countywide Total	**$621,143**	

903 Grants (Act 101)

Grant Summary: Provides a 50 percent reimbursement for County Recycling Coordinators' salary and expenses. This grant is only available to Pennsylvania county governments.

Eligibility: County only

https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2021/903_Grant_Instructions_REV_121621.pdf

Grantee	Funded (2020)	Purpose
Delaware County	$40,352	Recycling coordinator salary and expenses (housed in DCSWA)

904 Recycling Performance Grants (Act 101)

Grant Summary: Recycling Program Performance Grants are available to all Pennsylvania local governments with recycling programs. The grants awards are based on the total tons recycled and the applicant's recycling rate. Post-consumer aluminum and steel cans, glass, plastics, corrugated cardboard, newspapers and other marketable grades of paper are materials eligible for the grants. All eligible materials collected from residents, business, schools, colleges, universities and community events can be factored into the grant awards. Applicants must retain documentation demonstrating that materials claimed in the application were eligible for the grant, generated within the applicant's boundaries, and were recycled or marketed in the year covered by the application. Residues from the collection and/or marketing of recyclable materials are not eligible for grant consideration.

Eligibility/Opportunity: All municipalities in PA that meet Act 101 requirements are eligible. 26 of the 49 municipalities in the county received grants in 2019 (latest available), totaling over $700,000 in grants. The average grant per municipality was $28,000. The average grant per household for the municipalities that received grants was $5.97/household. If all municipalities performed as well and submitted grants, the county would bring in an additional $450,000/year.

https://www.dep.pa.gov/Business/Land/Waste/Recycling/Municipal-Resources/FinancialAssistance/Pages/Recycling-Performance-Grants.aspx

901 Planning Grants (Act 101)

Grantee	Funding (2019)	Purpose
Bethel Township	$11,483.82	**Based on reported recycling tonnage:** Total Award = (Base Award + Bonus Award + Commercial Incentive) X 80%
Brookhaven Borough	$43,579.65	
Chadds Ford Township	$7,075.54	
Chester Heights Borough	$7,149.77	
Concord Township	$39,426.87	
Edgmont Township	$7,090.00	
Glenolden Borough	$9,536.37	
Haverford Township	$82,553.00	
Marcus Hook Borough	$1,923.48	
Marple Township	$47,912.15	
Media Borough	$23,849.36	
Middletown Township	$24,834.61	
Nether Providence Township	$12,377.57	
Newtown Township	$42,140.72	
Prospect Park Borough	$3,866.83	
Radnor Township	$53,246.74	
Rose Valley Borough	$1,351.21	
Rutledge borough	$1,826.25	
Springfield Township	$76,256.00	
Swarthmore Borough	$8,561.46	
Thornbury Township	$11,217.62	
Upper Chichester Township	$31,373.16	
Upper Darby Township	$90,763.65	
Upper Providence Township	$21,763.17	
Aldan Borough	$7,453.89	

https://www.dep.pa.gov/Business/Land/Waste/Recycling/Municipal-Resources/FinancialAssistance/Pages/default.aspx

Delaware County Municipal Diversion and Disposal (2020 Base Year)

Municipality	Municipal Recycling Totals (tons)	Municipal Trash (tons)	Municipal Trash and Recycling (tons)	Municipal Recycling Percentages
Aldan	315.15	2,114.47	2,429.62	13%
Aston	408.90	7,933.64	8,342.54	5%
Bethel	1,004.10	3,721.46	4,725.56	21%
Brookhaven	434.19	3,182.69	3,616.88	12%
Chadds Ford	314.61	1,707.83	2,022.44	16%
Chester City	297.09	15,222.15	15,519.24	2%
Chester Heights	190.60	880.08	1,070.68	18%
Chester Township	185.64	2,229.41	2,415.05	8%
Clifton Heights	246.40	3,019.72	3,266.12	8%
Collingdale	138.52	4,566.38	4,704.90	3%
Colwyn	89.54	1,378.17	1,467.71	6%
Concord	1,334.13	5,405.48	6,739.61	20%
Darby Borough	113.90	5,518.17	5,632.07	2%
Darby Twp.	172.59	5,453.74	5,626.33	3%
East Lansdowne	5.44	1,557.67	1,563.11	0%
Eddystone	680.91	1,047.07	1,727.98	39%
Edgmont	474.91	1,311.55	1,786.46	27%
Folcroft	240.00	3,078.95	3,318.95	7%
Glenolden	347.50	3,029.95	3,377.45	10%
Haverford Twp.	12,210.90	19,948.36	32,159.26	38%
Lansdowne	204.42	4,128.23	4,332.65	5%
Lower Chichester Twp	-	1,928.87	1,928.87	0%
Marcus Hook	13.06	1,403.23	1,416.29	1%
Marple	5,431.79	10,289.37	15,721.16	35%
Media Borough	1,470.71	1,302.47	2,773.18	53%
Middletown	1,279.44	4,642.08	5,921.52	22%
Millbourne	-	534.12	534.12	0%
Morton	230.71	1,078.54	1,309.25	18%
Nether Providence	3,457.52	5,514.36	8,971.88	39%
Newtown	3,697.59	6,134.12	9,831.71	38%
Norwood	300.71	3,043.09	3,343.80	9%

Delaware County Municipal Diversion and Disposal (2020 Base Year)

Municipality	Municipal Recycling Totals (tons)	Municipal Trash (tons)	Municipal Trash and Recycling (tons)	Municipal Recycling Percentages
Parkside	193.53	1,249.93	1,443.46	13%
Prospect Park	62.50	2,850.43	2,912.93	2%
Radnor	6,984.00	7,596.79	14,580.79	48%
Ridley Park	668.72	2,749.62	3,418.34	20%
Ridley Township	3,102.96	16,030.97	19,133.93	16%
Rose Valley	469.00	901.02	1,370.02	34%
Rutledge	143.00	469.00	612.00	23%
Sharon Hill	140.68	2,743.48	2,884.16	5%
Springfield	3,257.10	12,422.64	15,679.74	21%
Swarthmore	1,410.04	1,360.67	2,770.71	51%
Thornbury	1,313.55	2,240.73	3,554.28	37%
Tinicum	26.16	2,645.16	2,671.32	1%
Trainer	8.73	1,265.54	1,274.27	1%
Upland	1,740.30	1,727.58	3,467.88	50%
Upper Chichester	1,795.03	7,257.22	9,052.25	20%
Upper Darby	5,519.34	36,555.72	42,075.06	13%
Upper Providence	228.33	4,130.57	4,358.90	5%
Yeadon	402.05	4,991.53	5,393.58	7%
Other	46.15	-	46.15	
Totals	**62,802.14**	**241,494.02**	**304,296.16**	21%

Sources: Municipal Surveys 2020-21, Pennsylvania Department of Environmental Protection

Delaware County Commercial Diversion and Disposal (2020 Base Year)

Municipality	Commercial Recycling Totals (tons)	Commercial Trash Totals (tons)	Commercial Recycling and Trash	Commercial Recycling Percentages
Aldan	403.57	1,223.47	1,627.04	25%
Aston	5,161.24	4,840.54	10,001.78	52%
Bethel	249.58	2,760.01	3,009.59	8%
Brookhaven	1,396.86	2,392.74	3,789.60	37%
Chadds Ford	19,928.90	1,145.06	21,073.96	95%

Delaware County Commercial Diversion and Disposal (2020 Base Year)

Municipality	Commercial Recycling Totals (tons)	Commercial Trash Totals (tons)	Commercial Recycling and Trash	Commercial Recycling Percentages
Chester City	4.00	9,399.43	9,403.43	0%
Chester Heights	171.39	835.15	1,006.54	17%
Chester Township	1,475.80	1,176.19	2,651.99	56%
Clifton Heights	360.67	1,978.48	2,339.15	15%
Collingdale	275.85	2,568.02	2,843.87	10%
Colwyn	15.62	713.21	728.83	2%
Concord	5,188.08	5,274.12	10,462.20	50%
Darby Borough	359.78	3,088.94	3,448.72	10%
Darby Twp.	100.83	2,657.67	2,758.50	4%
East Lansdowne	38.08	782.40	820.48	5%
Eddystone	1,837.06	708.89	2,545.95	72%
Edgmont	418.27	1,234.71	1,652.98	25%
Folcroft	1,009.97	1,958.01	2,967.98	34%
Glenolden	2,826.65	2,082.26	4,908.91	58%
Haverford Twp.	2,829.24	14,538.35	17,367.59	16%
Lansdowne	2,266.43	3,201.95	5,468.38	41%
Lower Chichester Twp	97.57	987.37	1,084.94	9%
Marcus Hook	931.08	707.44	1,638.52	57%
Marple	2,825.97	6,980.46	9,806.43	29%
Media Borough	2,328.09	1,701.15	4,029.24	58%
Middletown	1,099.33	4,720.04	5,819.37	19%
Millbourne	-	349.40	349.40	0%
Morton	240.41	800.85	1,041.26	23%
Nether Providence	456.10	4,187.30	4,643.40	10%
Newtown	1,937.80	4,324.81	6,262.61	31%
Norwood	49.98	1,713.26	1,763.24	3%
Parkside	2.30	669.10	671.40	0%
Prospect Park	118.06	1,852.79	1,970.85	6%
Radnor	5,689.27	9,579.03	15,268.30	37%
Ridley Park	812.82	2,071.59	2,884.41	28%
Ridley Township	1,509.82	8,952.02	10,461.84	14%
Rose Valley	3.00	330.95	333.95	1%

Delaware County Commercial Diversion and Disposal (2020 Base Year)

Municipality	Commercial Recycling Totals (tons)	Commercial Trash Totals (tons)	Commercial Recycling and Trash	Commercial Recycling Percentages
Rutledge	0.16	225.44	225.60	0%
Sharon Hill	857.16	1,733.73	2,590.89	33%
Springfield	3,243.20	7,227.23	10,470.43	31%
Swarthmore	1,355.29	1,886.23	3,241.52	42%
Thornbury	64.17	1,990.30	2,054.47	3%
Tinicum	342.92	1,148.23	1,491.15	23%
Trainer	25.58	569.65	595.23	4%
Upland	232.47	884.45	1,116.92	21%
Upper Chichester	1,765.99	4,871.39	6,637.38	27%
Upper Darby	4,519.66	24,700.29	29,219.95	15%
Upper Providence	229.51	3,128.44	3,357.95	7%
Yeadon	638.90	3,474.95	4,113.85	16%
Other	99,498.96	-	99,498.96	
Totals	**177,193.44**	**166,327.49**	**343,520.93**	52%

Sources: Municipal Surveys 2020-21, Pennsylvania Department of Environmental Protection

Delaware County Municipalities' Total Diversion and Disposal (2020 Base Year)

Municipality	Total Recycling (tons)	Total Trash (tons)	Total Trash and Recycling (tons)	Total Recycling Percentages
Aldan	718.72	3,337.94	4,056.66	18%
Aston	5,570.14	12,774.18	18,344.32	30%
Bethel	1,253.68	6,481.47	7,735.15	16%
Brookhaven	1,831.05	5,575.43	7,406.48	25%
Chadds Ford	20,243.51	2,852.89	23,096.40	88%
Chester City	301.09	24,621.58	24,922.67	1%
Chester Heights	361.99	1,715.23	2,077.22	17%
Chester Township	1,661.44	3,405.60	5,067.04	33%
Clifton Heights	607.07	4,998.20	5,605.27	11%
Collingdale	414.37	7,134.40	7,548.77	5%
Colwyn	105.16	2,091.38	2,196.54	5%
Concord	6,522.21	10,679.60	17,201.81	38%
Darby Borough	473.68	8,607.11	9,080.79	5%

Delaware County Municipalities' Total Diversion and Disposal (2020 Base Year)

Municipality	Total Recycling (tons)	Total Trash (tons)	Total Trash and Recycling (tons)	Total Recycling Percentages
Darby Twp.	273.42	8,111.41	8,384.83	3%
East Lansdowne	43.52	2,340.07	2,383.59	2%
Eddystone	2,517.97	1,755.96	4,273.93	59%
Edgmont	893.18	2,546.26	3,439.44	26%
Folcroft	1,249.97	5,036.96	6,286.93	20%
Glenolden	3,174.15	5,112.21	8,286.36	38%
Haverford Twp.	15,040.14	34,486.71	49,526.85	30%
Lansdowne	2,470.85	7,330.18	9,801.03	25%
Lower Chichester Twp	97.57	2,916.24	3,013.81	3%
Marcus Hook	944.14	2,110.67	3,054.81	31%
Marple	8,257.76	17,269.83	25,527.59	32%
Media Borough	3,798.80	3,003.62	6,802.42	56%
Middletown	2,378.77	9,362.12	11,740.89	20%
Millbourne	-	883.52	883.52	0%
Morton	471.12	1,879.39	2,350.51	20%
Nether Providence	3,913.62	9,701.66	13,615.28	29%
Newtown	5,635.39	10,458.93	16,094.32	35%
Norwood	350.69	4,756.35	5,107.04	7%
Parkside	195.83	1,919.03	2,114.86	9%
Prospect Park	180.56	4,703.22	4,883.78	4%
Radnor	12,673.27	17,175.82	29,849.09	42%
Ridley Park	1,481.54	4,821.21	6,302.75	24%
Ridley Township	4,612.78	24,982.99	29,595.77	16%
Rose Valley	472.00	1,231.97	1,703.97	28%
Rutledge	143.16	694.44	837.60	17%
Sharon Hill	997.84	4,477.21	5,475.05	18%
Springfield	6,500.30	19,649.87	26,150.17	25%
Swarthmore	2,765.33	3,246.90	6,012.23	46%
Thornbury	1,377.72	4,231.03	5,608.75	25%
Tinicum	369.08	3,793.39	4,162.47	9%
Trainer	34.31	1,835.19	1,869.50	2%
Upland	1,972.77	2,612.03	4,584.80	43%

Delaware County Municipalities' Total Diversion and Disposal (2020 Base Year)

Municipality	Total Recycling (tons)	Total Trash (tons)	Total Trash and Recycling (tons)	Total Recycling Percentages
Upper Chichester	3,561.02	12,128.61	15,689.63	23%
Upper Darby	10,039.00	61,256.01	71,295.01	14%
Upper Providence	457.84	7,259.01	7,716.85	6%
Yeadon	1,040.95	8,466.48	9,507.43	11%
Other	99,545.11	-	99,545.11	
Totals	**239,995.58**	**407,821.51**	**647,817.09**	37%

Sources: Municipal Surveys 2020-21, Pennsylvania Department of Environmental Protection

Municipality Total Discards (Trash, Recycling, Leaf/Yard) Compared to Diversion Rate

Municipality	Total Discards per Household per Year (pounds)	Municipal Diversion Rate
Aldan	2692	13%
Aston	2641	5%
Bethel	2807	21%
Brookhaven	1922	12%
Chadds Ford	2544	16%
Chester City	2213	2%
Chester Heights	1678	18%
Chester Township	2870	8%
Clifton Heights	2267	8%
Collingdale	2677	3%
Colwyn	3170	6%
Concord	1799	20%
Darby Borough	2876	2%
Darby Twp.	2892	3%
East Lansdowne	3053	0%
Eddystone	3402	39%
Edgmont	1932	27%
Folcroft	2517	7%
Glenolden	2158	10%
Haverford Twp.	3458	38%
Lansdowne	1723	5%

Municipality Total Discards (Trash, Recycling, Leaf/Yard) Compared to Diversion Rate

Municipality	Total Discards per Household per Year (pounds)	Municipal Diversion Rate
Lower Chichester Twp	2845	0%
Marcus Hook	2640	1%
Marple	3417	35%
Media Borough	1666	53%
Middletown	1772	22%
Millbourne	2374	0%
Morton	2134	18%
Nether Providence	3358	39%
Newtown	3036	38%
Norwood	2761	9%
Parkside	3172	13%
Prospect Park	2140	2%
Radnor	2670	48%
Ridley Park	2159	20%
Ridley Township	2981	16%
Rose Valley	6902	34%
Rutledge	4163	23%
Sharon Hill	2531	5%
Springfield	3533	21%
Swarthmore	2633	51%
Thornbury	3152	37%
Tinicum	2839	1%
Trainer	3435	1%
Upland	5250	50%
Upper Chichester	2469	20%
Upper Darby	2439	13%
Upper Providence	1968	5%
Yeadon	2187	7%

Note: Higher diversion rates are shown in darker green and lower diversion rates are shown in darker red
Higher generation rates are in shown in darker orange and lower generation are shown to darker green
Sources: Municipal Surveys 2020-21, Pennsylvania Department of Environmental Protection

Appendix C List of Licensed Haulers

Municipal Haulers

Aldan Borough
Aston Borough
Bethel Township
Boyle Disposal, Inc.
Brookhaven Borough
Chester Housing Authority
Chester Township
City of Chester
Clifton Heights Borough
Collingdale Borough
Community Action Agency
Concord Township
Darby Borough
Darby Township
Delaware County Garage
Delaware County Housing Authority
Delaware County Parks
Eddystone Borough
Folcroft Borough
Haverford School District
Haverford Township
Lansdowne Borough
Lower Chichester Township
Marcus Hook Borough
Marple Township
Mascaro
Media Borough
Middletown Township
Morton Borough
Nether Providence Township
Newtown Township
Parkside Borough
Prospect Park Borough
Radnor Township
Ridley Park Borough
Ridley Township
Sharon Hill Borough
Springfield Township
Swarthmore Borough
Tinicum Township
Trainer Borough
Upland Borough
Upper Chichester Township
Upper Darby Township
Upper Providence Township
Yeadon Borough

Commercial Haulers

Buxton Enterprises, LLC
Castner Group, Inc.
Catania Masonry
Cavan Construction Co., Inc.
CCL Property Management, LLC
Central Jersey Waste & Recycling
Cisco Masonry
Clark, Inc.
Clay Landscaping
Cleaver Cable Construction Inc.
Cocco's Container Service
College Hunks Hauling Junk
Con-Mac Disposal
County Line Construction Co.
Delco Restoration Inc.
DGS Landscaping, LLC
DiGiacomo Construction, Inc.
J & L Roofing Company
J.M. Salgado Disposal Services, Inc.
J.P. Mascaro & Sons
Joes' Building & Plumbing
Johnston & Sons, Inc.
Johnston Restoration LLC
Joseph J. Danielle, LLC
Junk King Greater Philadelphia
Jurich, Inc.
LWS Dumpsters, LLC
M & K Renovations, LLC
Mac's Demolition & Hauling, LLC
Marple Newtown Roofing Co.
Moving U & Junk U, LLC
Mulch Express Landscape
Nick Falcone & Sons
O'Connor, Inc.
O'Donnell Roofing Co.
TLJ Recycling Containers Service
Tomassian's Property Maintenance, LLC
Trash It, LLC
Villanova University
Waste Masters Solutions
WM Delaware
WM-Phila. South
Zizza Highway Services
Zizza Landscape Services

Municipal and Commercial Haulers

B & L Disposal Services
CityWide Services/ H & H Disposal
J & K Trash Removal, Inc.
JPS Equipment Co.
Laxton Enterprises, Inc.
Opdenaker & Sons, Inc.
Trash Tech, LLC

Appendix D Yard Trimmings and Food Scrap Collectors and Processors

List of where Townships take Leaf and Yard Trimmings

Townships/Compost Companies that go to Linvilla Orchards

Brookhaven

Kitchen Harvest

Mothers Compost*

*Media uses Mothers Compost site for municipal wide curbside pick-up program.

Townships that go to Mulch Express

Bethel Twp

Parkside Borough

Clifton Heights Borough

Prospect Park

Concord Twp

Ridley Twp

Folcroft Borough

Sharon Hill

Marcus Hook Borough

Thornbury Twp

Marple Twp

Tinicum Twp

Media Borough

Upland Borough

Middletown Twp

Upper Chichester Twp

Morton Borough

Upper Providence

Nether Providence

Yeadon Borough

Townships that go to Mulch Works

Nether Providence

Thornbury

Upper Chichester

Public and Private Yard Trimmings and Food Scraps Haulers

Facility Name	Exact Facility Address	Phone	Branches	Wood Waste	Stump Debris	Wood Chips	Brush	Christmas Trees	Food Scraps	Grass	Leaves	Mulch Product	Compost	Residential	Dropped off / picked up by	Final Compost Site
Media Township	Countywide curbside compost pick- up program	610-566-5210							X					X		Kitchen Harvest site at Linvilla Orchards
Newtown Township	Newtown Street Road, Newtown, 19073	610-356-0200						X			X			X		compost on site township residents only
Radnor Township	Skunk Hollow Park @ Willows, 490 Darby-Paoli Rd., Radnor, 19087	610-688-5600	X	*X		X	X	X			X	X	X	X		compost on site township residents only
Swarthmore Borough	Swarthmore College, 500 College Ave., Swarthmore, 19081	610-543-4599	X				X	X			X			X		B&L picks up and takes to Delco Mulch & Supply
Nether Providence Borough	5 W. Brookhaven Rd., Wallingford	610-566-4516	X				X	X		X	X	X		X	Township picks up and Residents drop off	Twigs & branches go to Mulch Works and the township compost all other items
Mulch Works	22 Mt. Pleasant Rd., Aston, 19014	888-214-4628	X		X	X	X	X			X	X	X	X	Nether Providence, Thornbury & Upper Chichester	
Mulch Express	21 Crozerville Road, Aston, 19014	610-558-3294	X	*X	X		X	X					X	X	Residents & Municipalities (list attached)	
Mulch Express	Concord Rd. & Incinerator Road (Plant 1)	610-558-3294									X		X	X	Residents & Municipalities (list attached)	
DelCo Mulch & Supply	1720 State Rd-Rear Lot, Upper Darby 19082	610-352-8008	X	*X	X	X	X	X		X	X	X	X	X	Upper Darby, Swarthmore, Rutledge & Lansdowne Borough	
Linvilla Orchards	137 West Knowlton Road, Media	610-876-7116		X		X	X				X	X	X		Brookhaven	
Kitchen Harvest	Chris@kitchenHarvest.com MyKitchenHarvest.com	610-952-2930							X					X	Hill, Folsom, Havertown, Lansdowne, Media & Swarthmore	Has a compost site at Linvilla Orchards
Mothers Compost	Colleen: motherscompost.com Havertown, Haverford & Drexel Hill	610-509-9700							X					X	Havertown, Haverford & Drexel Hill	Has a compost site at Linvilla Orchards
ROT STAR	Kristin Giambra kristin@rotstarcompost.com	610-291-8770							X					X	Media, Swarthmore, Wallingford, Rose Valley, Springfield, Broomall, Marple & Newtown Square.	Linvilla Orchards

*Pressure treated wood not accepted

Appendix E Drop-off Recycling Locations

Delaware County Solid Waste Authority Recycling Drop-off Locations

Chester City
Covanta Delaware Valley LP
10 Highland Ave.
Chester, PA 19013

Chester Township
DCSWA Transfer Station #1
2300 Concord Rd.
Chester, PA 19013

Collingdale Borough
Collingdale Borough Municipal Building
800 MacDade Blvd.
Collindale, PA 19023

Colwyn Borough
John Bosacco Park
101 Pine St.
Darby, PA 19023

Concord Township
Clayton Park
3173 Garnet Mine Rd.
Garnet Valley, PA 19060

Darby Borough
Darby Township Municipal Building
21 Bartrum Ave.
Glenolden, PA 19036

Darby Borough Police Station
1022 Ridge Ave.
Darby, PA 19023

East Lansdowne Borough
East Lansdowne Borough Municipal Building
155 Lexington Ave.
Lansdowne, PA 19050

Marcus Hook
Marcus Hook Borough Highway Garage
1111 Market Street
Marcus Hook, PA 19062

Marple Township
DCSWA Transfer Station #3
857 Sussex Blvd.
Broomall, PA 19008

Morton Borough
Morton Borough Municipal Building
500 Highland Ave.
Morton, PA 19070

Nether Township
Highway Garage
5 Brookhaven Rd.
Nether Providence, PA 19086

Smedley Park
20 Papermill Rd.
Springfield, PA 19064

Ridley Park Borough
Ridley Park Borough Garage
213 W. Ridley Ave.
Sharon Hill, PA 19078

Sharon Hill Borough
Sharon Hill Borough Garage
250 Sharon Ave.
Sharon Hill, PA 19079

Tinicum Township
Tinicum Township Library
620 Seneca St.
Essington, PA 19029

Upper Darby Township
Kent Park
3900 Bridge St.
Drexel Hill, PA 19026

Upper Providence Township
Rose Tree Park
1671 N. Providence Rd.
Media, PA 19063
(Back Parking Lot)

Materials accepted:
clear, green, brown glass
office paper, junk mail, newspapers, cardboard boxes, clean flattened,
plastic bottles, rinsed and lids off, metal and aluminum cans, rinsed

Appendix F Zero Waste Initiative Descriptions

1. Product Policies
Initiative Type: Policy
Hierarchy Level: All
Sector Focus: All

Initiative Background and Essential Information

Background
A wide variety of legislative strategies can be used to engage producers or require them to redesign their products and packaging as well as to accept responsibility for proper labeling, distribution, education, collection, processing, and enforcement according to the Zero Waste Hierarchy of Highest and Best Use. These include: bans; fees; deposits; targets; mandates; penalties; recycled content requirements; producer responsibility programs and Extended Producer Responsibility (EPR) with or without Producer Responsibility Organizations (PROs). Most state laws that are called EPR include many of these different types of legislative strategies.
Mandatory Services refer to requirements that haulers serving designated customers (e.g., residential, industrial, commercial and/or institutional) must provide recycling services.
Universal Services refer to requirements that residential, industrial, commercial and/or institutional trash collection service providers must also collect recyclables and, sometimes, compostables.

Pennsylvania Department of Environmental Protection Recommendations for improvements to the Municipal Waste Planning, Recycling and Waste Reduction Act of 1988 (Act 101) developed in 2021 include many of these types of product policies, and more:
Statutory Changes

- Prohibit certain materials from disposal.
- Require communities to collect all eight mandated materials.
- Require all businesses to implement recycling programs.
- Require increased recycling and recovery at landfills, resources recovery
- facilities and transfer stations.
- Increase the recycling fee to be consistent with current economics and
- provide real limitations on its use.
- Increase frequency of education efforts required by local governments.
- Implement phased-in organic collection requirements for certain
- municipalities.

Policy Changes

- Set aside funding for public Material Recovery Facilities.
- Provide enforcement/compliance assistance guidance for communities to gain compliance among commercial entities operating within their jurisdictions.
- Increase focus on reuse through existing businesses and provide grants for their expansion.
- Refocus on the hierarchy of Reduce – Reuse – Recycle.
- Work with the Green Government Council to prioritize recycling among all state agencies.

Regulatory Changes

- Eliminate the unnecessary air pollution and groundwater contamination associated with open burning waste.
- Expand county planning requirements to encompass more coordination of their respective recycling programs.
- Expand public participation in the county planning process.
- Allow counties to plan for the management of items like waste tires, leaf waste, HHW etc.
- Include specific reporting requirements for waste haulers to ensure recycling is properly reported.
- Update county and municipal scope and authority to implement recycling programs.

Local and Regional Examples:

PA Electronic Devices Ban Act 108 of 2010 banned certain covered devices (including televisions and computers) from going to landfills or incinerators. However, as there are limited locations in PA that accept TVs for recycling at no cost to the consumer, in most locations there are charges for TVs, monitors and printers to cover the costs of properly handling them.

New Jersey's statewide single-use bag ban adopted in November 2020 went into effect in May 2022. Grocery stores can no longer give customers single-use paper and plastic bags nor most polystyrene food service products (e.g. food containers, plates, and single-use foam cups). Since November 2021, restaurants are required to only give plastic straws to customers upon request.

Connecticut has mandated recycling since 1991. The State added #1 and #2 plastic, junk mail and boxboard in 2012. This applies to single-family and multi-family residents, businesses, non-profits, and institutions (e.g. colleges, hospitals, local and state government agencies). Items mandated to be recycled are bottles, cans, newspaper, cardboard, and Ni-Cd rechargeable batteries. Items banned from disposal include grass clippings and specific household electronic devices (televisions, monitors, printers and computers). Items taken back through extended producer responsibility (EPR) programs in CT are electronics, paint (with PaintCare), mercury thermostats, mattresses (with Mattress Recycling Council) and, newly adopted, residential gas cylinders. Items recycled through a deposit program are specific beverage containers (covered by the "Bottle Bill" nickel deposit) and lead acid (automobile) batteries. Large generators of organics (e.g. supermarkets, industrial food processors, resorts and conference centers) that are within 20 miles of a permitted facility are required to collect their food scraps for composting or anaerobic digestion.

Sturbridge, MA Mandatory Hauler Service Requirements include: Recycling must be provided to residential garbage customers at no extra cost. Haulers must not accept trash with greater than 5% by volume of recyclables. Haulers must provide educational materials to customers annually – to be submitted with annual permit application. Commercial garbage customers must have access to recycling. For residential subscribers the permitted collector will provide a cart, at least two recycling (bins) or recycling bin stickers to all customers for recycling. Haulers must submit quarterly recycling/disposal tonnage reports to the Board.

State of Delaware Bag Ban Starting July 1, 2022, all retail stores in the State of Delaware will no longer provide plastic bags at checkout. An updated plastic bag ban, passed by the Delaware General Assembly in 2021, expands the 2019 bag ban to all retail stores (excluding restaurants) regardless of size and bans all plastic bags at checkout.

Arlington, MA recently passed a water bottle ban. The new bylaw will prohibit the sale of plastic bottles of non-carbonated, non-flavored water in sizes of 1 liter or less. The ban

applies to any business in Arlington that sells bottled water, as well as to event planners, houses of worship, and Town departments such as schools. It will take effect Nov. 1.
National Examples:
San Luis Obispo County Integrated Waste Management Authority oversees the mandatory SLO Take Back Program established by county ordinance.
Examples of reusable takeout foodware service providers include Sparkl and Dispatch Goods in CA, GO Box in OR, Durham GreenToGo in NC, and DeliverZero in NY.

Initiative Proposed Action

Proposed Action:

The following initiatives could be implemented county-wide or by individual communities in the County.

- Ban several types of materials that are difficult to reuse, recycle, or compost including: plastic checkout bags and plastic foam ice chests, egg cartons, and foodware and packaging materials.
- Adopt a #SkipTheStuff ordinance that directs restaurants to provide accessories (e.g. straws, utensils, napkins, condiment packets) for takeout or delivery only if the customer requests them. A draft ordinance has been created by UPSTREAM and is available to entities that sign up.
- Adopt an ordinance that places a fee on the sale of certain disposable items, such as disposable plastic and paper shopping bags, to incentivize customer reuse.
- Encourage businesses to voluntarily take back products and associated packaging, especially items that are toxic in their manufacture, use, or disposal that are not currently reusable, recyclable or compostable locally. Send letters from local elected officials to businesses asking them to voluntarily participate in taking back products or packaging that they routinely handle.
- Require businesses that sell items to take those items back for proper reuse, recycling, or disposal if those items currently must be collected as household hazardous waste or are not currently reusable, recyclable, or compostable locally.
- Require restaurants to provide only reusable foodware for on-site dining.
- Issue an RFP for a pilot program to demonstrate the merits of a reusable takeout foodware service provider that would work with local food service establishments, institutions with food service operations, and community events to replace single-use disposables with reusable options. If embraced widely by local businesses after the pilot program, this approach could eliminate the need to ban single-use disposable foodware. This is a cutting-edge innovation; no municipality has yet contracted for this service.
- Project Components: Agree in principle on approaches to include in Zero Waste Plan. Adopt Zero Waste Plan. Research case studies. Present research to stakeholders and community and get their input on bans, fees, take-back and RFP for reusable takeout services. Conduct further research on details. Draft Ordinances and RFP. Engage with stakeholders and community to review Draft Ordinances and RFP. Revise Ordinances and RFP. Adopt Ordinances and RFP.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Product policies should have corresponding education and outreach, so the community is aware of the policies and knows how to get involved. This education could be conducted at community events, on websites, and through electronic, print and social media. There should be a concerted effort to communicate the product policies to help the County reach its goals.

Initiative Potential Outcome(s)

Potential Outcome(s):
Product policies can have net environmental benefits by limiting the production and use of environmentally harmful products, by promoting behavior change and the use of sustainable alternatives, and by increasing the capture of toxic, hard-to-recycle materials that would otherwise go to landfill. Bans move communities toward more sustainable materials use. Banning harmful products like single-use plastic bags drives innovation and can be a springboard to job creation. Fees are another means to raise revenue for Zero Waste and other programs that improve community health while take-back programs keep toxic materials out of landfills. Bag fees can be imposed while centering equity by including features like exempting WIC and SNAP recipients from the fee, funneling a percentage of the bag fees to help with pollution reduction efforts, education, and free reusable bag distribution and prioritizing these services in low- and fixed-income communities. Take-back programs create more opportunities for sustainable materials management and distribute the burden of that management among stakeholders instead of placing it all upon the municipality or the service providers.

Implementation Timeframe

Short (2024-2028)

2. Lead by Example
Initiative Type: Program
Hierarchy Level: Rethink/Redesign
Sector Focus: County and Municipal

Initiative Background and Essential Information

Background:
Early adoption of waste reduction initiatives (e.g., source reduction, sustainable procurement, recycling, and composting) in government buildings and on public property demonstrates leadership, provides model implementation examples, and encourages others to follow suit. Additionally, governments are often some of the largest employers in a community. According to the Pennsylvania Department of Labor and Industry, Delaware County is the 7th largest employer in the county. Lead by example would be a forward-facing effort by the County to implement waste reduction strategies in its buildings and in County-owned public spaces. These initiatives are shared with the

community to garner support and to help create the culture change that is needed to reach the goals. Lead by Example provides opportunities to engage and educate many people who work and live in the county.

Local and Regional Examples:
Hosted by the Northeast Recycling Council (NERC), the Government Recycling Demand Champion Program is an opportunity for state, local and regional government entities of any type, schools, colleges and universities (public and private) to support the recycling economy by buying products with post-consumer resin. The Program offers free technical assistance and training, recognition, and tools to support efforts.

The PA Department of General Services (DGS) Green Procurement Policy states that analysis is required on each material and service during the bid process to determine what green options are available. When an Environmentally Preferable Product (EPP) is comparable, statement of work or specifications are restricted to the EPP option. Commonwealth Agencies are expected to use their buying power to buy Environmentally Preferable Products and services in order to advance the protection of the environment and support sustainability.

The DGS State Surplus Property Program offers state-owned office furniture, equipment, and supplies for sale to the general public through a distribution center in Harrisburg and special sales are held periodically throughout the state or at online auctions. They also offer private online sales for municipalities to purchase heavy equipment and manage the Commonwealth's recycling program.

National Examples:
Fairfax County, VA is leading by example by adopting an "organization-wide focus on Zero Waste." As identified in the Fairfax County Government and Schools Zero Waste Plan, the scope of their focus includes administration, public safety, parks, public places, schools, social services, and operations/maintenance. As part of the Zero Waste plan, the County conducted an audit of its landfill, recycling, and pilot compost program streams to determine current and potential diversion. They found their current diversion rate is 15% and identified 57% of materials in the landfill stream could be diverted. They also surveyed County employees to gain input on current conditions (prior to COVID-19 restrictions) as well as ideas for Zero Waste solutions. County-specific facility upgrades are included in the plan's Zero Waste strategies. They include: design and retrofit for zero waste, standardize and increase waste receptacles and signage, implement reusable food service ware, install additional air hand dryers, and install additional bottle filling stations.

Through the County of Santa Clara, California Zero Waste in County Facilities program, the County reports diverting 64% of County facility's discards from disposal, up from 17% in baseline year 2009. In April 2021, the County launched a recycling program at the largest County-owned park.

This U.S. EPA website: Sustainable Marketplace: Greener Products and Services gives a wealth of sector-based information about products and services that allow for voluntary sustainable actions and program creation.

Initiative Proposed Action

Proposed Action:
Some lead by example components to consider are:
County building operations and employee culture:

- Create a waste reduction environment by implementing reduction programs such as printing less or printing double sided.
- Create a surplus exchange program within the County government, which can include furniture, office supplies, and other items.
- Create recycling and/or composting stations in common areas and contract for appropriate collection services.
- Create interdepartmental green teams.
- Encourage the use of municipal water sources instead of single-use bottled water.
- Install refillable water stations.
- Create a breakroom environment where reusable mugs, plates, cups, and silverware use are encouraged.
- Communicate efforts to the public through an outreach program.

Procurement:

- Establish standards for purchases including buying refurbished, buying used, buying durable items. Also buy post-consumer recycled content products when appropriate and applicable.
- Discuss zero packaging options with on-site vendors, if applicable.
- Use reusable foodware at employee only gatherings and County events open to the public. If disposable foodware is used and composting is available and "BPI-certified compostable" foodware is accepted, then consider purchasing compostable products that are free of per and polyfluoroalkyl substances (PFAS).
- Buy locally produced compost for use on public landscaping when soil amendment is needed.

Public spaces:

- Provide public receptacles and signage on County property that encourage residents in the County to recycle and/or compost.
- Provide training to the County employees who manage these receptacles.
- Public events:
- Adopt Zero Waste requirements for events held on County property.
- Implement an incentive program to spur the production of Zero Waste events.
- Provide tools and guidance through education, such as toolkits tailored to municipalities and event producers in the county, which could include:
- Zero Waste guidelines for events on public property.
- Tips on how to create a system to reduce and divert discarded materials through recycling and composting.

- Tips on how to adopt reuse systems in food service or, if disposables are used, educate about the importance of procuring PFAS-free compostable food service products.
- Tips on how to follow #SkiptheStuff guidelines.

Municipal Green Product/Procurement

- Encourage municipal adoption of the above County program through incentives (e.g., "Green Points" reduction of tipping fees).
- Lead by Example is a program to begin right away. The program is ongoing and should be continually updated and communicated to the community.

Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: The intention behind "Lead by Example" initiatives is to demonstrate their efficacy and to communicate them to the public. Ongoing and consistent outreach and education with clear messaging is ideal. Outreach and education opportunities include social media posts, tabling at local events, a County dedicated waste reduction website, and marketing campaigns. Information could be made available through signage or pamphlets to the public who visit County buildings and/or public spaces. In planning for communications, consider using events such as Earth Day and America Recycles Day as a backdrop for highlighting County programs.
Initiative Potential Outcome(s)
Potential Outcome(s): If the County were to lead by example, outcomes could include more support for County waste reduction goals, broader adoption of waste reduction initiatives by local municipalities, businesses, institutions, and residents, and community-wide cultural shift toward waste reduction behaviors. An additional outcome could include more requests for technical assistance from County staff by municipalities who need guidance in adoption of goals and implementation of programs. Measurable outcomes could include a number of similar initiatives adopted in municipalities in the county and a number of requests for technical assistance.
Implementation Timeframe
Short (2024-2028)

3. Deconstruction
Initiative Type: Policy
Hierarchy Level: Reduce/Reuse
Sector Focus: All

Initiative Background and Essential Information

Background:
Sometimes called "construction in reverse" or "unbuilding," deconstruction is the selective dismantling of building components, specifically for reuse, repurposing, and recycling. It differs from demolition where a site is cleared of its building by the most expedient means, which usually involves large machinery and targeted explosive devices. Deconstruction is a far more methodical approach than demolition and materials are often sorted on-site for reuse, recycling, and composting. Therefore, deconstruction job sites do not have the rubble removal requirements and expense of demolition. Deconstruction creates 6-8 more jobs than demolition, yet can be cost competitive when considering the reduction in disposal costs and the potential revenues from salvaged material. While diversion through recycling and composting occur on deconstruction job sites, the primary focus is the recovery of products for reuse, primarily high-value lumber and kitchen, bathroom, and electrical fixtures. In communities across the country, deconstruction has emerged as a career pathway into the construction industry for those experiencing barriers to employment.

The deconstruction sector requires local infrastructure, particularly Building Materials Reuse Centers, in order to have an outlet for salvaged materials to be made available to the community for reuse. Therefore, this initiative is directly tied to the Building Materials Reuse Centers initiative.

Local and Regional Examples:
The City of Pittsburgh is pursuing a building deconstruction policy meant to spur the potential recovery, recycling, and reuse of materials from certain city-owned condemned structures. Leaders say potential benefits of such a policy include removing blight from neighborhoods while decreasing waste sent to landfills, advancing climate action goals, and opening opportunities for job training. (source)

The Philadelphia Community Corps, incorporated as a 501(c)3 nonprofit corporation in 2011, offers job training and career development opportunities to entry-level and re-entry job training for individuals facing barriers to employment in the growing deconstruction sector. Qualified trainees participate in Philadelphia deconstruction projects preparing buildings for renovation or removal while salvaging items for reuse or recycling.

National Examples:
Hennepin County, MN offers Deconstruction Grants for building projects that use deconstruction techniques instead of standard demolition to remove materials from the destruction, alteration, or renovation of a building. Homeowners and developers of

residential properties can receive up to $5,000 to help offset the additional time and labor costs associated with deconstruction.

On July 6, 2016, Portland City Council adopted a Deconstruction ordinance, including code language, which requires certain projects seeking a demolition permit to be fully deconstructed as opposed to mechanically demolished. This ensures that valuable materials are salvaged for reuse instead of crushed and landfilled. All single-dwelling structures (houses and duplexes) in all zones are subject to the Deconstruction Ordinance if the structure was built in 1940 or earlier or the structure is designated as a historic resource. A Certified Deconstruction Contractor, trained to safely and effectively disassemble the house and salvage valuable materials for reuse, must perform the deconstruction work.

Initiative Proposed Action

Proposed Action:

- Actions the County can take to support deconstruction include:
- Adopt a deconstruction ordinance:
- Review deconstruction ordinances from counties across the country to identify and catalog approaches that could be employed in the county.
- Engage construction sector and labor union stakeholders in an ordinance development process to further refine approaches for the county.
- Initiate County ordinance development process.
- Support the growth of the county deconstruction sector:
- Partner with entities that can provide deconstruction job training for residents experiencing barriers to employment and partner with a local foundation, such as the Heinz Endowments who supported Project RE at Construction Junction in Pittsburgh, to secure funding.
- Create educational materials for cities, residents, contractors, and other partners.
- Launch a pre-demolition inspection program to help identify opportunities for deconstruction.
- Launch a deconstruction grant program.
- Partner with entities to publicize and host building material donation drop-off events.
- Support the establishment of building materials reuse centers in the county:
- Develop or contract for reuse centers for sale of salvaged building materials and used household items (see Building Materials Reuse Center initiative)

Planning, development, and implementation of activities in support of deconstruction in the county will require the involvement of many stakeholders and community partners and could be a lengthy process. It should be initiated as soon as possible.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach: If the County chooses to develop a deconstruction ordinance, it should engage the construction sector and labor unions in

the development of the ordinance. That will require targeted outreach followed by opportunities for the stakeholders to be educated on the benefits of the policy as well as to voice their concerns and guide the policy development. As the county deconstruction sector grows, through job training opportunities or building material reuse centers, the County can use its outreach mechanisms to promote them in the context of the Zero Waste goal.

Initiative Potential Outcome(s)

Potential Outcome(s):
If the County were to support deconstruction, outcomes could include significant decrease in disposal of reusable building materials, new partnerships with community organizations who are part of the county deconstruction sector, and economic development through job creation and local materials reuse. Measurable outcomes include tons diverted, jobs created, and dollars kept in the local reuse economy.

Implementation Timeframe

Short (2024-2028)

4. Universal Recycling/Composting (Model Ordinance)
Initiative Type: Policy
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
Universal Collection programs make diversion accessible to all by providing efficient collection of compostable and recyclable materials separate from trash as a base level of service. Universal Collection programs address barriers to participation, such as cost, thereby making diversion as convenient as wasting.

As collection is organized by each community in Delaware County, developing a Model Ordinance would provide a way for all the communities to phase in new recycling and composting services when their current arrangements end. By developing a uniform system county-wide, there would be greater efficiency for the collection programs, and a major increased opportunity for coordinated messages to go out throughout the county via electronic and print media, social media, websites, events and flyers to help minimize contamination and to encourage the public to recycle right.

Model Ordinances have been adopted to implement programs such as construction and demolition debris recycling county-wide (e.g. Alameda County, CA) or state-wide (CA).

Local and Regional Examples:
Abington Township, PA (population 55,468) provides weekly dual-stream recycling, yard trimmings, and trash collection services with municipal crews in fully-automated trucks for 18,200 households. All collection services are provided on the same day. The town provides dual-stream recycling in two carts (a 65-gallon cart for paper and a 35- or 65-gallon cart for commingled containers). Yard trimmings (grass clippings, leaves, small brush) collection is accepted March through January in 30-gallon brown biodegradable paper bags with a dedicated truck. Residents choose between a 95-, 65-, or 35-gallon cart provided by the Township for trash. The town has a high participation of 90%+ and residents are very well-educated in recycling. This system has enabled Abington Township to achieve a 57% diversion rate.
Cambridge, MA, The City mandates all residents and businesses to separate designated recyclable materials from refuse. See section 8.24.070 of City code "Mandatory Recycling".

National Examples:
StopWaste.org StopWaste helps businesses, residents, and schools in Alameda County, CA waste less, recycle properly, and use water, energy, and other resources efficiently. StopWaste is a public agency governed by the Alameda County Waste Management Authority, the Alameda County Source Reduction and Recycling Board, and the Energy Council. StopWaste has created model policies, ordinances and contract specifications in the following areas: Construction & Demolition Waste Management; Green Building; and Environmentally Preferable Purchasing. This is a great example for Delaware County about how a Model Ordinance could be developed and implemented.
Boulder, CO The City adopted an ordinance requiring that haulers collecting trash must provide recycling and composting to single-family residents and recycling to multi-family complexes (the City later adopted additional requirements that apply to residents and property owners or managers)
Eugene, OR The City requires that haulers provide curbside recycling and yard collection service to their single-family household customers.
Vail, CO. The Town adopted an ordinance requiring source separation of recyclables by residential, multi-family, and commercial customers
Fort Collins, CO The Community Recycling Ordinance of the City requires private haulers to provide curbside recycling to residents at no extra charge, apply volume-based pricing, and offer a range of trash can size options.
District of Columbia, Washington D.C. The City mandates all residents and businesses to separate designated recyclable materials from refuse.
Fairfax County, VA The County requires all businesses and institutions to recycle mixed paper and cardboard. Also, all residents are required to source-separate specific recyclable items from trash.
Santa Barbara County, CA The County's mandatory commercial recycling program prohibits specified recyclable materials from being discarded in the trash and enacts a non-compliance fee on businesses that do not recycle equal to 20% of their trash collection rate.
Portland, OR The City requires all businesses and multi-family complexes to recycle 75% of the solid waste they produce, including paper and recyclable containers. See section 17.102.270 of City code "Businesses and Multifamily Complexes Required to Recycle".

San Francisco, CA The City adopted a Mandatory Recycling and Composting Ordinance requiring residents and businesses to keep both compostables and recyclables out of their trash bins.
Seattle, WA By ordinance, the City requires recyclable and compostable materials be kept out of garbage. The ordinance is enforced through visual inspections, warning notices, and fees and the City tags garbage containers filled with more than 10% recyclables and compostables.

Initiative Proposed Action

Proposed Action:
A Model Ordinance could detail the expectations of generators (residents, businesses and/or institutions), haulers and processors (recycling and composting) and the end use of recovered materials/products. A Model Ordinance could address the types of materials to be collected, how they are to be collected (e.g. single-, dual- or multi-stream), when they are to be collected (e.g. weekly, bi-weekly) and in what type of containers.

A Universal Recycling and Composting Ordinance could: 1) require compliance of households and/or businesses with recycling and/or composting and properly separating recyclables and/or compostables from refuse; 2) require that owners of businesses, institutions, or multi-family complexes recycle a specific percentage of solid waste generated; 3) require that trash collection is contingent on recycling bin set out or that businesses and institutions have recycling plans and/or space for recycling; and/or 4) require haulers to offer or provide curbside recycling and/or compostable collection along with trash service for their customers (which sometimes require that there are at least equal amounts of waste diversion services as trash services).

This could be implemented in phases. Often, these ordinances are implemented after extensive review with stakeholders and the community to refine the expectations and timing for implementation. The first phase could be a review of the existing municipal codes and contracts. More significant aspects of this Ordinance would be adopted after stakeholder and community input and after the adoption of the Zero Waste Plan. They are often phased in with a focus on the largest commercial generators first, to gain experience with the details of implementing such policies and to demonstrate to smaller generators that they can be implemented well in this community, and how that was done.

May start composting by providing one or more pilot programs. May need less detail in an ordinance if requirements are implemented as 2-party agreements with haulers (e.g. as exclusive territories or non-exclusive agreements). Ordinance would require monthly and annual data reports from all haulers.

Project Components: Research case studies. Present research to stakeholders and community and get their input on options. Agree in principle on the approach to include. Adopt Plan. Conduct further research on details. Draft Ordinance. Engage with

stakeholders and the community to review Draft Ordinance. Revise Ordinance. Adopt Ordinance by County as a model. Encourage communities to adopt model.
Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: Strong, effective diversion collection programs rely upon the delivery of strong, effective outreach and education programs. Roll-out of Universal Collection will require significant education and outreach to customers serviced by the program before program startup, during startup, and on an on-going basis. A robust, multi-channel education and outreach effort prior to program launch will be necessary to ensure that customers understand the new program and how it works. Outreach channels can include online (website, social media), events, door-to-door, and print media (e.g., signage, ads, billboards) with clear and consistent messaging and branding that is as simple as possible. Ongoing engagement and technical assistance will be required to ensure the customer base remains educated as new residents move to the County or as the program evolves.
Initiative Potential Outcome(s)
Potential Outcome(s): The goal of this initiative is to provide affordable access to both recycling and compost collection programs to all in the community. This will make the collection system more efficient as there will not be as much of a distance between pickup locations, and it will divert resources from landfills and incinerators. This would decrease the amount of materials being disposed of and increase Delaware County's diversion rate.
Implementation Timeframe
Short (2024-2028)

5. Save-As-You-Throw Initiative Type: Policy Hierarchy Level: Reduce, Reuse, Recycle and Compost Sector Focus: Single-Family
Initiative Background and Essential Information
Background: Save-As-You-Throw (SAYT) programs enact a volume-based fee structure that pays for the combination of waste, recycling and composting services in one bill. These programs are also known as Pay As You Throw (PAYT), Unit Pricing and Save Money and Reduce Trash (SMART). This is just like is done for electricity and water services in many communities.

SAYT systems can shift the burden of waste management costs from local tax rolls to user fees. They can work in a wide variety of ways, including:

- Bag, Tags and Sticker Systems
- Residents buy special bags, tag or stickers at City Hall and local retailers. The price includes the cost of collection services. Tags/stickers can designate specific volumes of waste and can be used for bulky items. No billing system to administer. Can work with cart- or can-based collection systems. Inexpensive to implement. Can be used as method for charging for overflow waste.
- Variable Carts
- Generators pay a fixed price based on size or number of carts they select for waste service. The larger or greater number of carts used, the more they pay. There are significant costs to buy the carts, but those can be amortized affordably over a long-term (8-10 year) with public or private haulers.

Local and Regional Examples:
Carlisle Borough (Cumberland County), PA Residents place trash in Borough designated bags (produced by WasteZero) that are picked up weekly. Residents can buy bags at Borough Hall or at several area retailers. In 2022, the bags cost $5.85 each. Each bag must weigh no more than 40 pounds. Recycling is picked up the same day as trash is picked up. Recyclables must be in designated bins or rolling carts.
Concord, NH, began a PAYT program in July 2009. Over the first five years of the program, residential solid waste tonnage decreased by almost half, and the recycling rate more than doubled and there has been no increase in illegal dumping since the program began.
Natick, Massachusetts' mature pay-per-bag program was expanded in 2017 to include curbside pink bags for a recycling program for clothing and a variety of household goods.
Worcester, MA The City went from recycling 2% of their waste to 38% in one week and saved $94.5 million over the first 21 years. Concerns about illegal dumping and throwing of trash across the city never materialized.
Seekonk, MA residents generate 437 pounds of trash per capita annually with a curbside PAYT/SMART bag in cart program.
Connecticut - The State supports Save Money and Reduce Trash (SMART, aka PAYT) as a key strategy for reducing waste; most recently in the State's Comprehensive Materials Management Strategy (2016) and previously in the Modernizing Recycling Working Group Recommendations (2012) and the State's Solid Waste Management Plan (original dated 1991, amended in 2006).
Mansfield, CT Residents generate 500 pounds of trash per capita annually compared to average CT resident of 740 pounds
Stonington, CT has saved $7M on trash since 1992

National Examples:
San Francisco, CA has a PAYT rate structure with Recology.
San Jose, CA changed from unlimited garbage collection to a PAYT system in 1992, with a close to linear rate structure (the price for each 32 gallons of service is the same amount).

Castro Valley, CA The Castro Valley Sanitation District established volume-based rates for trash service, embedding the cost of recycling into trash service rates for businesses and multi-family properties that subscribe to no more than 3 cubic yards of trash service per week; 85% of commercial properties subscribe to 3-yard trash bins or smaller.
Gainesville, FL In establishing rates for residential solid waste collection that assess higher monthly rates for use of larger garbage containers, the City achieved an 18% reduction in the amount of solid waste collected.
Fort Collins, CO By ordinance, the City requires private haulers to provide curbside recycling to residents at no extra charge, apply volume-based pricing, and offer a range of trash can size options. The ordinance further requires that the charge for additional containers of the same volume capacity be no less than the charge for the first container.
The Colorado communities of Arvada, Carbondale, Golden, Lafayette, and Louisville changed from open subscription to a single-hauler system that provides single-stream recycling to residents. Most of these systems require their contractor to use PAYT Pricing and serve residents not living under homeowners associations. Lafayette and Louisville provide organics collection at no extra cost while Carbondale and Golden offer it for an additional fee. Golden subsidizes the organics collection to reduce rates for residents as a strategy to increase participation. Arvada does not currently offer organics collection through their contracted hauler. Carbondale residents opting out of the contracted hauler have the option to choose a different hauler, but still have a charge on their utility bill for the base costs for the Town's residential trash and recycling service. A case study from Lafayette explains the rationale behind their decision to move to a single hauler system.

Initiative Proposed Action

Proposed Action:
Through a Universal Recycling & Composting Ordinance or the procurement of such services by RFPs and contracts, the County or local cities could include detailed terms regarding the types of services to be provided, incentives to ensure those services are performed well, and customer service, education and reporting requirements. Rolling carts could be required to be provided by the contractor for all services, with different sizes available to residents to select. PAYT rates could be required, with recycling and composting services bundled with the payment of fees for trash cans, ideally with each additional cart being charged the same as the first cart (a linear rate structure). Residents could be given the option to opt out of a City-procured contract but be required to hire a private hauler providing the same or higher service level.

As collection is organized by each community in Delaware County, the County could develop a Request for Proposals (RFP) for Pay-As-You-Throw (PAYT) collection to be part of the universal recycling and composting services to be provided. Communities could opt in to such a system, that could be tailored to the timing of the end of existing contracts. That would provide a way to phase in new recycling and composting services when their current arrangements end. Other details would follow the same path as detailed in the Universal Recycling and Composting Initiative.

Alternatively, communities could negotiate with their current hauler (perhaps with assistance from the County) to implement PAYT and new recycling and composting services if they are satisfied with their current hauler's performance, prices and responsiveness.
Project Components: Agree in principle on the approach to include and adopt in Zero Waste Plan. Research case studies. Present research to stakeholders and community and get their input on options. Conduct further research on details. Solicit participation of communities to be part of a Request for Proposals (RFP) to be issued by the County on their behalf. Engage with stakeholders and the community to review Draft RFP. Revise RFP. Issue RFP. Evaluate Responses to RFP. Implement contracts with service providers and communities.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Communities in the county that pursue SAYT programs could coordinate on their messaging and outreach via electronic and print media, social media, websites, events and flyers to help minimize contamination and to encourage the public to recycle right.

Initiative Potential Outcome(s)

Potential Outcome(s):
A large proportion of the communities in the County could benefit from pursuing SAYT programs. It's likely that at least 50% of the communities would pursue SAYT once one or two communities demonstrate the value of it within the County.

Implementation Timeframe

Short (2024-2028)

6. Construction and Demolition Requirements
Initiative Type: Policy
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
The Pennsylvania Department of Environmental Protection reports that construction and demolition (C&D) debris makes up approximately 17.5 percent of Pennsylvania's municipal waste stream. In 2005, Pennsylvania disposed of over 2.25 million tons of C&D debris in municipal and C&D landfills. In addition, the NEWMOA C&D Materials Management Workgroup reports that Pennsylvania landfills are relied on by Connecticut,

Massachusetts, New Jersey, and New York for disposal of the majority of their C&D debris.

Local rules create incentives and encourage diversion of construction and demolition (C&D) waste, which can significantly reduce a community's discards. C&D requirements may apply to construction, renovation, and/or demolition projects. Cities, counties, and states across the country have adopted ordinances and disposal bans on C&D debris. Most C&D policies include recycling requirements for C&D debris, specifications on types and quantities of materials that must be recovered, reporting requirements, and compliance tools including fees and penalties for non-compliance. Disposal bans are an effective tool for increasing C&D debris diversion. The Pennsylvania Department of Environmental Protection hosts web pages that provide guidance on reducing Construction and Demolition Waste as well as on Minimizing Disposal of Renovation and Demolition Wastes.

C&D debris diversion requires processing infrastructure that can manage materials for recycling and composting. That can pose a chicken-and-egg dilemma for many communities considering C&D diversion requirements. That infrastructure is accessible to the county building construction sector via Revolution Recovery, a Philadelphia-based mixed C&D debris processor and roll-off container service provider. They accept, sort, and recycle wood, metal, drywall, rubble, cardboard, plastic, ceiling tile, paper, and carpet at three facilities in Eastern Pennsylvania.

Local and Regional Examples:
Chittenden County, VT has banned C&D debris from landfill disposal. The rationale provided is "because there are many reuse or recycling options available." Banned items include clean & unpainted plywood and OSB (oriented strand board), asbestos-free asphalt shingles, scrap metal, clean lumber & pallets, and mandatory recyclables.

National Examples:
Cook County, IL adopted a Demolition Debris Diversion ordinance, effective November 2012, requiring that 70% of demolition debris from commercial and residential structures (excluding garages and sheds) be recycled during the demolition process, with 5% of the residential structures being reused.

The City of Fitchburg, WI requires the reuse and/or recycling of materials from certain construction, roofing, remodeling, and demolition projects. Construction and demolition projects to which the ordinance applies will require a Preliminary Construction and Demolition Reuse/Recycling Plan, detailing the contractor or owners recycling efforts. Within 60 days of project completion, the contractor or owner will need to submit a Final CDRR Plan to the Fitchburg Public Works Department. The addition to the Chapter 41 Ordinance was the result of two years of work by the members of the Dane County Cities and Villages Association, The Community and Economic Development Authority, The Fitchburg Chamber of Commerce, the Resource Conservation Commission, and representatives of local construction, remodeling and demolition industries.

In 2020, Pitkin County, CO adopted a Construction and Demolition Diversion Regulation ordinance, which creates a framework for the county's new construction and demolition (C&D) debris recovery program. Through a collaboration between the Pitkin County Solid Waste Center (PCSWC) and the Pitkin County Community Development Department, C&D waste management requirements are now tied to the county's building and demolition permit process. In addition, the PCSWC implemented a new pricing structure in March for disposal of C&D materials to incentivize recycling. To obtain a Pitkin County building or demolition permit under the new regulations, the project owner will now pay a deposit based on the total estimated waste that will be produced by the project. The deposit is fully refunded if a project owner diverts at least 25 percent of their construction debris from the landfill and avoids trashing recyclable materials like concrete, scrap metal and others.

Initiative Proposed Action

Proposed Action:

- Actions the County can take to support deconstruction include:
- Adopt a landfill ban for C&D debris
- Adopt a C&D debris diversion ordinance:
- Review C&D debris diversion ordinances from counties across the country to identify and catalog approaches that could be employed in the County.
- Engage the building construction sector stakeholders in an ordinance development process to further refine approaches for the County.
- Initiate County ordinance development process.
- Support the growth of the county C&D diversion sector:
- Develop an inert materials recycling facility for rocks, asphalt, and concrete to provide a diversion option within the County.
- Create educational materials for cities, residents, contractors, and other partners.
- Launch a pre-demolition inspection program to help identify opportunities for C&D debris diversion.

Planning, development, and implementation of activities in support of C&D debris diversion in the county will require the involvement of many stakeholders and community partners and could be a lengthy process. It should be initiated as soon as possible.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
If the County chooses to develop C&D debris requirements, it should engage the county building construction sector in the development of those requirements. That will require targeted outreach followed by opportunities for the stakeholders to be educated on the benefits of an ordinance or landfill ban as well as to voice their concerns and guide policy development. As the county C&D diversion grows, through increased diversion resources and opportunities, the County can use its outreach mechanisms to promote them in the context of the Zero Waste goal.

Initiative Potential Outcome(s)
Potential Outcome(s): If the County were to support C&D debris diversion, outcomes could include significant decrease in disposal of building materials and economic development through new local diversion opportunities such as services and facilities and the jobs they create. Measurable outcomes include tons recycled or composted, number of new facilities or services, and number of new C&D debris diversion jobs.
Implementation Timeframe
Short (2024-2028)

7. Reduce Frequency of Trash Collection Initiative Type: Program Hierarchy Level: Reduce, Reuse, Recycle and Compost Sector Focus: Single-Family
Initiative Background and Essential Information
Background: When both organics and recyclables are collected separately from trash, little material is left to be collected as trash. One way to both minimize overall costs and maximize organics diversion is to collect trash less frequently, either every-other-week (EOW) or monthly. Over 50% of the municipalities in the county collect trash twice each week regularly or seasonally. A first step towards every-other-week (EOW) trash collection would be to reduce the frequency of trash collection to once each week, and adding additional recycling and composting services (preferably on the same day as trash collection). EOW goes a step further and modifies trash collection to every-other-week trash pickup. PAYT is often accompanied by the addition of more recycling services, including weekly organics collection. In most locations, “putrescibles” such as food scraps are required to be collected weekly. If food scraps are collected on a weekly basis apart from trash, then trash service can be adjusted to an EOW schedule. To reduce contamination from residences, programs will need to address proper diaper and pet waste disposal through education and/or separate pickups. EOW is best implemented with a comprehensive startup of new recycling and composting services so that this is not seen as a “reduction in services” or “takeaway”, but rather as a smart way to efficiently implement a comprehensive new system.

Another way to implement EOW is less-frequent collection for recyclables as well as for trash. In this option, every truck is a split body unit, which collects organics on one side each week, and on the other side alternates weekly between trash and recyclables, both of which are collected EOW. By reducing the types of trucks needed to serve a community from two to one, there are significant savings in the need for fewer spare trucks and more efficient maintenance.

Local and Regional Examples:
Centre County, PA The Centre Region Council of Governments (COG) manages a Refuse and Recycling contract for Patton, Harris, College, Ferguson and Benner Townships. They are considering EOW for trash collection as an option in the next contract in 2-3 years. That will be contingent on instituting organics recycling in those areas before they go out to bid.[12]

National Examples:
Renton, WA The City cost-effectively transitioned from weekly to every-other-week collection of residential garbage and recycling and weekly collection of organics, with no charge for setting out extra recyclable or compostable items. Additional resources are: Zero Waste Case Study: Renton, WA; and Waste Collection Contract - Renton
Vancouver, WA The City's rates for contracted commercial garbage collection service are lower for every-other week service for each container size option, with a once-per-month collection option for 32-gallon cart service offered at a rate less than half that of weekly collection; commercial customers are allowed up to two 96-gallon recycling carts for no additional charge
Portland, OR The City provides residential garbage pick-up every-other-week, with options to decrease the frequency of garbage service, along with weekly collection of recyclables and organics in 60-gallon carts; the switch to every-other-week trash collection led to a 35% reduction in the amount of garbage collected and tripled the amount of organics collected.
Niagara Region, Ontario, Canada EOW program started in 2020. Found garbage down 16% and green bin up 24% and recycling was up by 8%. Participation increased from 48% before EOW to over 60%. Other municipalities in the region saw the same results. The policy change is working. The green bins have state-of-the-art latches to keep unwanted intruders away from organics and to keep odors in. See website for more info.

Initiative Proposed Action
Proposed Action: As collection is organized by each community in Delaware County, the County could develop a Request for Proposals (RFP) for every-other-week (EOW) collection to be part of the universal recycling and composting services to be provided. Communities could opt in to such a system, that could be tailored to the timing of the end of existing

[12] Source: emails from Joanne Shafer, Centre County Recycling and Refuse Authority, 6-1-22. https://www.centrecountyrecycles.org

contracts. That would provide a way to phase in new recycling and composting services when their current arrangements end. Other details would follow the same path as detailed in the Universal Recycling and Composting Initiative.

Alternatively, communities could negotiate with their current hauler (perhaps with assistance from the County) to implement EOW and new recycling and composting services if they are satisfied with their current hauler's performance, prices and responsiveness.

Project Components: Research case studies. Present research to stakeholders and community and get their input on options. Agree in principle on the approach to include. Adopt a Plan. Conduct further research on details. Solicit participation of communities to be part of a Request for Proposals (RFP) to be issued by the County on their behalf. Engage with stakeholders and the community to review Draft RFP. Revise RFP. Issue RFP. Evaluate Responses to RFP. Implement contracts with service providers and communities.

Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: Communities in the county that pursue EOW programs could coordinate on their messaging and outreach via electronic and print media, social media, websites, events and flyers to help minimize contamination and to encourage the public to recycle right.
Initiative Potential Outcome(s)
Potential Outcome(s): Only a few of the most progressive communities in the county would likely implement this program. The best way to implement this would be to roll it out together with the startup of Universal Recycling and Composting services. That would be the most efficient system, and would help make the Universal Recycling and Composting Services more affordable. This is particularly important given that contracts for services will likely be costlier in the future due to inflation, rising fuel cost and supply chain issues. EOW is one of the best tools for addressing these other challenges.
Implementation Timeframe
Long (2029-2034)

8. Outreach, Education, and Technical Assistance
Initiative Type: Program
Hierarchy Level: All
Sector Focus: All

Initiative Background and Essential Information

Background:
This initiative describes the creation of outreach, education, and technical assistance for Delaware County as new Zero Waste policies and programs are created. Education and outreach are essential because this is the pathway for new Zero Waste information to reach residents and the business sector.
The outreach and education can include information about new Zero Waste programs and education on what, how, and why to work towards Zero Waste. With enhanced outreach and education, there is an excellent likelihood that new Zero Waste programs will be successful. The outreach and education created will focus on policies and programs related to reducing, repairing, reusing, recycling, and composting materials.
Technical assistance can include direct support to property owners of multi-family units, residents, or business owners related to new Zero Waste policies and programs. One-on-one direct help may be needed to source separating organic material or how to recycle right. Technical assistance will be beneficial for Delaware County to meet the standard of the ordinances and programs related to Zero Waste.

Local and Regional Examples:
The City of Philadelphia has a website dedicated to Zero Waste Initiatives. This page has educational materials on food waste reduction for businesses and residents, a Zero Waste partnership program that recognizes achievements related to Zero Waste, and an online search tool to find where you can donate or recycle items.

The Pennsylvania Department of Environmental Protection offers technical assistance programs to local governments selected to participate. This program aims to increase the recovery rate of recyclable materials.
The Pennsylvania Resource Council participates in the Department of Environmental Protection Recycling Technical Assistance Program (RTAP) and is available to help local governments chosen by the Department of Environmental Protection for this program.

The City of Pittsburgh has a webpage on Zero Waste with numerous educational information links. Their Zero Waste resources include education on reducing junk mail, reducing packaging, reusing items, composting, and information on hard-to-recycle items.

Media Borough has a webpage dedicated to helping businesses achieve Zero Waste. It's full of educational material and strategies a business can embrace to work toward Zero Waste.

All Together Now Pennsylvania has a Zero Waste Advisory Group that creates education, connects businesses to Zero Waste practices, and advocates for Zero Waste policies.

Their website offers Zero Waste resources and residents tips on working toward Zero Waste.

National Examples:
#SkiptheStuff is a campaign by Upstream Solutions to reduce the unnecessary distribution of take-out food accessories. This campaign saves the restaurant time and money by only giving out accessories when the customer asks for them.
Boulder, CO, created this short video with their Universal Zero Waste Ordinance. Eco-Cycle has created great videos on recycling, composting, and Zero Waste. These videos help communities understand the aspects of Zero Waste. Eco-Cycle has developed educational material on recycling, composting, and reuse. It has created a 10-part Zero Waste video series, a video featuring Captain Zero Waste, and a video on recycling at Boulder County Recycling Center featuring Mr. Can. All the videos come with downloaded activities.

Boulder, CO, also has a technical assistance program called the Partners for a Clean Environment. This is a technical assistance service for businesses. These technical services range from energy conservation to waste reduction, and they have at least one person on staff who is trained in Zero Waste.

Community-based social marketing is an example of a type of educational campaign and includes the following components:
Identify a behavior to change
Identify the barriers to the behavior
Develop a pilot program to overcome the barriers
Implement the program across the community
Evaluate the effectiveness of the program

The U.S. EPA has a website dedicated to tools, resources, information, and data on reducing food loss and waste called Sustainable Management of Food. Here municipalities can gather resources for businesses and organizations to reduce food loss and begin following the food-recovery hierarchy. The food-recovery hierarchy shows different management pathways to reduce food waste and can be a guide for the food service industry to follow. This website provides resources and information for community members to begin their wasted food reduction efforts.

Save the Food is a resource produced by the Natural Resources Defense Council and geared toward consumer-level actions that can be done to prevent food from being wasted. Still Tasty is another online resource that consumers can use to prevent food from being wasted.

The City of Fort Collins, CO Environmental Services Department offers a Waste Reduction and Recycling Assistance Program (WRAP). The WRAP program is free and provides technical assistance for multifamily units and businesses to begin or increase their recycling and composting efforts. They offer on-site assessments, in-person education, and educational materials.

Initiative Proposed Action

Proposed Action:

- Website for Zero Waste education materials. A Zero Waste website hub will be created to hold all educational materials, information on Zero Waste policies and programs, and videos for use by everyone in Delaware County. This website will be created as a one-time project, but the content will be continually added and updated as Zero Waste policies and programs are produced. This website will give zero waste information about reducing, reusing, recycling, and composting materials. It can house a directory of all reuse and repair locations in Delaware County. It can hold fact sheets and one-page information sheets that can be downloaded or used by someone doing technical assistance. Community partners in Delaware County and private business owners can also use these resources to work toward Zero Waste.
- Technical Assistance to residents and businesses. A technical assistance program would include Delaware County employees or municipal employees in Delaware County going to companies, multi-family units, or residential events to provide on-site program assistance. This might involve taking educational material to a restaurant and teaching the employees how to source separate recyclable and compostable materials from the trash. Technical assistance could also be accomplished by a collaborating organization that works closely with Delaware County. This organization could be the one that visits the place of business or community event with the education materials and helps them understand and comply with the Zero Waste policy or program. An example of when technical assistance may be needed is to assist multifamily residential communities working on recycling or composting. Multifamily waste reduction, reuse, recycling, and composting can be difficult. These resources can help municipalities with case studies, best practices, and materials that work: Guide to Multifamily Recycling, Complex Recycling Issues Strategies for Record-Setting Waste Reduction in Multifamily Dwellings, and Exploring Multifamily Recycling.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
This initiative will create an educational system to house information about reducing consumption, repairing and reusing durable goods, recycling right, and composting food scraps. The goal is to help residents and businesses understand Zero Waste policies and programs and join in the effort to create a Zero Waste Delaware County. An educational website will be made with videos, fact sheets, information about new Zero Waste policies and programs, and Zero Waste resources for all sectors in Delaware County. These education items (e.g., fact sheets) will be used for outreach, technical assistance, and by business owners and residents. This resource hub for Zero Waste will be built as new Zero Waste initiatives are developed for Delaware County.

Implementation Timeframe

Short (2024-2028)

9. Reuse Collection
Initiative Type: Program
Hierarchy Level: Reuse
Sector Focus: Single-Family Residents

Initiative Background and Essential Information

Background:
The Reuse Collection initiative describes a pathway to collect durable and some non-durable, reusable materials from residents in Delaware County that will stay in the local reuse economy. For this initiative, the definition of durable goods, such as furniture and appliances, are items that have a lifespan of three or more years.[13] Nondurable goods are items, such as clothing, shoes, and other textiles, that generally have a lifespan of less than three years.[14] The goal of this initiative is to divert reusable materials from the disposal stream and keep these items in the local economy to be used again.
Reuse is a very important part of Zero Waste programs and reuse is high in the Zero Waste International Alliance's Hierarchy of Highest and Best Use. Reusable materials can include durable goods, building materials, clothing and textiles, and household items.

Programs to keep reusable goods in use for their original purpose is important. Reuse of goods and materials helps to create good green local jobs, offers low cost items to the community, reduces the materials going to the landfill and incinerators, and supports the local circular economy. It also reduces the greenhouse gas emissions and water and air pollution associated with mining resources, and manufacturing and transportation of new items.

The REUSE Primer defines reuse as "*extending the life of a product, packaging, or resource by 1) using it more than once with little to no processing (same or new function), 2) repairing it so it can be used longer, 3) sharing or renting it, or 4) selling or donating it to another party. It should be noted that even though reuse always reduces waste, source reduction doesn't always incorporate reuse. Ideally, when products reach end of life (e.g., used, repaired, repeat) it would then be recycled.*"

Local and Regional Examples:

[13] U.S. EPA Durable Goods – Product Specific Data: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/durable-goods-product-specific-data#:~:text=EPA%20defines%20durable%20goods%20as,although%20there%20are%20some%20exceptions.

[14] U.S. EPA Nondurable Good- Project Specific Data: https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/nondurable-goods-product-specific-data#:~:text=The%20Department%20of%20Commerce%20defines,and%20landfilling%20of%20nondurable%20goods.

Many municipalities in Delaware County currently have agreements with Retrievr to provide on demand collection of textiles and e-waste to residents. Regionally, Bottle Underground is providing collection opportunities to facility glass reuse.

The City of Philadelphia's Office of Sustainability has a Resident's Guide to Recycling and Donating Used Clothing and Other Textiles that lists ways to donate, sell, and recycle textiles.

The City of Cambridge, MS offers a free curbside Clothing and Textile Recycling program. This program is in collaboration with HELPSY and Cambridge residents can place clothing, shoes, other textiles, and linens curbside for pickup. These items will either be reused as their original purpose, recycled into rags, or used as insulation. This program is part of the City of Cambridge's Zero Waste Master Plan.
The City of Boston Public Works Department has a Curbside Textile Recycling Program for residents that collects clothing and other textiles for recycling. Items collected are shown in this flyer and this program is part of their Zero Waste plan.

National Examples:
In Austin, TX there is a program where Austinites can request a pickup of clothes, textiles, or household items. They are mailed a bag to put the items in and then the bag is placed curbside for pick up for reuse or recycling. This program is a collaborative effort between Austin Resource Recovery and Goodwill Central Texas.
Central Contra Costa Solid Waste Authority, in California, hosts a Reuse Day, which is in partnership with Recycle Smart, Mt Diablo Resource Recovery, and Republic Services. Through this program, residents can place durable items at the curb to be collected and kept in the local reuse economy. They receive this information sheet with their Reuse Day date when they sign up.
Castro Valley Sanitary District (CVSan) hosts a Bulky and Reuse Pickup program in Alameda County, CA. Residents can schedule one Bulky and Reuse pickup a year for free. CVSan also offers a textile collection system twice a year.

Initiative Proposed Action

- Proposed Action:
- This initiative would create a curbside residential program for the collection of durable goods and non-durable textiles to be collected for reuse and/or recycling. This program can be created by Delaware County in collaboration with nonprofit and for-profit organizations that specialize in the reuse and recycling of durable goods and nondurable textiles.
- Create a bulky durable goods collection system where residents can place durable goods curbside for pickup. These items will stay in the local used goods market. This program can be created by Delaware County in collaboration with a nonprofit or for-profit reuse center or thrift store. The curbside collection of durable goods could be monthly, quarterly, or on-demand systems.
- The local haulers in Delaware County could partner with a local reuse store like the ReStore for pickup or the local hauler could pick the items up themselves. To keep the bulky items in the best condition for resale, a box truck or flatbed truck

should be used when collecting the items. These reusables that are collected curbside could be distributed to local thrift/reuse/repair stores. CheckSammy is a for-profit sustainability company that works with communities to collect bulky items and textiles for reuse and recycling. Working with a private company like CheckSammy is another alternative for a program like this.

- Create a nondurable textile curbside collection system where residents can place textiles curbside for collection. These textiles would be collected for reuse if possible or recycling. This system could be created by Delaware county in collaboration with a nonprofit or for-profit textile collection organization.
- Change the bulky item collection program to include both reusable items and bulky items for recycling (including scrap metal and wood).
- The creation of this initiative should begin right away. This initiative will be ongoing, and it should be partnered with education and outreach on reuse.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Delaware County can create a Reuse Campaign with the goal to help residents understand that their buying habits affect the local reuse economy. This education campaign can encourage residents to buy durable, long lasting, and repairable items. It can also encourage them to use the local repair infrastructure and to buy used. Delaware County can also create education dedicated to the reuse collection program that they create. This can include what item can be placed curbside, how to participate, when to place items curbside, and the benefits of participating in this program.

Initiative Potential Outcome:

Potential Outcome(s):
The goal of this initiative is to reduce the volume and amount of durable goods and nondurable textiles from entering the disposal stream. Another goal is to create more awareness on reuse and why it is an important part of a Zero Waste program. A measurable outcome of a reuse collection program could be a decrease in the durable materials and nondurable textiles entering the disposal stream.

Implementation Timeframe

Short (2024-2028)

10. Edible Food Donation
Initiative Type: Program
Hierarchy Level: Reuse
Sector Focus: Industrial/Commercial/Institutional (ICI)

Initiative Background and Essential Information

Background:
An Edible Food Donation program creates a system to collect pre-consumer edible food from food-generating businesses and redirects the food to those in need. According to the USDA, 30-40% of the food in the United States is wasted.[15] At the same time, many Americans face food insecurity (USDA estimates that 10% of Americans faced food insecurity in 2019).[16] Up to 28% of the food that is wasted occurs at consumer-facing businesses such as grocery stores, restaurants, and other foodservice businesses.[17] A program to collect edible food and redirect the food to people in need helps mitigate several problems including climate change and food insecurity, while it also reduces resources going to landfills and incineration.

Local and Regional Examples:
Some established food recovery systems in Delaware County are: Delaware County, Pennsylvania Food Pantries, the Delaware County Interfaith Food Assistance Network, and the Delco Food Project. In 2020 the Pennsylvania Department of Environment gave out Food Recovery Infrastructure grants totaling over $9 million dollars. These were the four recipients from Delaware County: Community Action Agency of Delaware County Inc Delaware, Family & Community Service of Delaware Co. Delaware, Memorial Church of God in Christ of Haverford Inc Delaware, and Upper Darby Community Outreach Corporation. These organizations and many others are already working on food recovery infrastructure and have systems in place to recover food and get it to those who need it.
Philly Food Rescue works with food donors to schedule pickups of excess food. The food is picked up by volunteers using the Food Rescue Hero app and then delivered to appropriate partners. The Center for EcoTechnology has partnered with the City of Philadelphia to help them achieve their Zero Waste goals by creating a pilot program for businesses to engage in wasted food prevention and recycling programs. The Center for EcoTechnology also created this short report to highlight some commercial businesses in Philadelphia that are doing the right thing by preventing food from being wasted and rescuing edible food.
Feeding Pennsylvania, in partnership with Feeding America, works in all 67 counties to coordinate excess edible food collection and distribution to food banks in Pennsylvania.

Food Link serves eastern Massachusetts and rescues edible food that would have been wasted and delivers the food to community partners serving the food insecure. Food Link has over 100 food-generating business partners and 250 volunteers. In 2021, Food Link rescued over 1.4 million pounds of fresh food.
Table to Table is a nonprofit organization that operates in several counties in New Jersey. Their mission is to help end hunger while fighting food waste. They collect food from over 200 donors and deliver the food to food donation organizations.

[15] U.S. Department of Agriculture - Food Waste Data: https://www.usda.gov/foodlossandwaste/faqs

[16] Household Food Insecurity in the United States in 2019: https://www.ers.usda.gov/publications/pub-details/?pubid=99281

[17] ReFed: https://refed.org/food-waste/the-problem/#what_is_food_waste

National Examples:
The Urban Green Lab in Nashville, TN has helped establish the Nashville Food Waste Initiative. One of the goals of this joint effort is to establish systems in Nashville to rescue edible food for the food insecure.
In California, Santa Clara County's program to divert excess edible food from the waste stream and get it to those who need it is called the Food Recovery Program. An estimated 12% of those in Santa Clara County are food insecure.
Urban Gleaners is an organization in Portland, OR that rescues edible food and delivers it to those who need it. Urban Gleaners works with a growing list of grocery stores, farms, restaurants, institutions, and special events to collect their excess edible food. They use a warehouse to sort and package the food into meals and then distribute to over 35 partners.
Abound Food Care is a nonprofit organization in Santa Ana, CA that uses logistical expertise to connect available food with the nonprofit agencies that can serve it quickly and safely. They also provide data to the donating organization.
This system of collecting edible food for donation can be assisted by nonprofit organizations that are available to pick up the food. These systems are often supported through smart phone applications that solve logistical problems with technology. Some food recovery systems that use smart phone apps to connect edible surplus food to those in need are MEANS Database, Goodr, and Food Rescue Hero. MEANS Database works in all 50 states with the goal of reducing food waste and getting that food to those who need it. Goodr also works nationwide connecting edible food for consumption and collects inedible food for composting. Food Rescue Heroes uses an app to collect food and connect the edible food to those who need it. They work in Pennsylvania, California, New Jersey, and in Iowa.

Initiative Proposed Action

- Proposed Action:
- The Edible Food Donation Initiative is a program that coordinates edible food recovery with community partners who organize and distribute food. Actions that Delaware County could take include:
- Create a system to collect pre-consumer edible food from food-generating businesses such as grocery stores, restaurants, and other foodservice businesses. This food is picked up and taken directly to a community partner or food bank for distribution. For this initiative to be successful, clear collaboration between food-generating businesses, city officials, and community partners needs to be established. Setting a goal for the amount or percentage of pre-consumer edible food to be collected for donation can be created to establish a benchmark to measure against.
- Delaware County can potentially partner with current food recovery efforts and build on their success and established systems. These systems could be expanded to accommodate the additional edible food that could be rescued.
- Delaware County could create two surveys to gather information on the needs, barriers, and systems in place prior to creating an edible food donation program. One of the surveys should be directed to organizations that accept food donations and organize and distribute food. The other survey should be created for food-

generating businesses, such as grocery stores, restaurants, caterers, and other foodservice industries. The information collected will provide Delaware County with a wealth of information on how to begin this program, what is needed, and what barriers to overcome.

- The County could provide grants to food banks and food rescue operations to support their expansion (e.g. providing refrigerated storage facilities, refrigerated trucks and mobile storage containers for collecting and distributing edible food).
- This initiative should begin immediately because there are already people in need and excess edible food available.
- This initiative will be on-going because there will always be excess edible food to rescue. New food-generating businesses that begin will need outreach to know how to donate edible food and who to work with. Once a system to rescue edible food is established in Delaware County, that system will need monitoring and continual updating to ensure efficiency.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
A program to capture pre-consumer edible food for donation will be more successful if it is created in collaboration with an educational program. The goal of an educational program is to provide needed information for the sectors in Delaware County (i.e., residents, commercial, and institutions) that will participate in this program. Delaware County can create a webpage that is devoted to educational material with fact sheets, videos, and other content. This educational website can also devote space to identifying specific local information on how to donate edible food. The following information should be included on this educational website:

- Specific information on how food donors (e.g., grocery stores, restaurants, event coordinators, caterers, and other food specific generators) can participate, What app-based food pick up system are available to use, such as MEANS Database
- Which food banks are accepting food donations

Readily available education can be linked to the educational website that Delaware County creates. Information from the U.S. EPA's website Sustainable Management of Food, including tools, resources, information, and data on reducing food loss and waste, can be used. An educational program can include the U.S. EPA Food Recovery Hierarchy as a model to follow. The food-recovery hierarchy shows different management pathways to reduce food waste and can be a guide for the food service industry to follow.

Delaware County could curate sector specific educational material on reducing wasted food, how to donate edible food, and then where and how to compost food scraps. For residents there could be a list of resources that residents can use such as savethefood.com, stilltasty.com and zerowastechef.com. The EPA site Reducing Wasted Food at Home can be utilized on this webpage as well.

For businesses, this EPA website offers information on preventing food waste. Harvard Food Law and Policy Clinic has created four fact sheets on food waste issues in Pennsylvania that can be shared with Delaware County businesses that are working to

reduce wasted food. The four legal facts share are: Pennsylvania Food Donation: Tax Incentives, Pennsylvania Food Donation: Liability Protections, Pennsylvania Food Donation: Food Scraps for Animals, and Pennsylvania Food Donation: Date Labels. These legal fact sheets can be linked to the Delaware County's educational website.

Initiative Potential Outcomes

Potential Outcomes: (*describe the goal of this initiative and possible measurable outcomes*)
The goal of this initiative is to divert edible food from the disposal stream and get it to those in need. This will accomplish two things: it will help get needed food to the food insecure, and it will divert resources (i.e., edible food) from landfills and incinerators. This should decrease the amount of materials being disposed of and increase Delaware County's diversion rate.

Implementation Timeframe

Short (2024-2028)

11. Reuse & Repair
Initiative Type: Program
Hierarchy Level: Reuse
Sector Focus: All

Initiative Background and Essential Information

Background:
This initiative describes the creation of a reuse and repair program that includes information on repair fairs, lending libraries, reuse and repair directories, and material exchange. The goal of this initiative is to create a culture where reuse is an everyday activity in Delaware County, and community members have the information needed to participate in reuse and repair.

Reuse is high in the Zero Waste International Alliance's Hierarchy of Highest and Best Use, and therefore reuse should be an important part of a Zero Waste Community Plan. Repair is a component of reuse and allows for durable goods to stay in use at their highest and best use longer.

Programs to keep reusable goods in use for their original purpose is important. Reuse of goods and materials through repair helps to create good green local jobs, extends the life of the item, reduces the materials going to the landfill and incinerators, and supports the local circular economy. It also reduces the greenhouse gas emissions and water and air pollution associated with mining resources, and manufacturing and transportation of new items.

Local and Regional Examples:
Repair Café events bring community members together with the goal of fixing items. Repair keeps items in use longer. Philadelphia has held repair cafes, along with Phoenixville, PA. The Awesome Foundation sponsored Community Repair Clinics in Bloomfield (Pittsburg, PA) in 2020.
The Central Vermont Solid Waste Management District partners with the Onion River Exchange and the Center for an Agricultural Economy to host a Repair Café where community members can bring their household items for repair.

There are several tool lending libraries in Pennsylvania including two in Philadelphia: The West Philadelphia Tool Library and the Tacony Tool Library. These lending libraries are both membership-based. Another tool lending library in Pennsylvania is the Erie Tool Lending Library, which lists the tools online that are available for checkout.

Pennsylvania Resource Council facilitates a mobile and desktop application called Reuse Central that connects donated items from businesses and institutions to those who want these items. Their goal is to make it easy and convenient to keep durable goods out of the landfill and in use.
Baltimore County, and St. Mary's County Maryland government both maintain Reuse Directories. These directories list businesses and organizations that accept donations of items from the community for resale.
Donate NYC Exchange is an online tool that allows businesses and nonprofits to find places to donate items or request surplus items. This tool is operated by the New York City Department of Sanitation. There is an online directory and an exchange list of available and wanted items.

National Examples:
Fixit Clinic and Repair Café are model programs that set standards on repair events that local communities and community groups can produce. The goal of these events is to keep reusable items, like clothing, electronics, furniture, and household items in use longer. Communities and community groups across the country have held Fixit Clinics and Repair Cafés such as Hennepin County, MN, Zero Waste San Diego, and Chandler, AZ.

Boulder County, CO has many reuse programs in place including a tool lending library and fix-it clinics. Boulder County residents are also encouraged to use an online trading site for building materials (buildingsurplus.com) and they have access to reusable building materials at Resource Central, a large reuse center with a salvage yard, warehouse, and showroom.

Home ReSource, a building materials reuse center in Missoula, MT, also hosts Fixit Clinics with the goal of demystifying repair, skill-sharing, and keeping items functioning.

Austin, TX has an interactive Reuse Directory where you can find locations to donate, resell, buy responsibly, rent, and repair items in Austin and surrounding areas. The Austin Materials Marketplace is an online platform that allows businesses to connect with excess materials or hard to recycle materials with the goal of spurring innovation.

Through the online platform, community groups and businesses find and exchange underutilized materials.

Initiative Proposed Action

Proposed Action:

- Create a reuse and repair program in Delaware County that includes events and resources that the community can access. Some components of this initiative include:
- Organize Fixit Clinic and Repair Café in Delaware County. These events would repair and prolong the life of the items and there are model events throughout the world that can be replicated locally. These events can be held regularly to help create the culture change in Delaware County around resource conservation. Zero Waste Delco might be a good partner organization for a Fixit or Repair event.
- Lending Libraries allow community members to check out tools or other household items instead of buying them. This allows a community to create a sharing economy and allows community members to access tools that they might otherwise not have access to. Lending libraries are sometimes organized by a nonprofit or they might be in conjunction with a reuse center. They can start out small with only a few items and grow from there. They are often membership based. There are resources online to help start a lending library.
- Reuse, repair, and share directories is a great online resource for community members. This directory would offer information on where to divert materials for reuse, list local repair shops, list local reuse stores, and/or list lending libraries. These resources can be created by the Delaware County government or could be created in conjunction with a community partner. These directories are often online documents such as the Reuse Directory created by the Department of Public Works in Baltimore County or the Reuse Directory created by St. Mary's County, Maryland.
- Material Exchange platforms are an online electronic product and materials matching service that allows businesses, schools, and nonprofits to list surplus materials. A materials exchange platform also can allow users to ask for or accept surplus materials that are not listed. The Minnesota Material Exchange is an interactive website that allows users to see and claim materials. This website lists items available for sale or for free through the exchange tab. It also lists reuse charities and recycling organizations. Delaware County could create a similar material exchange online program. This would be another avenue that Delaware County could explore to keep resources out of the disposal stream and in use locally.
- These programs could begin right away and once the directory or exchange are created, then it would just be the upkeep that is needed. Some of the events, like a fix-it-clinic, could occur on a regular basis. These programs should all be ongoing in Delaware County. Zero Waste Delco could be a community partner with this initiative.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Delaware County can create general education on reuse and why it is part of waste reduction, how to keep items longer (i.e., repair), where to buy used (via the directory), and the best way to support the local reuse economy. This reuse education will help the community members and local reuse industry enhance and embrace reuse.

Initiative Potential Outcome

Potential Outcome(s):
This initiative aims to reduce the volume and amount of durable goods entering the disposal stream. Another goal of a reuse and repair program is to create more awareness about the benefits of reuse. Delaware County could measure this initiative by how often the directories are used and by how many residents participate in fixit events. Another measurable outcome could be seen by a reduction of durable materials entering the disposal stream.

Implementation Timeframe

Short (2024-2028)

12. Universal Recycling & Composting Collection (all generators)
Initiative Type: Program
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
Universal Collection programs make diversion accessible to all by providing efficient collection of compostable and recyclable materials separate from trash as a base level of service. Universal Collection programs address barriers to participation, such as cost, thereby making diversion as convenient as wasting.

The County or Authority could work with all the communities in the County to design a system that could be procured to be offered in as many communities are interested. This program could be phased in over time, with the County setting a target of the number of minimum households needed to pursue this most efficiently (e.g. 50,000). Once enough communities agree to participate that represent that many households, a Request for Proposals (RFP) could be issued on behalf of all those municipalities.

The RFP would include a Draft agreement to achieve high diversion by providing incentives or setting requirements (e.g. contract extensions, lower fees, bonuses or liquidated damages, limited or no disposal payments, and/or required local productive use of organics).

Local and Regional Examples:
Wellesley, MA - The Town's 88-acre Recycling and Disposal Facility transfer station accepts yard and wood debris drop-off by residents and businesses.
Onondaga County, NY - The Onondaga County Resource Recovery Agency has been composting commercial and institutional food waste since 2007 at its Amboy Compost Facility.
National Examples:
South Bayside Waste Management Authority (SBWMA, aka Rethink Waste) - The SBWMA is a joint powers authority of 11 of the 20 communities in San Mateo County, CA along with the County of San Mateo and the West Bay Sanitary District. The other communities in the County continue to manage their own services. The SBWMA provides cost-effective waste reduction, recycling, and solid waste programs to communities, residents and businesses in the service area through franchised waste and recycling collection and processing services. SBWMA purchased the Shoreway Environmental Center (SEC) materials recovery facility from a private operator and upgraded it to expand its diversion capabilities. The SEC now includes a 3,000-ton-per-day transfer station, material recovery facility (MRF), an Organics-to-Energy (O2E) system (which includes an Anaergia organics extraction press (OREX™) to recover organic materials from source separated organic materials for the purposes of converting the organic materials to energy), public recycling center, and other associated facilities on 16 acres centrally located within the county.

Examples of Innovative Contracting:
San Jose, CA - The City's innovative contract mechanisms include a tiered incentive payment based on levels of residential diversion achieved, an 80% minimum diversion standard of all material collected from commercial premises, and tipping fee incentives for cleaner commercial organics feedstock
Santa Clara, CA - The City provides reduced franchise fees for non-exclusive franchised haulers that demonstrate meeting specific recycling targets.

Initiative Proposed Action

Proposed Action:
As collection is organized by each community in Delaware County, the County or Authority could develop a Request for Proposals (RFP) for universal recycling and composting services to be provided. Communities could opt in to such a system, that could be tailored to the timing of the end of existing contracts. That would provide a way to phase in new recycling and composting services when their current arrangements end.

To ensure that this type of procurement is competitive, the County needs to first secure sufficient landfill capacity and processing capacity (recycling and composting) for the collectors to feel comfortable that they can risk investing over $100,000 in preparing responses to an RFP. San Jose, CA demonstrated that the commitment of landfill capacity and processing capacity made available to the successful collection hauler(s) is key to attracting more potential proposers to the process. There are many more companies

that can provide collection services than can provide landfill and processing capacity in the region. As collection costs represent 80-90% of the total costs of any solid waste or recycling system, providing a level playing field to get more competitors for the collection part of the system will get the best financial results.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
By developing a uniform system county-wide, there would be greater efficiency for the collection programs, and a major increased opportunity for coordinated messages to go out throughout the county via electronic and print media, social media, websites, events and flyers to help minimize contamination and to encourage the public to recycle right.

Initiative Potential Outcome(s)

Potential Outcome(s):
A large proportion of the communities in the County could benefit from economies of scale to keep rates affordable while adding more reuse, recycling and composting services. Based on the experience of a comparable community in California (SBWMA), it is expected that about 50% of the communities would join in such an effort representing 285,648 of the total population (571,295) of the County, about 71,411 households. This is well above the amount needed for the most efficient routing of trucks (50,000 households) so should be able to achieve economies of scale. However, it will take additional efforts to ensure that this type of procurement is successfully competitive.

Implementation Timeframe

Long (2029-2034)

13. Materials Characterization
Initiative Type: Program
Hierarchy Level: All
Sector Focus: All

Initiative Background and Essential Information

Background:
This initiative describes Material Characterization studies and why Delaware County needs to have this as part of its Zero Waste plan. Material Characterization studies sort and identify the materials in the municipal solid waste (residents, commercial, and institutional) stream (landfill or combustion). They can also study the recycling and composting streams for residents and businesses.

Material Characterization studies supply data and information on the types and qualities of disposed materials. These data will help municipalities plan and organize Zero Waste policies and programs. Material Characterization studies can also characterize the recycling, composting, and construction and demolition (C&D) stream.
Most material characterization studies are carried out by hand sort. This system collects random samples of trash by sector (single-family, multi-family, and commercial/institutional) and sorts the materials into material categories. The sorted materials are weighed, revealing an estimated stream's analyzed composition. Hand-sort characterization studies generally follow the American Society for Testing Materials (ASTM)'s Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste (ASTM D5231).

Other types of material characterization studies are visual sort and desktop study. A visual sort also material characterization study collects trash by sector, but it estimates the amount of trash by volume, not weight. This is often performed in construction and demolition materials and when evaluating bulky materials. The results reveal an estimated composition of the stream being analyzed. The desktop study evaluates several material composition studies with similar characteristics to the municipality being analyzed and to identify the composition of the municipality.

Local and Regional Examples:
2018 Vermont Waste Characterization
2017 NYC Residential, School, and NYCHA Waste Characterization Study
2016 Chester County, Pennsylvania Solid Waste Characterization Study (begins on page 20)
2021 Desktop Waste Characterization Study – District of Columbia (desktop study)

National Examples:
Waste Characterization Study – City of San Antonio
2015 Waste Characterization Study – City of Phoenix
2017 Waste Composition Study – City and County of Honolulu
2021 Baseline Waste Composition Study – Missoula, Montana (desktop study)
2020 City of Cupertino Waste Characterization Study
2021 Miami-Dade County Waste Composition Study

Initiative Proposed Action

Proposed Action:

- A material characterization study should be conducted on Delaware County's disposal stream (trash going through the transfer stations to waste-to-energy), recycling stream, and compost stream, if applicable. This study can be performed by county staff or contracted out to a firm to plan, conduct, and create a report.
- The material characterization study should be a hand sort of the disposal stream of randomly chosen samples of trash by sector (single-family, multi-family, and

commercial). This study should contain two seasons of sampling to have at least 30 samples per sector each season.
- The construction and demolition (C&D) stream should also be characterized by gathering a random number of samples from C&D haulers for a visual characterization analysis.
- Recycling stream samples should be obtained from all sectors and hand-sorted to identify the level of contamination. The exact process can take place with the compost stream if applicable.
- The outcome of this study would be a deep understanding of the materials being thrown away in Delaware County and what percentage of the disposal stream each of the different material types represents. Therefore, the data gathered during this study can further direct the county with its Zero Waste direction. This study will allow Delaware County officials to know the amount and types of materials going to disposal that can be diverted for reuse, recycling, and composting. It can also identify problem materials (e.g., plastic cups) that may need to be reduced through policy.
- A material characterization study can be performed every five years as the county works toward Zero Waste.

Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: The results of this study should be published and available to the community once a report is finalized. Allowing the community to know the study results will help them understand why the county is working toward Zero Waste and help them understand why specific Zero Waste policies and programs will be initiated. The study results will also reveal the amount and types of contaminated materials in the recycling stream. This information can help the municipalities focus their recycling education on the mistakes made in sorting recyclables.
Initiative Potential Outcome(s)
Potential Outcome(s): The goal of completing a material characterization study on the material streams in Delaware County is to gain an understanding of what is thrown away by residents and businesses. This study will also help county officials know the amount and types of contamination in the recycling bins. This will help direct the Zero Waste policies and programs in Delaware County and help refine what kind of education is needed.
Implementation Timeframe
Long (2029-2034)

14. Refillable Stations
Initiative Type: Infrastructure
Hierarchy Level: Reduce/Reuse
Sector Focus: Commercial/Institutional

Initiative Background and Essential Information

Background:
According to the US EPA, containers and packaging accounted for 28.1 percent of total municipal solid waste generation in 2018. Although 53.9 percent of that material was recycled, waste reduction and reuse are preferred materials management approaches as per the Zero Waste hierarchy of highest and best use. Refillable stations focus on the product, not the package, and reduce the use of disposable containers and packaging making reuse more affordable and accessible. Refill in food (e.g. grocery bulk bins) and beverages (e.g. travel coffee mugs) is common and can be expanded. Other opportunities for refill are emerging in the areas of bulk personal care and homecare products.

Local and Regional Examples:
Many local and regional examples of bulk food, personal care, and homecare refill stations are identified in the Zero Packaging Stores initiative. Regionally, Echo Systems assists businesses through servicing of bulk containers, sterilization of reusable containers and consulting on systems design. Bottle Underground is working to facilitate glass bottle sterilization and reuse.

Refill not Landfill is a global campaign that was created to address consumption of water in single-use plastic bottles. It has been adopted, modified, and implemented at the local level. The City of Lebanon, NH, for instance, celebrates Earth Month with an annual Refill not Landfill education campaign to promote waste reduction through reuse and refill for any products, not just drinking water. The campaign encourages residents to take the refill pledge and awards weekly prizes with support from a local business, the Hanover Consumer Cooperative.
Algramo has piloted kiosk refill stations in New York City where customers can fill their own containers with popular cleaning supplies for less than what they cost in stores.

National Examples:
Ecopod offers a vending machine refill format for personal care and cleaning products.

In 2019, California amended its Retail Food Code with protocols for businesses to safely fill customers' reusable food and beverage containers, emphasizing contactless refill methods.

In 2019, the Brooke Army Medical Center in San Antonio, TX implemented a reusable container option at the dining areas throughout the hospital. Patrons choose to use a reusable plastic container when getting food at a dining area within the hospital.

In 2014, the Minnesota Pollution Control Agency published a case study on the benefits of reusable food service ware in schools. In the first year, the schools saved approximately

$3,000 combined by buying the reusable utensils and bowls. The annual per student costs for food-ware dropped from $6.89 to $4.83. Environmental impacts included prevention of about 6,000 lb. of on-site solid waste in the first year. Instead of buying 700,000 plastic utensils, the school purchased just 12,000 metal reusable utensils. On-site impacts to water and electricity use were found to be negligible and did not change the net overall magnitude of the lifecycle benefits of the reusables. Changes to staff routines were easily accommodated.

Reuse Blitz is a campaign developed by non-profit advocacy organization Upstream that any person, group, or community can launch at any time. The idea is to lift up, through social media, all the businesses that offer customers reuse and refill options, and to let businesses that aren't offering reusables know that it's safe to do so.

Initiative Proposed Action

Proposed Action:

- Actions the County can take to support refillable stations include:
- Promote use of refillables in all County buildings:
- Install water refill stations
- Onsite dining or take-out meals and beverages
- Promote existing community refill options such as:
- Onsite dining or take-out meals and beverages
- Foods - dry goods, oils, condiments, yogurts, etc.
- Consumer goods - cleaning products, cosmetics
- Support the growth of refillable stations across the county:
- Develop a Refillables Task Force to explore opportunities for expansion of refillable systems across the county
- Conduct outreach and technical support to refill & reuse candidates including food service establishments, K-12 schools, colleges and universities, grocery stores, and hospitals.

The broad adoption of refillable stations and reuse systems will require the engagement of many different stakeholders, most of whom operate outside of the County's circle of control. Therefore, the County's role in supporting these systems will largely be to influence and persuade based on the benefits that the systems will bring to the community. The County can also explore ways to invest in these systems, particularly at public educational institutions, to expedite adoption. For example, the County could develop a small grants program to help fund refillable stations as models for different industries and applications/types of materials.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Adoption of consumer refillable stations and institutional reuse systems such as in schools and hospitals will primarily take place outside of the County's circle of control.

Outreach could include promotion of existing systems, education about new systems, and technical support to assist in adopting new systems.

Initiative Potential Outcome(s)

Potential Outcome(s): (*describe the goal of this initiative and possible measurable outcomes*)
If the County were to support adoption of refillable stations and refill systems, outcomes could include a decrease in discarded packaging and an increase in reuse behaviors. Measurable outcomes could include tons of discarded packaging reduced, number of new locations of consumer refillable stations, and number of new locations of institutional reuse systems such as in schools and hospitals.

Implementation Timeframe

Short (2024-2028)

15. Zero Packaging Stores
Initiative Type: Infrastructure
Hierarchy Level: Reduce/Reuse
Sector Focus: Commercial

Initiative Background and Essential Information

Background:
According to the US EPA, containers and packaging accounted for 28.1 percent of total municipal solid waste generation in 2018. Although 53.9 percent of that material was recycled, waste reduction and reuse are preferred materials management approaches as per the Zero Waste hierarchy of highest and best use. Zero Packaging Stores would reduce the use of disposable containers and packaging and could make reuse more affordable and accessible.

This initiative shares many similarities with the Refillable Stations initiative.

Local and Regional Examples:
Good Buy Supply is a Philadelphia-based retail shop dedicated to low-waste and plastic-free alternatives for everyday life offering bulk soaps, home goods, and more.

FD Market in Emmaus, PA is a sustainable goods shop and zero-waste refillery offering bulk products including dishwasher and laundry pods and powder and toothpaste and mouthwash tablets.

Jar - The Zero Waste Store in Somerset, PA offers bulk food, kombucha, and soap refills. They offer a 10% discount for customers that bring their own containers.

The mission of The Refillery in Pittsburgh, PA is to reduce single-use plastic and single-use packaging by making reusing & refilling easy, accessible, and affordable. They offer personal & home essentials including lotion, hand soap, and laundry soap.

The student-run Roz's Café at Bennington College in Bennington, VT is focused on the elimination of all single-use and plastic packaging by providing reusable mugs, jars, and bulk dry goods as well as house-made baked goods.

Algramo has piloted kiosk refill stations in New York City where customers can fill their own containers with popular cleaning supplies for less than what they cost in stores.

National Examples: Ecopod offers a vending machine refill format for personal care and cleaning products.

Initiative Proposed Action

Proposed Action:
Actions the County can take to support zero packaging stores include:

- Support the growth of zero packaging stores across the county
- Initiate a Zero Packaging Consortium to mobilize retailers in the county interested in offering zero packaging options.
- Use the County's procurement power to purchase zero packaging options at a rate that consortium members can benefit from and keep prices affordable.

Zero packaging stores is a new retail movement that supports the County's Zero Waste goal. The County could potentially accelerate the proliferation of zero packaging options at retail outlets across the county.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
In the early stages of this initiative, outreach should be targeted to retailers who could be potential members of the Zero Packaging Consortium including grocery stores, markets, etc. As zero packaging options become available, the County should promote those as opportunities for residents to support the Zero Waste goal.

Initiative Potential Outcome(s)

Potential Outcome(s):
If the County were to support the proliferation of zero packaging stores, outcomes could include a decrease in discarded packaging, an increase in reuse behaviors, and an increase in affordability for zero packaging options. Measurable outcomes could include number of members of the Zero Packaging Consortium, number of zero packaging products available, and number of zero packaging stores.

Implementation Timeframe
Short (2024-2028)

16. Building Materials Reuse Centers Initiative Type: Infrastructure Hierarchy Level: Reduce/Reuse Sector Focus: All
Initiative Background and Essential Information
Background: The Pennsylvania Department of Environmental Protection reports that construction and demolition (C&D) debris makes up approximately 17.5 percent of Pennsylvania's municipal waste stream. In 2005, Pennsylvania disposed of over 2.25 million tons of C&D debris in municipal and C&D landfills. The EPA estimates that 90 percent of C&D debris results from building demolition and renovation with 40 percent of total debris resulting from residential and nonresidential renovation projects. The Department of Environmental Protection recognizes that renovation and demolition debris consists of salvageable materials and reusable materials and maintains a web page that lists C&D Salvaged Material Outlets, Recyclers, and Service Providers across the state. Building Materials Reuse Centers (BMRCs) provide the infrastructure necessary to support deconstruction. Therefore, this initiative is tied directly to the Deconstruction initiative. Local and Regional Examples: The County was home to one for-profit BMRC, Frank's Demolition Salvage in Woodlyn. Neither the phone number nor the website are functional. The business is assumed to now be closed. Philadelphia, PA is home to several BMRCs including the non-profit Habitat for Humanity Philadelphia ReStore, non-profit Philly Reclaim, non-profit The Resource Exchange, and for-profit, family-owned Philadelphia Salvage, which occupies an historic 40,000 square foot building that once housed the Bureau Brothers Foundry. The Philadelphia Salvage site is an excellent example of adaptive reuse and could be a redevelopment model for the County if similarly historic buildings exist and are underutilized. Through its Zero Waste initiative, the Town of New Paltz, NY established a municipally-owned Reuse Center that accepts donations of craft supplies and building materials in usable condition for re-sale. The Town promotes deconstruction and provides volunteer opportunities for residents. Town staff created a municipally-owned and operated reuse center business plan.

National Examples:
Resource Central's reuse center in Boulder County is a non-profit BMRC that sells a variety of goods from used construction & building materials to unique one-of-a-kind treasures at affordable prices. It is co-located with a Center for Hard to Recycle Materials operated by the non-profit EcoCycle.

Home ReSource is a non-profit BMRC in Missoula, MT with a large retail store spanning two warehouses and two large yards, job training programs, and community engagement and education programs.

In 2020, the County of San Mateo, CA contracted with PlaceMakers, a for-profit BMRC, to expand their existing operations and focus on providing affordable building materials to the community.

Initiative Proposed Action

Proposed Action:

- Actions the County can take to support building materials reuse and BMRCs include the following that could be in partnership with one or more of the existing nonprofit or private operations in the area that could lease one of the sites for the development and operation of the site for mutual benefit:
- Expand the SWA Transfer Stations to include the collection of used building materials
- Ask local big box home stores (e.g. Home Depot or Lowe's) to site a BMRC at their store(s) in the county.
- Assess municipally-owned properties to determine if a suitable site for development of a BMRC exists
- Establish a grant or loan program to support the development of a BMRC.

Planning, development, and implementation of activities in support of building materials reuse in the County will require the involvement of many stakeholders and community partners and could be a lengthy process. It should be initiated as soon as possible.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
If the County chooses to support the development of building materials reuse centers, it should reach out to existing BMRC operators in the area to explore opportunities for partnerships. That will require targeted outreach followed by one-on-one meetings. If new BMRCs are established in the county, the County can use its outreach mechanisms to promote them in the context of the Zero Waste goal.

Initiative Potential Outcome(s)

Potential Outcome(s):
If the County were to support the development of building materials reuse centers, outcomes could include significant decrease in disposal of building materials and

economic development through new BMRCs and the jobs they create. Measurable outcomes include tons recycled or composted, number of new BMRCs, and number of new BMRC jobs.

Implementation Timeframe

Long (2029-2034)

17. Center for Hard to Recycle Materials (CHaRM)
Initiative Type: Infrastructure
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
Some divertible materials are not accepted in curbside recycling collection programs or at drop-off recycling centers. Those materials are often "hard to recycle" because they may contain hazardous materials or their end markets may be more difficult to secure than typical household recyclable commodities such as paper, cardboard, bottles, and cans.

A Center for Hard to Recycle Materials, or CHaRM, is a kind of drop-off facility that provides an opportunity for community members to divert more types of materials from disposal. CHaRM facilities are known to accept household appliances, metals, books, textiles, electronics, mattresses, hard to recycle plastics, ceramics, concrete, and other materials based on availability of local markets. CHaRM facilities collect these items, may deconstruct or process some items such as electronics, and market the materials for recycling, repurposing, or reuse. CHaRM facilities create jobs through collection, processing, deconstruction, and marketing.

Local and Regional Examples:
The Town of Saugus, MA opened a CHaRM facility in September 2015. The center accepts textiles/fabrics and electronics such as televisions and computers. In addition to clothing items in any condition, residents can drop off footwear, linens, backpacks, stuffed animals, curtains, towels, and other fabric materials. The center also has a collection area for scrap metal items such as bed frames, siding, fixtures, and other items made from stainless steel, lead, and cast iron. The center also accepts traditional recyclables such as paper/cardboard and bottles/cans for residents who do not have access to weekly curbside municipal collection. There is no charge to drop off items at the Saugus CHaRM facility.

While not called a CHaRM, the Household Material Recovery Facility (H-MRF) in Valhalla, NY is a Westchester County-operated hard to recycle materials facility that accepts household hazardous waste and other items worthy of special handling from county

residents year-round. The facility also accepts hazardous chemicals and fluorescent bulbs from any school, institution or business that qualifies as a Conditionally Exempt Small Quantity Generator (CESQG). Accepted materials include automotive fluids (except motor oil), car tires (with or without rims), pesticides, insecticides, herbicides, metal, jewelry and furniture polish, kerosene and other flammable liquids, photo and swimming pool chemicals, mercury thermometers and thermostats, propane tanks, electronics, wood preservatives and stains, refrigerant-containing household appliances, fluorescent light bulbs, expired or unused pharmaceuticals, rechargeable batteries, fire extinguishers, and textiles.

National Examples:
The Center for Hard to Recycle Materials (CHaRM) in Atlanta, GA is a permanent drop-off facility operated by the nonprofit Live Thrive. Accepted items include Styrofoam, musical instruments, bikes, electronics, paint, chemicals, mattresses, compost, cooking oil, tires, textiles, flat glass, food-grade glass, appliances, metals, books, cigarette butts, and cartons. The Live Thrive CHaRM facility also accepts sorted single-stream items for those who do not have access to curbside recycling. All operating expenses for the facility are covered by grants, donations, and recycling fees. The facility website includes information on markets for collected materials, some of which are not considered acceptable in the Zero Waste hierarchy of highest and best use.

Boulder, CO is home to the nation's first CHaRM facility, operated by the non-profit EcoCycle. This mostly outdoor drive-through facility provides drop-off bins in covered areas where visitors can recycle electronics, hard-to-recycle plastics, appliances, mattresses & box springs, bicycles & parts, books & manuals, cooking oil, porcelain toilets, sinks & urinals, concrete, fire extinguishers, shredded paper, yoga mats, and textiles. The facility also includes a small hardback book processing room and a 6,000 square foot warehouse that houses e-waste processing, an expanded polystyrene densifier, and office space. The EcoCycle CHaRM facility keeps functional items in use locally and they also accept traditional recyclables and compostables. Each vehicle is charged a $3 facility use fee. Additional charges apply for some items. This CHaRM facility is also funded in part by the City of Boulder trash tax dollars.

SustainAbility in Arvada, CO is a for-profit social enterprise that employs people of varying abilities facing barriers to employment at a CHaRM. Employees are matched according to skill level with electronic deconstruction jobs. Each vehicle is charged a $2 facility use fee. Additional charges apply for some items. Due to the program's social benefit, the CHaRM is also supported through Medicaid and grant funding.

Initiative Proposed Action

Proposed Action:

- Actions the County can take to support a Center for Hard to Recycle Materials (CHaRM) facility or facilities include:
- Expand the SWA Transfer Stations to include the collection of hard to recycle materials
- Research local markets to determine what hard to recycle materials to add

- Support the development of a stand-alone CHaRM facility or facilities
- Assess municipally-owned properties to determine if a suitable site for development of a CHaRM exists; the County could lease the site to one or more nonprofit or private operators and enter an MOU for the development and operation of the site for mutual benefit.
- Explore partnerships with existing private recycling facilities that may want to expand their services to include drop-off of hard to recycle materials
- Establish a grant or loan program to support the development of a CHaRM.

Planning, development, and implementation of activities in support of a CHaRM facility or facilities in the county will require the involvement of many stakeholders and community partners and could be a lengthy process. It should be initiated as soon as possible.

Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: If the County chooses to support the development of a CHaRM facility or facilities, it should reach out to other municipalities that have been involved in establishing CHaRM facilities in their communities. That will require research and targeted outreach followed by one-on-one meetings. If a CHaRM facility or facilities are established in the county, the County can use its outreach mechanisms to promote them in the context of the Zero Waste goal.
Initiative Potential Outcome(s)
Potential Outcome(s): If the County were to support the development of a CHaRM facility or facilities, outcomes could include significant decrease in disposal of hard to recycle materials, new community partnerships, and economic development through new CHaRM facilities and the jobs they create. Measurable outcomes include number of types of materials that can be recycled through CHaRM facilities, tons collected through CHaRM facilities, number of community partners involved in CHaRM facilities, number of CHaRM facilities, and number of new jobs at CHaRM operations.
Implementation Timeframe
Short (2024-2028)

18. Recyclables Processing
Initiative Type: Infrastructure
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
A Materials Recovery Facility, or MRF, is where recyclables are processed and prepared for sale to manufacturers as raw materials for new products. MRFs are important links in the recycling system chain as they provide communities a place for recyclable material to go after collection. They can be public, private, or operated through public/private partnerships. The DCSWA does not currently accept recycling at the transfer stations. Municipalities contract directly with a private MRF. There are several MRFs operating within the region or with access to a regional transfer station, each with different

Local and Regional Examples:
The Center County Recycling and Waste Authority operates a MRF processing over 11,000 tons of dual-stream recycling per year and a collection fleet serving almost 30,000 residential and commercial customers.

The Rockland County Solid Waste Authority in Rockland County, NY operates a dual-stream MRF to process recyclables collected curbside by private haulers from all of the towns and villages in the County. The MRF is housed in a 36,000 square foot building which includes a 10,000 square foot tipping floor. The process area includes 5,000 square feet for bale storage. The MRF was constructed in 1998 at a cost of $5.8 million.

The Chittenden Solid Waste District (CSWD) is a municipality created by the State of Vermont to manage the solid waste generated within Chittenden County. The CSWD owns a single-stream MRF operated under contract by Casella Waste Management. The MRF processes glass bottles, plastic bottles, cans and other containers, mixed paper, and cardboard.

National Examples:
Isabella County, MI operates a MRF that is jointly owned by the County and the City of Mt. Pleasant. The MRF employs recycling collection drivers and processors who sort and prepare material for shipment. The facility accepts recyclables collected curbside as well via drop-off including newspaper, cardboard, office paper, metals, glass, plastic, automotive materials, yard waste, tires, Styrofoam, and books. They have a goal to ship material to Michigan-based processing facilities whenever possible. The facility was built in the 1990s and County Commissioners recently expressed interest in reviewing operations to increase efficiency and capacity.

Since 1991, Waukesha County, WI has processed recyclables collected for partner municipalities at a county-owned MRF. In 2014, the County entered an intergovernmental agreement with the City of Milwaukee to jointly build a state-of-the-art single-stream county/City MRF. The County/City contracted with a private

company, ReCommunity Recycling (acquired by Republic Services in 2017), to design, build, and operate an updated MRF. The County/City retain 80% revenue from the sale of their respective recyclable tons delivered to the Joint MRF, which is prorated based on the tested composition of the material. The City/County also retain host fees and revenue share from third party tons, pay approximately $31/ton processing fee, and pay all residue disposal costs.

The Dalton-Whitfield Solid Waste Authority in Whitfield County, GA (population 104,628) constructed a $2 million, 40,000 square foot materials recovery facility (MRF) at the county landfill funded by the Authority's enterprise fund. Although the facility was primarily designed to divert carpet industry solid waste from the Subtitle D landfill, the MRF currently processes and markets #1 & #2 plastic bottles & jugs, newspaper & magazines, mixed paper, bi-metal cans, telephone books, cardboard, aluminum cans, glass (clear, brown, blue, & green) as well as carpet, carpet pad, and tubes, cores, and cones from the carpet industry. The MRF utilizes four full-time employees and an inmate labor crew. The MRF can process over 100 tons per day, store up to 20 trailer loads of baled recyclables, and can deliver 25 to 50 trailer loads to market each month.

York County, SC owns and operates a single-stream MRF in in Fort Mill, SC where it accepts most recyclables including mixed paper, chipboard (such as cookie, cracker, or drink boxes), cardboard, magazines, office paper, steel cans, and aluminum cans/pans/foil, and plastic jugs, jars or bottles with their lids on. However, the facility does not accept glass, as well as other forms of plastic (such as bags, berry containers, or tubs). The system is designed to process 10,000 to 15,000 tons per year of mixed single-stream recyclables that come primarily from residences with a limited amount of commercial material. In 2018, the facility switched to single-stream after operating a mostly-manual dual-stream sorting system for many years.

Initiative Proposed Action

Proposed Action:
Actions the County can take to support a Materials Recovery Facility for municipalities in the County include:

- Begin accepting recycling at the DCSWA transfer stations and contract with a private MRF for transfer.
- Develop or contract for a Material Recovery Facility to process recyclables collected within the county.

Planning, development, and implementation of activities in support of a MRF in the county could be a lengthy process that could include developing and issuing an RFP for qualified vendors to design, build, and possibly operate the facility. It should be initiated in the short term with plans to bring the facility online before the start of potential Universal Recycling services within the county.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
Currently each MRF servicing municipalities in Delaware County accepts different materials with different rules for recycling. By providing centralized recycling processing, rules could be uniformly applied across the county. If the County chooses to support the development of a MRF, it should reach out to other municipalities that have established MRFs in their communities. That will require research and targeted outreach followed by one-on-one meetings to glean best practices, benefits, and challenges. If a MRF is established in the county, the County can use its outreach mechanisms to promote the facility in the context of the Zero Waste goal.

Initiative Potential Outcome(s)

Potential Outcome(s):
If the County were to support the development of a MRF, outcomes could include increased accountability and transparency for recycling in the county, cost savings to municipalities and ability to coordinate education county wide. This would increase the ability for material collected for recycling to be used for its highest and best use and to direct material to local market development initiatives for use as feedstock. Increased access could bring in new municipalities not currently recycling to increase diversion of recyclables. A county-run MRF could bring in new revenue streams from tipping fees and materials sales and provide job creation and workforce development opportunities for returning citizens and other populations. Measurable outcomes include tons diverted through the MRF, annual revenue, job training opportunities created, number of new jobs at the MRF, cost savings to municipalities.

Implementation Timeframe

Long (2029-2034)

19. Organics Processing
Initiative Type: Infrastructure
Hierarchy Level: Recycle/Compost
Sector Focus: All

Initiative Background and Essential Information

Background:
Organics processing/compost facility is where compostable materials such as yard trimmings, food scraps, and compostable paper are converted into a nutrient-rich soil amendment. They can be public, private, or operated through public/private partnerships. Currently in PA, there is a stricter permitting process for food scraps than yard waste, resulting in limited capacity for food scraps. The DCSWA previously operated yard waste composting at both transfer stations, but has since stopped providing those services and currently does not accept yard waste or food scraps for composting.

Local and Regional Examples:
A community composting network was recently launched in Philadelphia through a partnership of the Office of Sustainability and Parks and Recs. The program will provide drop off and compost processing at over 30 locations, including rec centers at no cost to residents.

Media Borough currently provides municipal collection of food scraps and brings it to a private company, Kitchen Harvest at Linvilla for composting. Additionally, there is a growing and robust network of small scale composters throughout the Delaware County and Philadelphia regions actively looking to expand access to composting to residents and businesses.

The Onondaga County Resource Recovery Agency in Onondaga County, NY operates the Amboy Compost Site where residents, landscapers, small-business users and commercial haulers can drop off yard waste and food scraps, as well as purchase high-quality mulch and compost in bulk.

Over 50,000 tons of material is processed annually at the County Organics Composting Facility in Prince George's County, MD. In 2013, the County began a food scraps composting pilot at its yard trimmings composting facility processing food scraps commingled with mulch and yard trimmings in covered, positively aerated static piles. Food scraps are accepted from pre and post-consumer entities, including residential, commercial, and institutional sectors. Revenue from the sale of the finished compost is returned to the County to offset the cost of the composting operation.

National Examples:
In the summer of 2017, Prince William County, VA entered a public-private partnership (PPP) with Freestate Farms LLC to construct a facility to process yard trimmings, food scraps, and wood debris. As per the 20-year agreement, which includes extension options, Freestate Farms will finance the facility development on county land. At capacity, the facility will process more than 80,000 tons of organics a year into high-value compost, soil products, and non-synthetic fertilizers. It will also generate baseload renewable energy and environmental attributes; and it will produce sustainable and locally-grown fresh fruits and vegetables for sale back into the community.

In 2016, the City of Missoula, MT purchased an existing privately-owned biosolids composting operation adjacent to its wastewater treatment plant. State-of-the-art upgrades included installation of an aerated static pile system. Along with biosolids, Garden City Compost now accepts all food scraps, BPI-certified compostable items, pallets, untreated wood scraps from deconstruction projects, yard debris, and land clearing debris. The facility is operated by City staff and is open to the public for drop-off and for purchase of finished compost March through December. The facility is open to commercial organics haulers like Missoula Compost Collection year-round.

Initiative Proposed Action

Proposed Action: Actions the County can take to support organics processing for municipalities in the county include: Begin accepting organics at the DCSWA transfer stations and contract with a private facility(ies) for transfer. Develop or contract for organics processing/compost facility to process yard trimmings, food scraps, and compostable paper collected within the county. Planning, development, and implementation of activities in support of organics processing/compost facility in the county could be a lengthy process that could include developing and issuing an RFP for qualified vendors to design, build, and possibly operate the facility. It should be initiated in the short term with plans to bring the facility online before the implementation of Universal Recycling and Composting collection services are started.
Public Education and Outreach Mechanisms
Proposed Public Education and Outreach: If the County chooses to support the development of organics processing/compost facility, it should reach out to other municipalities that have secured organics processing in their communities. That will require research and targeted outreach followed by one-on-one meetings to glean best practices, benefits, and challenges. If organics processing/compost facility is established in the county, the County can use its outreach mechanisms to promote the facility in the context of the Zero Waste goal.
Initiative Potential Outcome(s)
Potential Outcome(s): If the County were to support the development of organics processing/compost facility, outcomes could include significant increase in diversion of compostable organics and jobs created, including workforce development opportunities. A county run composting facility, or drop off location will increase access to municipalities and potentially lower costs through economies of scale. If it is a County facility new revenue streams from tipping fees and finished compost sales could be outcomes as well. Measurable outcomes include tons diverted through the composting, annual revenue, and number of new jobs and workforce development opportunities at the facility.
Implementation Timeframe
Long (2029-2034)

20. Biological Stabilization
Mixed Organics Processing (after source separation)
Initiative Type: Infrastructure
Hierarchy Level: Material Recovery
Sector Focus: All

Initiative Background and Essential Information

Background:
A mixed organics processing facility sorts municipal solid waste to separate materials that can be recovered for recycling or composting. This facility manages the residual materials after a municipality has already source separated its reusable, recyclable, and compostable materials. The goal of this process is to recover all recoverable materials before they are sent to disposal at either a landfill or combustion facility.

The type of processing facility this initiative is describing sorts materials after a municipality already has programs in place to capture reusable, recyclable, and compostable materials from the disposal stream. Some facilities process the entire disposal stream without effort to source separate before disposal, such as Placer Recycles, as described by GreenBlue. That type of facility is not what this initiative intends to describe.

Local and Regional Examples:
A Mixed Waste Composting Review article from 2011 lists ten facilities. Three of those facilities that were reviewed in 2011 were in the northeast. Those northeast facilities may not remain because they could not be located.

National Examples:
Columbia County, Wisconsin, has a recycling and waste processing facility. The waste processing facility receives municipal solid waste from Columbia County and processes it to separate the organic material from the rest. The residual materials are sent 60 miles to a landfill. The organic material that is recovered is composted.
Sevier Solid Waste, Inc. operates a mixed co-composter facility. This facility receives municipal solid waste from the Great Smoky Mountain National Park and several cities surrounding the park after some source-separated recycling has occurred. The municipal solid waste is mixed with bio-solids and placed in a digester for three days. After that, the "compost" is screened to separate anything that did not compost. The residual material is landfilled, and the compost is used locally.
San Mateo County, California, uses an Organic Extrusion Press to remove contaminants from the source-separated organic stream. This system is designed to separate any inorganic material from the organic material before composting. This system is in conjunction with a source separation system where recyclables and compostable materials are kept separate from other materials. This device aims to separate any contamination from the organic material before composting.
San Jose, California, has a mixed waste processing center called GreenWaste that processes municipal solid waste after some source-separated recycling has occurred.

The goal of this facility is to sort through municipal solid waste to recover recyclable or compostable material before disposal.

Initiative Proposed Action

Proposed Action:

- This initiative describes a mixed organics processing facility that collects and sorts municipal solid waste discarded after the municipality has engaged in separating reusable, recyclable, or compostable items from the disposal. The facility would use a sorting line or machinery to open the trash bags and sort out recoverable items like cardboard, plastic bottles, metal cans, or compostable items like food-soiled paper or food scraps. This facility aims to recover all recoverable materials before sending the small residual amount to a landfill or combustion facility for final disposal.
- This 2013 article in BioCycle written by EcoCycle staff clearly states that the purpose of a mixed organics processing facility is to recover recyclable and compostable materials that failed to be source separated before disposal. This type of facility can work well with a Zero Waste community that already source separate recyclable and compostable materials.

Public Education and Outreach Mechanisms

Proposed Public Education and Outreach:
If Delaware County invested in a mixed organics processing facility or sent their residual materials to one of these facilities, they still need education focusing on their Zero Waste programs. Delaware County still needs to invest heavily in reduction, reuse, recycling, and composting education and outreach. The priority will be for residents and businesses in Delaware County to source separate materials for their highest and best use. The policies and programs that include reuse and source separation for recycling and composting need corresponding education for them to be successful.

Initiative Potential Outcome(s)

Potential Outcome(s):
The goal of a mixed organics processing facility would be to sort, separate, and collect recoverable materials (e.g., plastic bottles, paper, metal cans, food-soiled paper, and food scraps) from the disposal stream. This should be a last resort, and every effort should be made to create policies and programs that require and encourage source separation of materials prior to disposal. A mixed processing facility can help a municipality increase its diversion rate to reach Zero Waste.

Implementation Timeframe

Long (2029-2034)

Appendix G Assumptions and Methodology

A diversion potential analysis was conducted to estimate the possible tons of combusted materials that can be diverted and reduced through the chosen initiatives. The disposal tonnage data for 2020 used in this analysis were obtained from the Pennsylvania Department of Environmental Protection (DEP) CE Data Reporting System.[18] The total disposal data obtained from the Pennsylvania DEP were divided into residential and commercial disposal tons for this analysis.[19] This analysis required the disposal data to be divided into material types based on a material characterization study. The material characterization data used in this analysis were from the Pennsylvania Department of Environmental Protection, Waste Characterization Study, MSW Consultants, September 2022.[20]

This analysis was performed by sector (residential and commercial) in two phases. This analysis was performed in two phases because some initiatives were not projected to begin until phase two per the plan. The total tons of residential materials going to combustion in 2020 were analyzed in two phases with the corresponding initiatives. The total tons of commercial materials going to combustion in 2020 were analyzed in two phases. Some initiatives are only related to the residential sector, and others are related only to the commercial sector. Some initiatives applied to both sectors and were analyzed accordingly. Analyzing the initiatives by sector made the analysis more precise and only applied initiatives to the sector where the diversion was possible.

Each appropriate initiative was analyzed for each sector and phase to estimate the diversion potential (tons). This analysis began by estimating the initiative's capture rate for each material type that the initiative is expected to impact (e.g., an initiative related to edible food recovery would affect the food material type only). The capture rate estimation was based on knowledge from other community initiative implementations, published reports, or best estimates and leaned on the side of a conservative estimate. The estimated capture rate for each material type corresponding to the initiative was multiplied by the estimated tons that material

---

[18] Pennsylvania Department of Environmental Protection: http://cedatareporting.pa.gov/reports/powerbi/Public/DEP/WM/PBI/Solid_Waste_Disposal_Information

[19] Disposal tons for the residential and commercial sectors were provided by the Delaware County Solid Waste Authority.

[20] Pennsylvania Department of Environmental Protection Waste Characterization Study, MSW Consultants, September 2022: https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2022/PA_DEP_Report_FINAL_10-04-2022.pdf

represents in the disposal stream. This method was repeated for each material category that related to the initiative.

For each initiative within each sector, the tons estimated to be diverted by material type were added up to show the total tons estimated to be reduced for that initiative. Next, each initiative's capture rates were calculated by dividing the total tons estimated to be diverted by the total tons going to the combustion facility by sector.

The last step in this analysis combined the total capture rate, total estimated tons diverted, phases, and sectors. The total estimated tons diverted through the Zero Waste Initiatives are then combined with the baseline (2020) tons diverted to show an increase in total diversion for Delaware County. This analysis illustrates the potential diversion and potential GHG emissions reduced yearly once all initiatives are implemented in Delaware County.

Appendix H Municipal Ordinance Granting Flow Control

Ordinance No. 2702
Upper Darby Township
Delaware County, Pennsylvania

AN ORDINANCE OF UPPER DARBY TOWNSHIP
DELAWARE COUNTY, PENNSYLVANIA, REGULATING
DISPOSAL OF MUNICIPAL SOLID WASTE FROM THE MUNICIPALITY;
REQUIRING DISPOSAL AT APPROVED SITE;
PROVIDING FOR LICENSING OF SOLID WASTE COLLECTORS;
PROVIDING FOR REGULATIONS AND PENALTIES;
ENTERING INTO A JOINT COOPERATION AGREEMENT
WITH THE COUNTY OF DELAWARE, PENNSYLVANIA;
AND ADOPTING THE DELAWARE COUNTY
SOLID WASTE MANAGEMENT PLAN

WHEREAS, the MUNICIPALITY (as hereinafter defined) finds it necessary to regulate the collection of Municipal Solid Waste (as hereinafter defined) generated within its boundaries in order to protect the public health, safety, and welfare of its taxpayers and residents; and

WHEREAS, Act No. 180 of July 12, 1972, 53 P.S. §§ 481 et seq., authorizes a municipality to enter into joint cooperation agreements with other municipalities in the exercise or in the performance of their respective governmental functions, powers, or responsibilities; and

WHEREAS, the Pennsylvania Solid Waste Management Act of 1980, as amended, 35 P.S. §6018.101 et seq. (hereinafter referred to as the "Act"), authorizes a municipality to require by ordinance that all municipal wastes generated within its jurisdiction shall be disposed of at a designated facility; and

WHEREAS, pursuant to the provisions of the Act, the Delaware County Council has caused to be prepared the Delaware County Solid Waste Management Plan of 1985, which was reviewed by the Pennsylvania Department of Environmental Resources, revised, and is dated December, 1986 (the "County Plan"), which recommends that for the foreseeable future the solid waste from this Municipality be disposed of by means of regional facilities authorized by the County, the Delaware County Solid Waste Authority, and/or the Authority's contractor (hereinafter collectively referred to as the "County"); and

WHEREAS THE COUNTY PLAN, in February, 1987, received preliminary approval from the Pennsylvania Department of Environmental Resources, with final DER approval conditional upon the County obtaining such municipal adoptions of the County Plan as may be necessary for its implementation; and

WHEREAS, the County Plan concludes that a County-wide solid waste disposal system should include a resources recovery plant or plants located within the County, because it would be the most environmentally sound and cost-effective method of disposing of Municipal Solid Waste within the County; and

WHEREAS, in order to obtain the environmental, economic, and public benefits from the plant or plants as discussed in the County Plan, it is necessary that commitments be obtained from the local municipalities within the County as to the use of the plant or plants for the disposal of Municipal Solid Waste from such municipalities; and

WHEREAS, Upper Darby Township has full authority under the applicable laws to provide for the management of Municipal Solid Waste within its boundaries as hereinafter provided; and

WHEREAS, the form of this Ordinance has been approved by the County, and it has been, or will be, included in the County's Solid Waste Management Plan, which has been or will be filed with the Pennsylvania Department of Environmental Resources ("DER"); and

WHEREAS, the County agrees to assist in the implementation of the County Plan, but only after this Ordinance has been enacted by a sufficient number of municipalities in the County to make the construction of such plant or plants as proposed in the County Plan feasible; and

WHEREAS, under the Act, any municipality with a population density in excess of three hundred (300) persons per square mile, or has a solid waste disposal problem, must develop a solid waste management plan to be approved by DER but may, at its option and with the County's agreement, delegate this duty to the County; and

WHEREAS, this Municipality has delegated this aforesaid duty to the County, and the County has accepted this responsibility.

NOW, THEREFORE, IT IS HEREBY ENACTED AND ORDAINED BY THE Council of Upper Darby Township as follows:

1. DEFINITION. The following terms shall have the following meaning in this Ordinance:

(a) "Collector" - Any person collecting or transporting Municipal Solid Waste for owners or occupants of property in the Municipality, including the Municipality itself if it undertakes the collection of Municipal Solid Waste directly, and any business or institution within the Municipality which generates Municipal Solid Waste and uses its own employees and equipment for the collection and transport of the waste.

(b) "Municipal Solid Waste" - Any garbage, refuse, industrial, lunchroom or office waste, and other material including solid or semi-solid material generated in residential, municipal, commercial, or institutional establishments and from community activities, and other solid waste which is within the definition of "Municipal Solid Waste" as set forth in the Act and which the County, Authority, or Contractor by its ordinance or regulations is willing to accept at the plant, but excluding: (i) any liquid waste or sludge, (ii) all wastes which are defined by existing or future Federal or State Law or Regulations as hazardous waste or industrial residual waste, (iii) any waste which may be marketable and which is intentionally segregated for purposes of recycling, and (iv) materials specifically excluded under applicable County Ordinances.

(c) "Contractor" - Shall mean one or more contractors with whom the County or the Delaware County Solid Waste Authority (hereinafter referred to as "Authority") contracts

for construction and operation of the proposed resource recovery plant or plants, or other Solid Waste Facilities.

(d) "Municipality" - Shall mean Upper Darby Township.

(e) "Person" - Any individual, partnership, association, corporation, or governmental entity, with the exception of the County, Authority, or designated Contractor.

(f) "Solid Waste Facility" - Any site owned and operated by the County, the Authority, or its designated Contractor for the purpose of transfer, processing, or disposal or Municipal Solid Waste, including landfills, resource recovery plants, and transfer stations.

(g) "Plant" - The energy and/or material recovery facility or facilities, transfer station or solid waste plants owned by the County or Authority or the Contractor, including all associated property and equipment.

(h) Certain terms used herein are also defined in the recitals hereto.

2. PROHIBITIONS. It is hereby declared to be unlawful and a public nuisance for any person to accumulate upon any property in this Municipality, any Municipal Solid Waste or to dispose of it except in accordance with this Ordinance, and other applicable laws, ordinances or regulations.

3. COUNTY/AUTHORITY OPERATIONS AND CHARGES. The Municipality has been advised by the County that the Solid Waste Plan proposes to provide for a plant or plants which will

be operated efficiently and economically by the Contractor and/or by the County and in accordance with all applicable laws and regulations, and also that the Contractor and/or the County will impose reasonable charges, which will be uniform among all classes of users of the plant or plants.

4. OPERATIONS BY LICENSED COLLECTORS. Except as it pertains to Municipal Solid Waste collected directly by this Municipality, collectors of Municipal Solid Waste generated within the Municipality must be licensed by the Municipality and shall be responsible for collecting Municipal Solid Waste from properties in the Municipality pursuant to a contract between them and the Municipality and/or contracts between them and the owners, users or occupants of properties.

5. DISPOSAL AT DESIGNATED SITE. All Collectors shall deliver and dispose of all Municipal Solid Waste collected within the Municipality at the Solid Waste Facility designated by the County subject to such reasonable regulations for the operation thereof as may be established by the County and/or Contractor. Delivery and disposal at any other place shall be a violation of this Ordinance and cause for revocation of the Collector's license, except in special circumstances approved in advance by the Municipality and the County and/or Contractor. All Collectors shall comply with their operation with all applicable laws, ordinances, and regulations pertaining to the collection and transportation of Municipal Solid Waste.

6. PRIVATE DUMPS, TRANSFER STATIONS, AND LANDFILLS PROHIBITED. No person shall use or permit to be used any property within the Municipality as a public or private dump, transfer station, or landfill for Municipal Solid Waste, whether generated within the Municipality or elsewhere, without the express written approval of the Municipality.

7. PENALTIES. Any person who shall violate any provision of this Ordinance shall, upon conviction thereof, in a summary proceeding before a District Justice, be sentenced to pay a fine of not more than Three Hundred Dollars ($300.00) and, in default of payment thereof, shall be committed to the County jail for a period not exceeding thirty (30) days; and each day's continuance of a violation of this Ordinance as well as each truckload of illegally delivered trash shall constitute a separate offense.

8. ABATEMENT OF NUISANCE. In addition to the remedies provided in Section 7 herein, any continued violation of this Ordinance or other applicable law which shall constitute a nuisance in fact, or which in the opinion of the governing body of this Municipality shall constitute a nuisance, may be abated by proceeding against the violator in a court of equity for relief.

9. REGULATIONS. The collection of Municipal Solid Waste in the Municipality and the disposal thereof shall be subject to such further reasonable rules and regulations as may from

time to time, be promulgated by the governing body of the Municipality, including but without limitation regulations as to the form of license application, the amount of fee to be charged for said licenses, and the terms of the licenses and license issuance procedures: PROVIDED, HOWEVER, that no such rules and regulations shall be contrary to the provisions of this Ordinance, the County Solid Waste Plan, or other applicable law.

10. AMENDMENTS, CONTRACT. The Municipality reserves the right to amend this Ordinance or repeal it at any time: PROVIDED, HOWEVER, that the requirement for use of the designated Solid Waste Facility for disposal of Municipal Solid Waste from the Municipality shall not be amended or repealed without the prior express written approval of the County during the term of the contract between the County (or Authority) and Contractor providing for the construction and operation of the Plant, which contract shall have a term of twenty-five (25) years. For the purposes of securing the Contractor's financing, such requirement shall be deemed to be a contract between the County, the Contractor, and the Municipality, which the Municipality (subject to the terms of the JOINT COOPERATION AGREEMENT set forth below) agrees to enforce so that the Municipal Solid Waste from the Municipality will be available to provide a source of energy for the Plant. If the Municipality is not now a Collector but in the future it becomes a

Collector it agrees to deliver all Municipal Solid Waste so collected to the Plant.

11. JOINT COOPERATION AGREEMENT.

(a) Municipality agrees to deliver or cause to be delivered during the term of this Agreement all Municipal Solid Waste, as defined herein, generated within the Municipality for disposal at a facility designated by the County.

(b) County agrees to accept for disposal all such Municipal Solid Waste described in subsection (a) above upon completion and commencement of operation of the Plant in accordance with a contract, containing terms satisfactory to the County, with the Contractor providing for construction and operation of the plant.

(c) The term of this Agreement shall be for a period of twenty-five (25) years, and said term shall commence on the date the County advises the Municipality that the Plant is operational. The Municipality at its option may terminate this Agreement with thirty (30) days' written notice to the County in the event that the Municipality will incur substantial costs over and above the costs generally accepted by the other municipalities in delivering Municipal Solid Waste to the County during the term of this Agreement, provided the Municipality has first obtained final approval from the Department of Environmental Resources for their own Plan under the Act, or an approval from the Department for a modification that brings the

Municipality under another Plan that has already obtained final approval. Upon any such termination of this Agreement by the Municipality, the County, the Authority, and/or the County's Contractor shall be relieved of any responsibility to accept and dispose of Municipal Solid Waste generated with the Municipality. Any such termination of this Agreement by the Municipality shall constitute a repeal, whether express or implied, of Section 12 of this Ordinance.

(d) The County shall hold harmless and defend the Municipality from any suit, claim or action challenging the legality of this Ordinance against the Municipality. In the event that any such suit, claim or action is brought against the Municipality, the Municipality shall authorize the County, through its designated legal counsel, to defend against the same, and the Municipality shall cooperate with the County in said defense and shall give the County Solicitor notice of any such suit, claim or action within five (5) days of the municipality's receiving notice thereof.

12. ADOPTION OF SOLID WASTE MANAGEMENT PLAN.

(a) DER has recommended that the requirements of the Solid Waste Management Act can best be accomplished on a County-wide basis.

(b) The Municipality, by formal resolution dated February 19, 1986, authorized the County to prepare the Solid Waste Management Plan on the Municipality's behalf.

(c) The County, through the staff of its Public Works Department, its Planning Commission, and Charles M. Harris and Associates, Inc., Consulting Engineers, prepared a ten-year plan for Solid Waste Management.

(d) The appropriate municipal officials of this Municipality have reviewed the findings and recommendations of the Plan as it affects this Municipality, have found the plan acceptable, and have recommended that the Plan be adopted.

(e) The Municipality, accordingly, hereby accepts and adopts the Solid Waste Management Study prepared by the County as the ten-year Plan for Solid Waste Management required by the Act.

(f) The County is hereby authorized to submit the Plan to DER for the final approval on behalf of the Municipality.

13. SEVERABILITY. If any part of this Ordinance is for any reason found to be illegal or invalid, such illegality or invalidation shall not affect any of the remaining parts of this Ordinance, which shall continue to be fully operative as if the illegal or invalid part had not been enacted.

14. REPEALER. All provisions of any other Ordinance which are inconsistent with the provisions of this Ordinance are hereby repealed.

15. EFFECTIVE DATE. This Ordinance shall become effective upon enactment. Notwithstanding the foregoing, Municipality shall have neither the right or the obligation to

dispose of its Municipal Solid Waste at the Plant which is contemplated under this Ordinance until said Plant is constructed and fully operational.

ENACTED AND ORDAINED, this 2nd day of September, A.D., 1987.

UPPER DARBY TOWNSHIP

BY: Rudolph A. D'Alesio
RUDOLPH A. D'ALESIO
VICE PRESIDENT OF COUNCIL

Attest: E. J. Truitt
EDWIN J. TRUITT
Secretary of Council

Ordinance No. 2702 above is hereby approved this 2nd day of September, A.D., 1987.

James J. Ward
JAMES J. WARD, Mayor

Attest: F. Raymond Shay
F. RAYMOND SHAY
Chief Administrative Officer

Appendix I Life Cycle Analysis

Life Cycle Assessment (LCA) and Monetization for Nine Human and Environmental Health Impacts from Delaware County, Pennsylvania MSW Diversion & Disposal

2020 Baseline and Recommended Zero Waste Plan

Prepared by Dr. Jeffrey Morris, Sound Resource Management Group, Inc.

Prepared for Delaware County and Zero Waste Associates

June 2023

Table of Contents

Table of Contents (continued)

I. Introduction

This report details a life cycle assessment (LCA) and monetization of human and environmental health impacts from current diversion and disposal of municipal solid waste (MSW) generated in Delaware County, Pennsylvania in 2020. Similar analysis of projected diversion and disposal levels following implementation of a recommended Zero Waste Plan highlights the substantial human and environmental health benefits of the Zero Waste Plan recommendations.

Sound Resource Management Group's LCA tool, Measuring Environmental Benefits Calculator (MEBCalc), provides results. MEBCalc relies on a number of supporting tools, scientific research papers, and reliable data on MSW management systems and facilities as well as data estimates specific to Delaware County.

MEBCalc outputs cover nine different human and environmental health impacts, ranging from global climate health to local human health. Monetization in terms of environmental economic value (EEV) for each impact enables comparison among impact costs,[1] as well as calculation of a single indicator of overall EEV costs and benefits for MSW disposal and diversion. Global and local EEV benefits in this study flow from avoidance of two aspects of MSW materials' life cycles:

1. Upstream virgin-content manufacturing of materials and products using extracted ecosystem resources, and
2. Downstream disposal EEV cost impacts when MSW is not reduced, reused, recycled, or composted.

The report is divided into 10 main sections, of which this introductory section is the first. Section II summarizes LCA and monetization results. Sections III and IV, detail methodology and life cycle carbon accounting practices used by MEBCalc.

Section V describes general data and sources, as well as data and sources specific to Delaware County. Ruth Abbe (Zero Waste Associates), Alex Danovitch (Nothing Left to Waste), and Amanda Waddle (Zero Waste Associates) researched and cataloged the data and sources on Delaware County's current and recommended MSW management systems. These data provide the Delaware County specifics for LCA and monetization results reported herein.

Section VI details LCA results on pollutant emissions quantities in 2020 driving each of the nine human and environmental health impacts. Readers can skip directly to this section and Section VIII for more information and discussion regarding the LCA and monetization results briefed in Section II.

Section VII discusses MEBCalc methodology and estimates for monetizing LCA results on physical emissions for each of the nine human and environmental health impacts.

Section VIII brings the LCA physical emissions summary results and monetization thereof together to estimate overarching EEV benefits and costs for diversion and disposal of Delaware County generated MSW in 2020. Section IX discusses and compares specific EEVs for the Rolling Hills Landfill located in Earl Township (Berks County) and the Covanta Delaware Valley incinerator located in Chester City (Delaware County).

Section X details LCA results and monetization thereof for diversion and remaining disposal quantities once Zero Waste Plan recommendations are fully implemented.

Appendices A through E provide tables of supporting information for LCA and monetization findings.

[1] For example, the relative economic cost impact of one ton of greenhouse gas emissions on global climate health versus the economic cost impact of one ton of particulate or nitrogen oxides emissions on local human respiratory health.

II. Summary of LCA Results

This section summarizes eight major results from our LCA study on Delaware County MSW diversion and disposal.

1. Overall LCA and Monetization Results

Disposal of MSW generated in Delaware County in 2020 amounted to 467,770 tons. Disposal tons were almost entirely distributed among the four disposal facilities assessed in this LCA – Covanta Delaware Valley, Covanta Plymouth, Rolling Hills Landfill, and Fairless Landfill. Disposal facilities used for Delaware County (Delco) MSW and the proportions of the 467,770 tons received at each are detailed in the following chart:

Facility	Type	Owner/Operator	County	Municipality	Tons Delco MSW Received (2020)	% Delco MSW Received (2020)
Covanta Delaware Valley	Incinerator[2]	Covanta	Delaware	Chester City	380,122.7	81.3%
Covanta Plymouth	Incinerator[2]	Covanta	Montgomery	Plymouth Twp	5,032.1	1.1%
Rolling Hills Landfill	Landfill	Delaware County Solid Waste Authority	Berks	Earl Twp	1,187.1*	0.3%
Fairless Landfill	Landfill	Waste Management, Inc. (now "WM")	Bucks	Falls Twp	81,275.3	17.4%
Three other landfills	Landfill				152.7	0.0%

* Excludes Covanta Delaware Valley incinerator ash that is received at Rolling Hills Landfill.

Delaware County diversion of MSW from disposal in 2020 to recycling and composting totaled 218,599 tons. The diversion rate from disposal was 32% out of 686,369 tons MSW generated in 2020.

A. Carbon Emissions

Diversion in 2020 avoided emissions of 246,000 tons of carbon dioxide equivalents (eCO_2). This includes climate impacts of collecting, recycling markets preparation at a material recovery facility (MRF) that separates and bales mixed recyclables, composting of food scraps and yard wastes, and hauling and/or shipping prepared material to end users that make recycled-content products and materials from the diverted MSW materials. The 246,000 tons accounts for manufacturing of recycled-content products, as well as avoidance of virgin-content manufacturing of those products.

For biogenic (also known as "organic") materials diverted to composting, carbon emissions from petroleum-based fertilizers and pesticides production are avoided by soil amendments composted from biogenic materials. The total for avoided emissions of carbon dioxide equivalents also includes incremental carbon sequestration via healthier soils enhancing plant growth.

According to the U.S. Environmental Protection Agency (EPA), avoidance of 246,000 tons of carbon dioxide equivalents in 2020 provided the same climate benefit as taking 48,000 gasoline-powered passenger vehicles off the road in that year, or reducing annual miles driven by gasoline-powered passenger cars by 554 million miles.

Disposal of 467,770 tons of MSW in 2020 at landfills and incineration facilities, including landfill disposal of ash from incineration of Delaware County MSW, has a carbon footprint of 391,000 tons eCO_2 emitted into the atmosphere and contributing to climate change. This metric includes deductions of offsetting credits for displacement of fossil-natural-gas-based power by electricity generated at incinerators, as well as deductions for recovery and recycling of ferrous and

[2] EPA categorizes large municipal waste combustors (LMWCs) as non-hazardous solid waste incinerators burning on average more than 250 tons per day of MSW. Covanta Delaware Valley and Covanta Plymouth incinerators are LMWCs. This report mostly uses the term "incinerator" when referring to these two Covanta MSW incineration disposal facilities. The report occasionally uses "large municipal waste combustor" or its acronym "LMWC" instead of "incinerator" when referencing Covanta Delaware Valley or Covanta Plymouth incinerators. See U.S. Environmental Protection Agency (EPA) at: https://www.epa.gov/stationary-sources-air-pollution/large-municipal-waste-combustors-lmwc-new-source-performance .

non-ferrous metals from incinerator combustion ash residues. Delaware County's MSW 2020 disposal climate footprint is equivalent to annual carbon dioxide emissions from 76,000 gas-powered passenger vehicles driving 880 million miles.

B. Small Particulate Emissions

Small particulates no greater than 2.5 microns in diameter, including the many but very light nanoparticles, cause increases in morbidity and reduced life spans for humans impacted by those emissions. Diversion in Delaware County in 2020 avoided emissions of 294 tons of small particulates, while disposal of MSW that year increased particulate emissions by 12 tons. Virtually all particulate emissions avoidance due to recycling and composting is a benefit for households and businesses located outside of Delaware County, while particulate pollution health costs from 81% of Delaware County's MSW disposal at Covanta Delaware Valley impacts local households and businesses, especially in Chester where that incineration facility is located.

C. Monetization of Physical Emission Quantities

The disparity in absolute magnitudes between climate changing carbon emissions and human respiratory disease-causing emissions may seem to imply that particulate pollution is not a significant issue for Delaware County. However, particulate emissions have severe acute and long-term medical health effects on those living within the fallout zones of particulate pollutant emissions. Monetization of human health impacts due to respiratory and toxic pollutant emissions provides estimates for the economic costs of human respiratory and toxic emissions as compared to carbon emissions, as indicated in Table 1 of Section VII. Furthermore, human health costs of particulate and toxic emissions per ton of pollution for disposal facilities tend to be concentrated locally and occur in the near term, compared to the more globally dispersed and long-term costs of carbon emissions.

Figure S1 shows environmental[3] economic value (EEV) costs and benefits for Delaware County MSW 2020 disposal and diversion quantities. It shows EEVs in total for all nine impacts, as well as for several separate impacts of special significance.

The graph exhibits the well-recognized result that diversion from disposal to recycling and composting has substantial human and environmental health benefits. These EEV benefits total $399 million, with human health benefits alone accounting for $273 million, or 68%, of that EEV total.

Delaware County MSW disposal at Covanta Delaware Valley and Covanta Plymouth incinerators in 2020 incurred $104 million in net EEV costs after deductions for offsets from electricity generation and metals recycling by the two incinerators. Climate health and human health, respectively, accounted for $80 million and $23 million of those net costs.

The report dissects these results for diversion and disposal by separating local from global impacts, noting that both disposal and diversion activities depend on local collections for disposal, recycling and composting, as well as local transfer, hauling and processing activities. All of which impose EEV costs. In addition, over 81% of disposal takes place at the Covanta Delaware Valley trash incinerator located in the City of Chester. This incineration activity in the midst of a Delaware County population center has substantial local human health impacts with their attendant EEV costs.

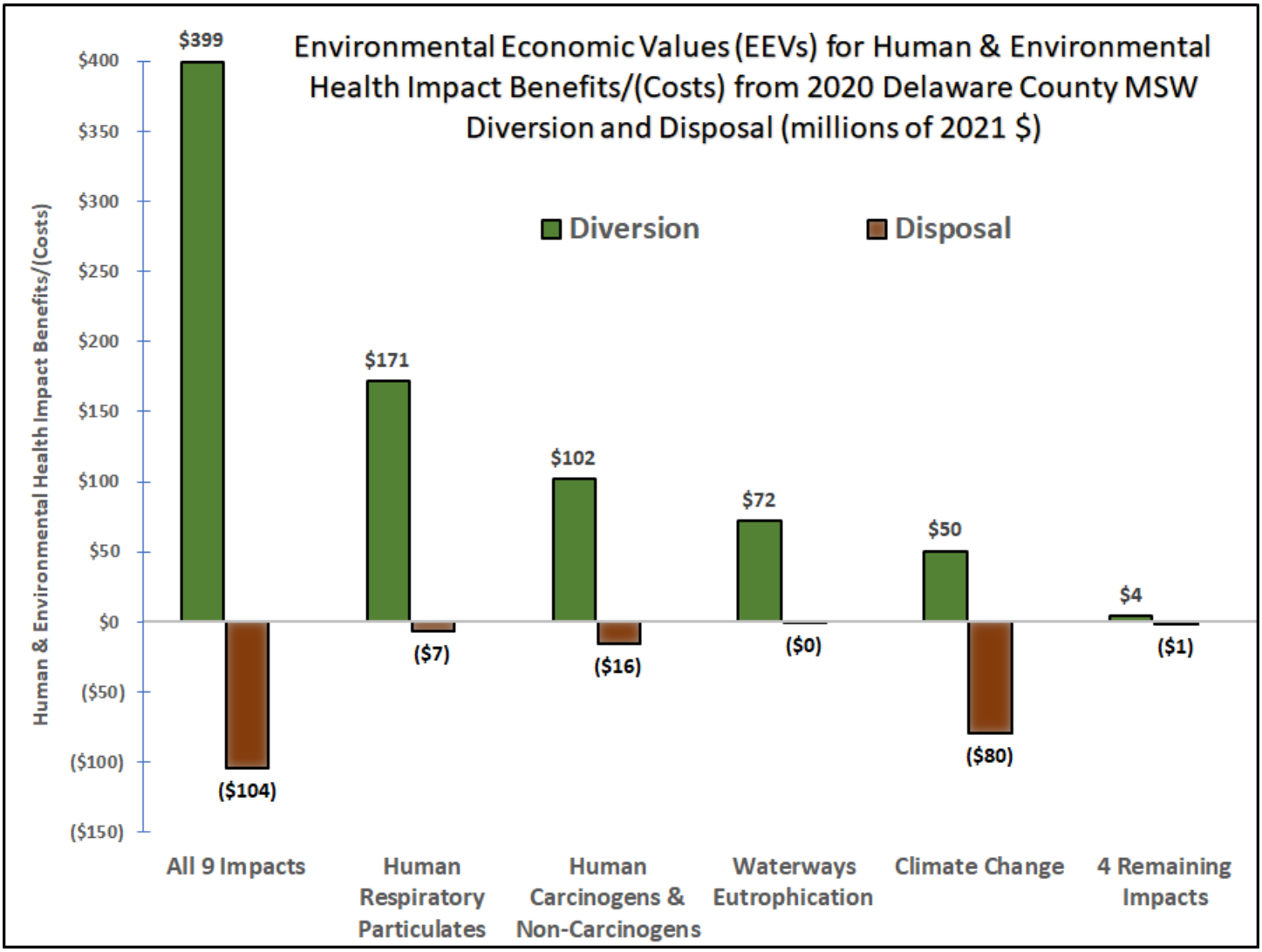
Human and environmental health benefits from recycling and composting are mostly due to displacement of products and materials manufacturing based on virgin resource and energy extraction from global ecosystems. This displacement, or avoidance, is achieved through diversion of discards from disposal to recycling and composting.

The avoided virgin manufacturing activities to produce new materials, products and soil amendments are widely dispersed across the U.S. and globally. There are some domestic manufacturing activities in Delaware County, such as Kimberly-Clark Tissue Corporation in Chester, oil refining in Trainer, and polypropylene manufacturing in Marcus Hook. Most displaced virgin manufacturing activities related to recyclables diversion from Delaware County MSW in this LCA,

[3] Note that the word "environmental" in the acronym EEV encompasses economic values for both human and environmental health.

however, occur outside of Delaware County. Most recycled-content manufacturing activities also likely occur outside of Delaware County, with notable exceptions such as Aero Aggregates in Eddystone.

Figure S1: EEVs for Benefits/(Costs) of All Nine Impacts and Separate EEVs for Climate Change, Human Respiratory Particulates, Human Carcinogens + Non-Carcinogens, Waterways Eutrophication, & the Remaining Four Impacts



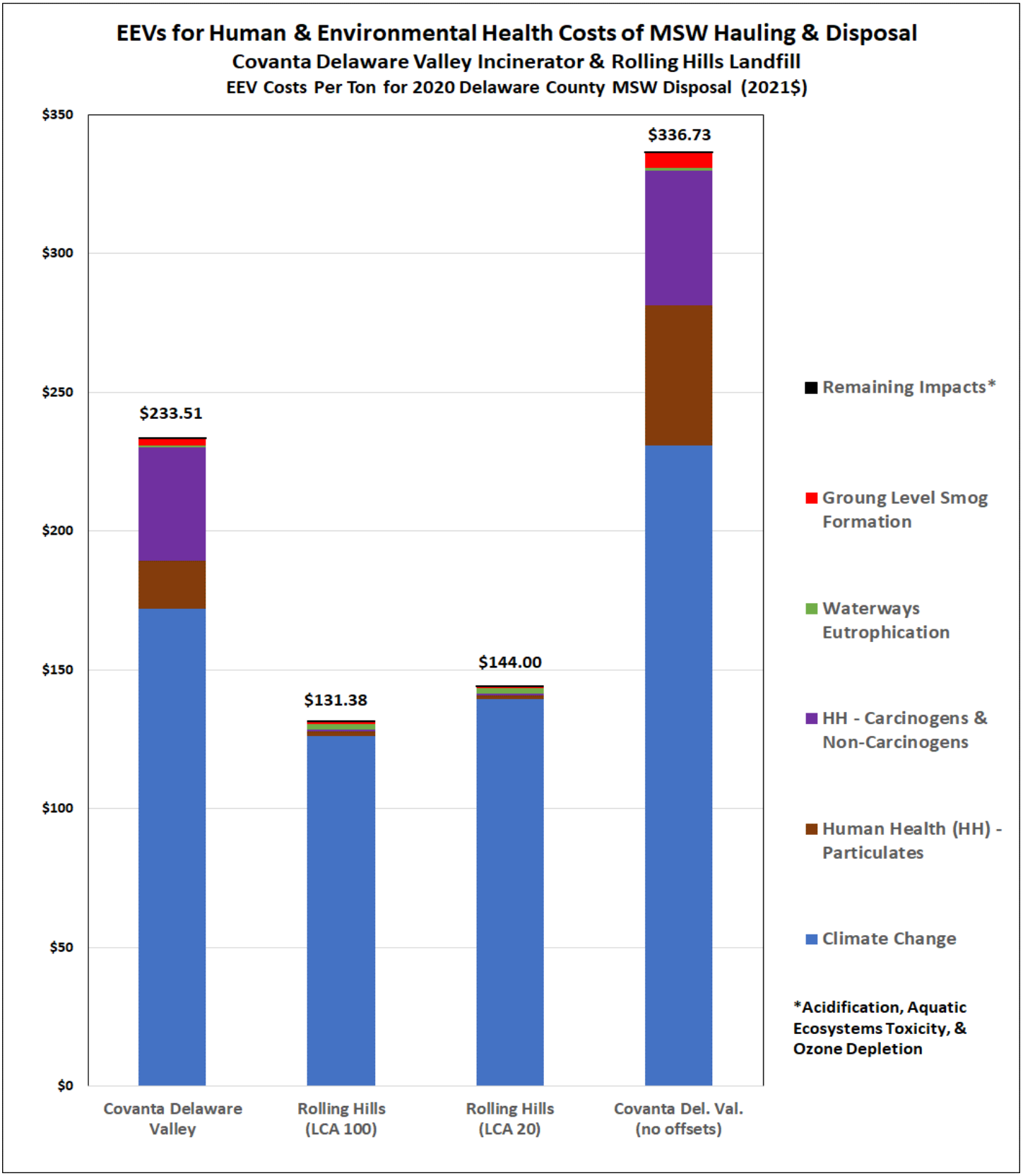
At the same time, even recycling has its own impacts. Both disposal and diversion activities such as collection, processing and hauling impose local human and environmental health costs caused by pollution from managing MSW generated in Delaware County. This finding puts emphasis on the need to minimize local human and environmental health costs from choices, especially for disposal, for managing Delaware County MSW.

2. *Incineration and Landfilling EEV Cost Comparisons*

Figure S2 shows additional detail on LCA disposal results that suggests an important avenue for reducing Delaware County local EEV costs. In Figure S2 EEV costs are shown as positive numbers for ease of presentation. The stacked bar labeled Covanta Delaware Valley on Figure S2 exhibits EEV costs per ton in 2020 for MSW hauling to, and disposal at, the Covanta Delaware Valley incinerator in Delaware County's City of Chester. The stacked bar labeled Rolling Hills (LCA 100) on Figure S2 portrays EEV costs per ton for hauling to, and disposal at, the Rolling Hills Landfill in Berks County, PA. The graph shows per ton EEV human and environmental health impacts in total, along with color bands in each stacked bar that detail the major human and environmental health impacts that encompass those EEV cost totals.

Covanta Delaware Valley incineration's total EEV cost is $234 per ton of Delaware County MSW burned. This cost is 78% higher than Rolling Hills Landfill's $131 total EEV cost per ton of Delaware County MSW buried there.

Figure S2: Stacked EEVs for Human and Environmental Costs Per Ton of 2020 MSW Hauling and Disposal: Covanta Delaware Valley Incinerator vs. Rolling Hills Landfill



Covanta Delaware Valley incinerator climate change EEV costs per ton burned exceed Rolling Hills Landfill climate EEV costs by 37%. Furthermore, Covanta Delaware Valley human health EEV costs are 23 times higher than Rolling Hills Landfill human health EEV costs, even though Rolling Hills EEV human health costs reflect a hauling distance from the Delaware County Solid Waste Authority's two garbage transfer stations for hauling MSW to Rolling Hills that is more than five times further than the hauling distance to Covanta Delaware Valley.

3. Sensitivity of Rolling Hills EEV Cost to LCA Time Frame

The two stacked bars on the right side of Figure S2 provide an indication of the effect of potential major sensitivities for existing EEV hauling and disposal costs for the Rolling Hills Landfill and Covanta Delaware Valley incinerator. The sensitivity comparison for Rolling Hills Landfill labeled Rolling Hills (LCA 20) exhibits the typical result that landfill climate impacts are higher over the first 20 years following MSW landfill disposal than they are over the first 100 years. This result is due to methane in landfill gas (LFG) emissions to the atmosphere. Blue-shaded bar sections of the stacked bar labeled Rolling Hills (LCA 20) portray the $139 20-year LCA climate impact EEV cost per ton landfilled at Rolling Hills Landfill. This is $13, or 10.6%, more than the $126 100-year LCA climate EEV cost for Rolling Hills Landfill portrayed by the stacked bar labeled Rolling Hills (100 LCA).

Section VIII discusses and explains details for this perhaps surprising result for readers expecting a larger difference in climate impacts. The United Nations Intergovernmental Panel on Climate Change (IPCC) 20-year global warming potential (GWP) characterization factor for methane is 81.2 carbon dioxide equivalents (eCO_2) versus IPCC's 100-year GWP climate impact characterization factor for methane of 27.9 eCO_2.

Rolling Hills Landfill EEVs for the other eight human and environmental health impacts decrease slightly when evaluated over 20 years instead of 100 years. This is because landfill pollutant emission quantities are all smaller in total over 20 versus 100 years, while impact characterization factors for each pollutant in each impact category are the same for both time periods for each impact other than climate change.

4. Sensitivity of Covanta Delaware Valley EEV Cost Offsets for Electricity Generation & Metals Recycling

Next, to more accurately portray the potential local human health impacts from incinerating MSW at Covanta Delaware Valley, we calculated that facility's pollution footprint excluding credits for offsets. The two EEV cost reductions included in Covanta Delaware Valley's $234 per ton EEV cost shown on the stacked bar labeled Covanta Delaware Valley on Figure S2 are for:

- Displacing fossil-natural-gas-generated electricity with power generated by burning MSW. This yields an offset EEV credit of $72 per ton of MSW burned.
- Recycling metals recovered from the combustion ash produced from burning MSW. Metals recycling yields an offset EEV credit of $31 per MSW ton incinerated.

The displaced natural gas power credit is based on assuming that when Covanta Delaware Valley partially or fully shuts down (e.g., for regular maintenance, operational difficulties, or other reasons), Pennsylvania electric power grid operators replace the decrease in electricity generation at Covanta Delaware Valley with electricity produced by standby peaking power natural-gas-fired generators. When Covanta Delaware Valley comes back online, its power output then replaces this short-term use of natural gas power.

If Covanta Delaware Valley were to permanently close down, the power source that would come online for the grid at this point in time likely would be natural-gas-based generation. In the future, that base load addition will increasingly be sourced from wind or solar generated electricity that has energy storage capabilities.

Removing these cost reduction credits increases Covanta Delaware Valley's human and environmental health EEV costs in total by $103 to $337 per ton of MSW incinerated, as indicated by the right-hand stacked bar labeled Covanta Del. Val. (no offsets) in Figure S2. This $103 total EEV cost increase per ton burned breaks down to increases of $59 for climate change, $41 for human health, and $3 for the remaining five environmental health impacts.

5. Local Human Health EEV Costs for Covanta Delaware Valley and Rolling Hills MSW Disposal

Human health EEV costs for MSW hauling and incineration at Covanta Delaware Valley, excluding offset credits, total $99 per ton burned. For comparison, human health EEV costs from hauling and landfilling MSW at Rolling Hills are $3 per ton.

The $99 per ton incinerated human health EEV costs for MSW hauling and disposal at Covanta Delaware Valley are portrayed on Figure S2 by brown and purple bands in the stacked bars. These human health costs are from particulates and toxics (non-carcinogens and carcinogens) emitted from incineration of MSW. At $99 per ton of MSW incinerated, local human morbidity and early mortality health costs from incinerating 380,000 tons of Delaware County MSW at Covanta Delaware Valley in 2020 total $38 million.

Delaware County MSW accounts for less than 31% of wastes burned at Covanta Delaware Valley. Including wastes from Philadelphia, New York City, New Jersey sources and elsewhere, local human health cost burdens from Covanta Delaware Valley operations total $123 million, most of which is borne by residents and workers in the City of Chester and nearby surrounding communities. Sections VII and VIII provide additional discussion on local human health costs from burning MSW at Covanta Delaware Valley.

6. Rolling Hills Landfill EEV Costs Sensitivity to LFG Capture Rate

This report also provides a sensitivity analysis for landfilling EEV costs for Rolling Hills Landfill at 70%, 30% and 0% landfill gas (LFG) capture rates. 70% is the LFG capture rate used for most LCA calculations in the report. Figure S3 exhibits landfill disposal impact EEV costs at a much lower 30% LFG capture rate, as well as disposal EEV costs if there were no LFG capture at all.

Figure S3 portrays estimates for MSW collection, hauling and disposal components of landfilling and incineration EEV costs, as well as indicating estimates for the local versus global impact EEV costs for just the disposal component.[4] Note that Figure S3 includes EEV costs for collection, whereas Figure S2 did not include collection EEV costs. Section VIII provides additional analysis and discussion regarding local versus global human and environmental health impacts and their EEV costs.

The sensitivity analysis shown on Figure S3 for Rolling Hills LFG capture rates indicates that regardless of LFG capture rate, MSW collection, hauling and landfilling at Rolling Hills have lower total human and environmental health EEV costs than collection, hauling and incinerating garbage at Covanta Delaware Valley, absent EEV cost offsets to that incinerator's impacts for electricity generation and metals recycling. Covanta Delaware Valley's total per ton EEV costs for MSW collection, hauling and disposal are $344 per ton excluding those offsets.

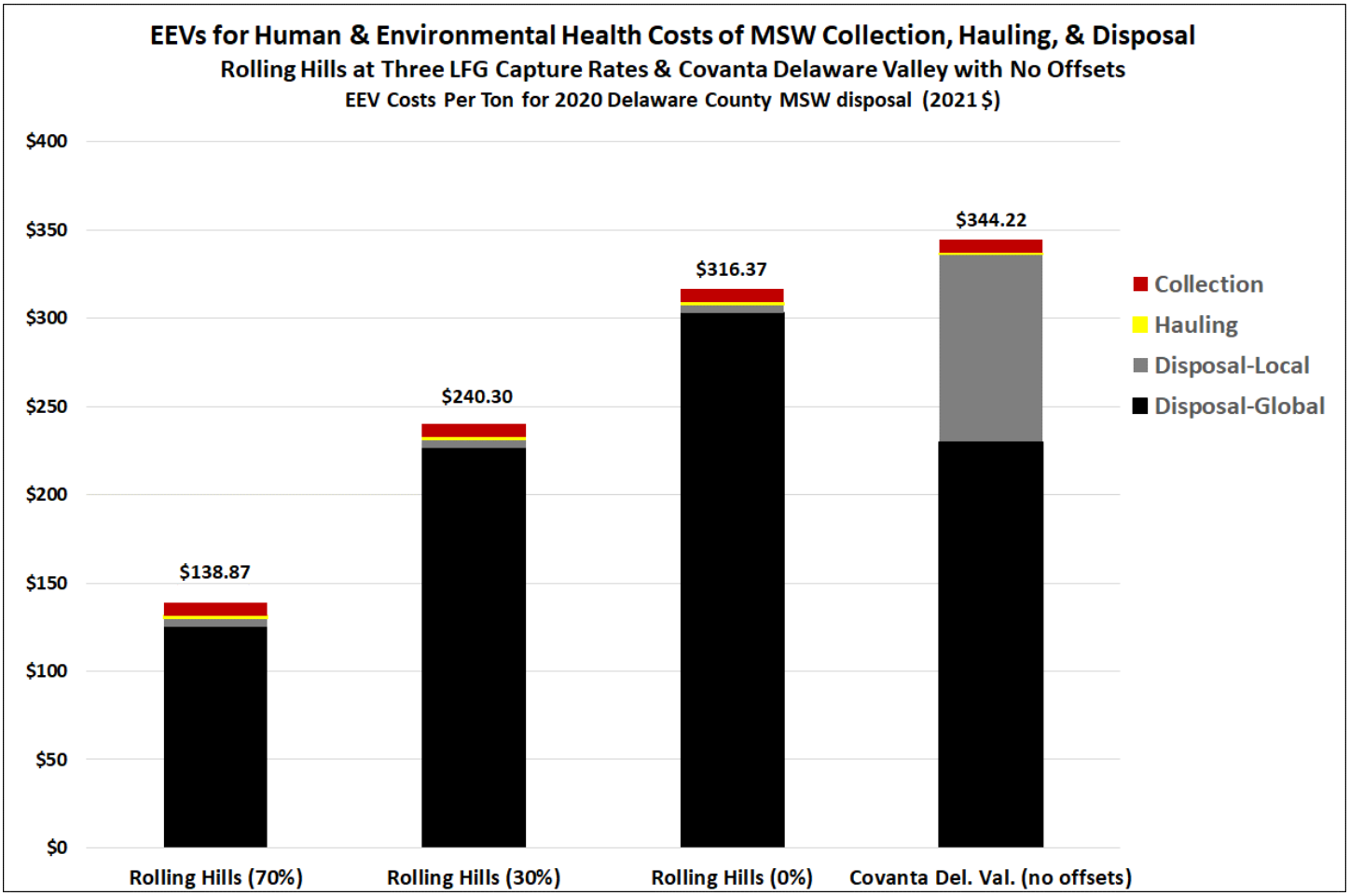
Total EEV costs for Covanta Delaware Valley including MSW collection costs as well as the offsets for electricity generation and metals recycling is $241.[5] At landfill gas capture rates of at least 30%, Rolling Hills total EEV cost is lower than Covanta Delaware Valley total EEV cost even when including cost offsets for Covanta Delaware Valley electricity generation and metals recycling.

Although not shown on Figure S3, it's also worth noting that when looking at only climate change, a 52% or higher LFG capture rate is sufficient for landfilling at Rolling Hills to have lower EEV costs than incineration at Covanta Delaware Valley even when including those Covanta Delaware Valley EEV cost offsets.

[4] Global impacts for disposal include climate change and stratospheric ozone depletion. Ozone depletion EEV costs for disposal are insignificant. Hence, EEVs for global disposal costs on Figure S3 are essentially equal to EEVs for climate change disposal costs.

[5] The $241 Covanta Delaware Valley total per ton EEV costs including offsets is higher than the $234 per ton costs shown on Figure S2 because the $241 estimate includes the EEV cost for garbage collection. In Figure S2 disposal costs include hauling costs but not collection costs. Figure S3 includes collection costs along with hauling and facility disposal costs to illustrate the point that collection and hauling human and environmental health impacts are much smaller than those impacts for disposal facility operations.

Figure S3: Stacked EEVs for Human & Environmental Health Costs Per Ton of MSW Collection, Hauling, and Disposal: Rolling Hills Landfill vs. Covanta Delaware Valley Incinerator



7. Hauling: MSW to Covanta Delaware Valley & Rolling Hills; Ash Covanta Delaware Valley to Rolling Hills

Figure S3 portrays MSW garbage EEV collection costs and hauling costs in addition to disposal EEV costs. This graphically shows that MSW collection and hauling for disposal account for a minor portion of human and environmental health impact costs for disposal of Delaware County garbage.

Specifically with respect to hauling, Rolling Hills Landfill is over 5 times more distant from Delaware County transfer stations than the Covanta Delaware Valley incinerator. Yet per ton EEV costs for hauling MSW to Rolling Hills Landfill account for just $1.52 of total per ton EEV costs. This compares to $0.76 per ton of MSW disposal for hauling MSW to Covanta Delaware Valley and hauling resultant combustion ash from Covanta Delaware Valley to Rolling Hills for burial.

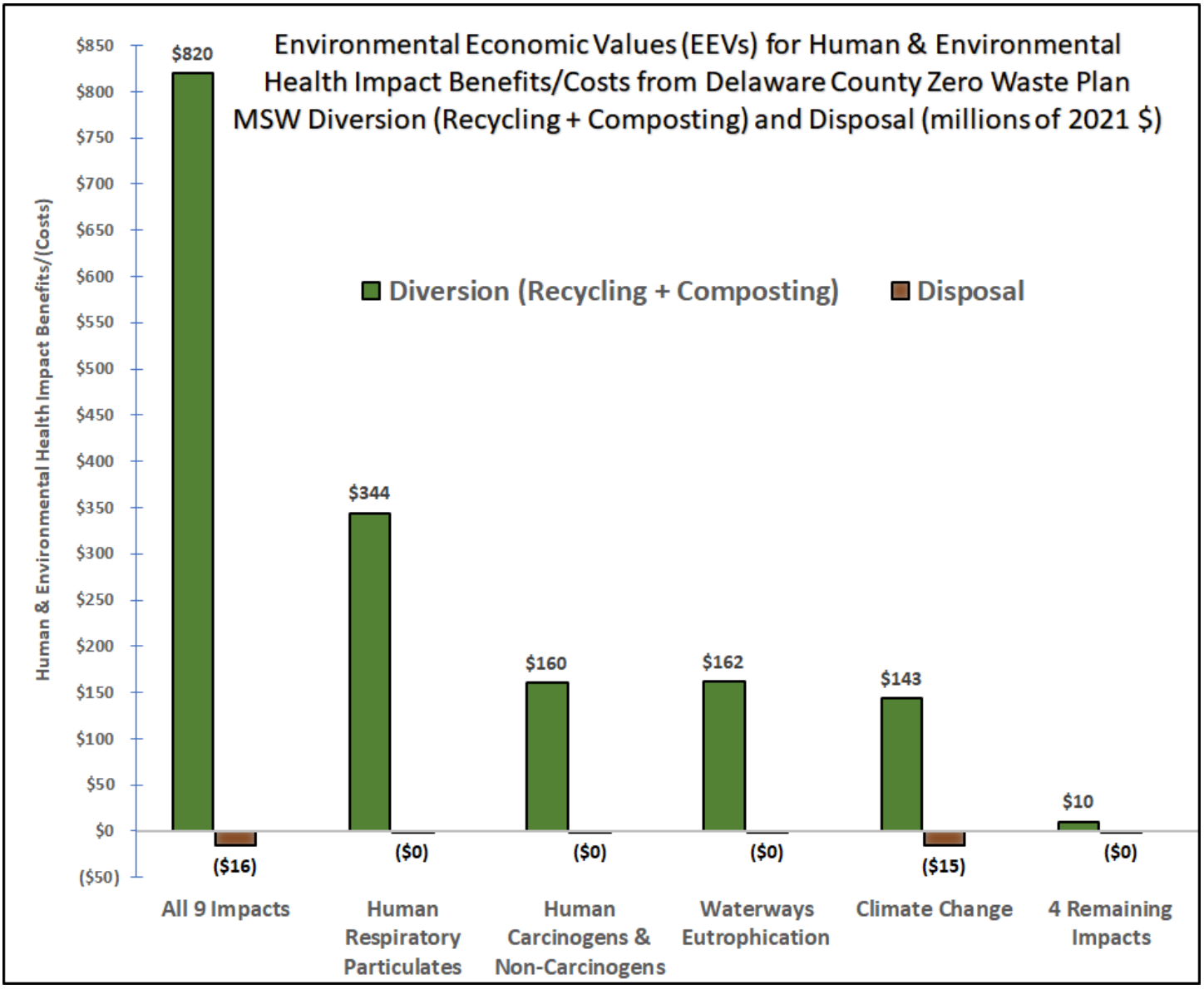
8. Summary of LCA and Monetization Results for the Recommended Zero Waste Plan

Section X describes LCA results for diversion and disposal of Delaware County MSW assuming full implementation of Zero Waste Plan recommendations, as described in the *Delaware County, Pennsylvania Municipal Waste Management Plan 2023-2033*. Figure S4 portrays information similar to Figure S1, except that LCA results displayed on Figure S4 are based on disposal and diversion projections following full implementation of the Zero Waste Plan recommendations. Tables B1 and B2 in Appendix B show LCA results for the recommended Zero Waste Plan for Delaware County disposal and diversion to recycling and composting.

Following successful implementation of Zero Waste diversion and disposal programs, diversion from disposal to recycling and composting would total 522,126 tons, more than doubling 2020 diversion's 218,599 tons. Source reduction from potential waste generation would total 51,613 tons. Disposal would be reduced by 76% to 112,697 tons from 2020

baseline 467,770 tons. Waste requiring management by Delaware County would decrease to 634,823 tons due to source reduction. The County's diversion rate would increase to 82.2%.

Figure S4: EEVs for Zero Waste Plan Projected Benefits/(Costs) of All Nine Impacts and Separate EEVs for Climate Change, Human Respiratory Particulates, Human Carcinogens + Non-Carcinogens, Waterways Eutrophication, & the Remaining Four Impacts



As indicated on Figure S4, Zero Waste Plan diversion from disposal to recycling and composting has total EEV benefits of $820 million. Human health EEV benefits account for $504 million, or 61%, of total benefits.

Delaware County MSW disposal under the Zero Waste Plan would be entirely at Rolling Hills Landfill. It would incur $16 million in total human and environmental health EEV costs. All but 4% of that total EEV cost would be caused by climate changing GHG emissions.

III. Methodology for Indexing & Summarizing Pollutant Emissions Causing the Nine Impacts

There are thousands of potentially harmful substances involved in the production, consumption, and waste management activities associated with goods and services. Some of these substances are released to the environment during natural resource extraction and refining of energy and materials used to manufacture goods and offer services. Some are released during manufacturing.

Resource acquisition and manufacturing are the upstream phase of product life cycles. Consumption of goods and services is the use phase. Management of wastes, perhaps more accurately called discards, via activities such as collection, recycling, composting and disposal encompass the downstream life cycle phase. Chemical and non-chemical harmful substances can be released to the environment during activities, such as shipping and hauling or fuel combustion for heat and power, which may accompany any of these stages in the life cycle of a good or service.

The challenge is that policy makers cannot readily assess human and environmental health impacts when looking at a report listing releases of thousands of individual chemical and other harmful substances. Grouping pollutant releases into a small number of human and environmental health impact categories provides a partial solution to this conundrum. Monetizing the nine impacts goes further to provide a single index that summarizes benefits and costs in dollar terms for the nine categories of human and environmental health effects.

Initial sections of this report define the nine categories and the roots of their indexing methodologies, MEBCalc's carbon accounting methods for measuring climate change, and sources for measuring pollutant emissions across the life cycles of the many materials encountered in managing MSW. Subsequent sections discuss physical emissions results for the nine impacts, as well as monetization of the nine impact results into a single dollar benefit-cost index for environmental economic value (EEV).

1. IPCC Method for Indexing Greenhouse Gas Pollutants Causing Climate Change

The method that is used for assessing each greenhouse gas (GHG) pollutants' potential climate impact is an example of how research scientists can synthesize a large number of harmful emissions into an index number, in this case carbon dioxide emissions equivalents, that provides a metric for characterizing potential climate changing impacts from releases of GHG pollutants to the atmosphere. The United Nations Intergovernmental Panel on Climate Change (IPCC) popularized this index – carbon dioxide equivalents (denoted as eCO_2 or CO_2E) – that defines, in one number, the amount of climate forcing emissions released into Earth's atmosphere. The climate forcing strengths of GHG pollutants are characterized by global warming potentials (GWPs) for each atmospheric pollutant that contributes to trapping incoming solar radiation.

Examples from the IPCC's *2022 Sixth Assessment Report* (AR6) of GWPs for GHGs range from 1 for carbon dioxide (CO_2), 27.9 for methane (CH_4), and 273 for nitrous oxide (N_2O), up to 24,300 for sulfur hexafluoride (SF_6). These GWPs represent each GHG's average climate forcing effect over the 100 years following their release.

IPCC also publishes GWPs for climate forcing over 20 years and 500 years. This study uses the 100-year time frame for most LCA calculations presented herein. The exception is that LCA results are also provided for landfilled materials in 2020 over a 20-year time horizon to reflect especially the higher 20-year methane GWP of 81.2 versus its 100-year GWP of 27.9.[6]

[6] MEBCalc's modeling and peer-reviewed article sources mostly use the 100-year time frame for LCA calculations. Re-calculating results over the 20-year time horizon would reduce impacts for all but climate change. It would also reduce climate change impacts for landfilled materials such as wood, mechanically-pulped paper products, and other materials that generate methane and carbon dioxide very slowly. Wood and mechanically-pulped paper products contain lignin which is very resistant to formation of methane. Chemically pulped paper and paperboard products are chemically pulped to, in part, remove the lignin. Hence, they have much higher average climate impacts over 20-years. This report evaluated landfill impacts over both 20- and 100-years to check for sensitivity of results when comparing incineration to landfilling. Based on results shown on Figure S2, landfilling MSW is not very sensitive to whether the LCA time frame is 20 years instead of 100 years. See Section VIII for more on this issue.

GWPs are characterization factors that express the climate forcing potential of any greenhouse gas relative to that of carbon dioxide. GWP users calculate the climate change index eCO_2 by multiplying each GHG's GWP, its climate change characterization factor, by the amount of that GHG released to the atmosphere. Adding up these indexed emissions yields the summary number of carbon dioxide equivalents that represents climate forcing impacts over the subsequent 100 years.

2. TRACI Tool for Indexing the Other Eight Human and Environmental Health Impacts

In a similar vein, the U.S. Environmental Protection Agency (EPA) has a tool, TRACI (Tool for the Reduction and Assessment of Chemical and other environmental Impacts), that provides impact potential characterization factors for releases of nearly 4,000 chemicals and other substances for eight more human and environmental health impacts in addition to climate change.[7] For climate change, the TRACI characterization factors are the IPCC 100-year GWPs.

Many chemicals and substances have TRACI characterization factors of zero for some impacts, meaning that they do not contribute to damages for those particular impacts. For example, for climate change only 91 of the 3,944 chemicals and substances codified by TRACI 2.1 have GWP characterization factors greater than zero.

For each of the eight human and environmental health categories besides climate change, users of TRACI, such as MEBCalc, can select a particular pollutant to serve as the reference indicator for that impact, just as carbon dioxide equivalents (eCO_2) serve as the widely used climate impact potential indicator for GHG emissions. This means that all pollutants in each category are converted to the units of the reference indicator based on their characterization factors for each impact. Their releases, thus, can be multiplied by their reference indicator characterization factors, and added up to obtain an index of total impact from those releases for that category of human and environmental health impacts. Note, once again, that these eight human and environmental health impact categories have impact characterization factors for each pollutant in each impact category that are the same for 20-year and 100-year LCAs.

TRACI's characterization factors in some instances indicate that a pollutant has more than one human or environmental health impact. For example, sulfur dioxide, causes both environmental health acidification and human health respiratory damages. To prevent what might appear to be a potential for double counting in such instances, TRACI's nine categories assess mutually exclusive human and environmental health impacts. What might seem like a possibility for double counting is, thus, avoided using TRACI methodology for keeping impacts mutually exclusive.[8]

The nine human and environmental health impacts assessed by MEBCalc use the IPCC and TRACI 2.1 characterization factors. Brief comments on each of the nine categories of human and environmental health impacts, some of the pollutants that cause each impact, and the reference substance used to index each impact, follow:[9]

- **Climate change** – the potential increase in greenhouse effects due to anthropogenic atmospheric emissions. Carbon dioxide (CO_2) from burning fossil fuels is the most common source of GHGs. Methane (CH_4) from anaerobic decomposition of biogenic materials such as food scraps or discarded paper, say, from burial in a landfill, is another large source of GHG effects. Pollutants that have climate impacts are characterized by GWPs and converted into their reference substance impacts carbon dioxide equivalents, eCO_2.

[7] https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci .

[8] More information on TRACI is provided in the following references: Bare J. C., *Developing a Consistent Decision-Making Framework by Using the U.S. EPA's TRACI,* U.S. Environmental Protection Agency, Cincinnati, OH, 2002; Bare J. C., Norris, G. A., Pennington, D. W., and McKone, T., TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. *Journal of Industrial Ecology* 2003, 6(3-4): 49-78; and Bare, J. C., TRACI 2.0: the tool for the reduction and assessment of chemical and other environmental Impacts 2.0. *Clean Technologies and Environmental Policy*, 2011, 13(5) 687-696. These articles provide expositions on the original and more recent versions of the TRACI model.

[9] These nine human and environmental health impact categories match the impact categories used in TRACI, and are widely used in life cycle assessments and the scientific literature that assess damages from human and environmental health impacts.

- **Human respiratory disease and death from particulates** – potential human health impacts from anthropogenic atmospheric releases of coarse particles known to aggravate respiratory conditions such as asthma, fine particles that can lead to more serious respiratory symptoms and disease such as lung cancer, and particulate precursors such as nitrogen oxides (NO_x) and sulfur dioxide (SO_2). Activities that are large sources of particulate emissions include combustion of fuels such as coal, natural gas, wood, and petroleum diesel. Grinding, combusting, or otherwise processing municipal solid wastes also generates particulate emissions. Emissions of pollutants that have respiratory health impacts are characterized and converted into reference pollutant equivalents, $ePM_{2.5}$, where $PM_{2.5}$ is particulate matter 2.5 microns or less in diameter.[10]
- **Human disease and death from non-carcinogenic toxics** – potential human health impacts (other than particulates' respiratory and toxics' carcinogenic impacts) from releases of chemicals that are toxic to humans. There are many chemical and heavy metal pollutants that are toxic to humans, including 2,4-dichlorophenoxy acetic acid (2,4-D), benzene, dichloro-diphenyl-trichloroethane (DDT), formaldehyde, permethrin, toluene, chromium, copper, lead, mercury, silver, and zinc. Examples of these pollutants' human toxicity effects include heart diseases, kidney failure, reproductive disorders, cognitive effects, and disruption of the endocrine system. MEBCalc uses TRACI characterization factors to convert emissions of pollutants that have human health non-carcinogenic toxicity impacts into reference pollutant equivalents, eT, where T is toluene.
- **Human disease and death from carcinogenic toxics** – potential human health impacts from releases of chemicals that are carcinogenic to humans (other than particulates respiratory cancers impact). There also are many chemical and heavy metal pollutants that are carcinogenic to humans, including 2,4-D, benzene, DDT, dioxins and furans, formaldehyde, kepone, permethrin, chromium, lead, and mercury. MEBCalc's reference substance for human carcinogenic potential is benzene. MEBCalc aggregates the pollutants that have human carcinogenic impacts into benzene equivalents, eB.
- **Eutrophication** – potential environmental impacts from the addition of macro nutrients to soil or water resulting from emissions of eutrophying pollutants to air, soil or water. The addition to soil or water of mineral nutrients, such as nitrogen and phosphorous, can yield generally undesirable shifts in the number of species in ecosystems and a reduction in ecological diversity. In water, nutrient additions tend to increase algae growth, which can lead to reductions in oxygen and death of fish and other species. Pollutants that have waterways eutrophying impacts are characterized by nitrogen equivalents, eN.
- **Acidification** – potential environmental impacts from anthropogenic releases of acidifying compounds, principally from fossil fuel and biomass combustion, which affect trees, soil, buildings, animals and humans. The main pollutants involved in acidification are sulfur, nitrogen and hydrogen compounds – e.g., sulfur dioxide, sulfuric acid, nitrogen oxides, hydrochloric acid, and ammonia. The pollutants that have acidifying impacts are characterized and referenced by sulfur dioxide equivalents, eSO_2.
- **Aquatic ecosystems toxicity** – the relative potential for chemicals released into the environment to harm aquatic ecosystems, including wildlife. There are many chemical and heavy metal pollutants that are toxic to ecosystems, including 2,4-D, benzene, DDT, dioxins and furans, ethyl benzene, formaldehyde, kepone, permethrin, toluene, chromium, copper, lead, silver, and zinc. Pollutants that have toxicity impacts to aquatic ecosystems are characterized and referenced by 2,4-dichlorophenoxy acetic acid equivalents, e2,4-D.
- **Ozone depletion** – the relative potential for chemical compounds released into the atmosphere to cause degradation of the Earth's ozone layer. The reference substance for ozone depletion potential (ODP) is

[10] For comparison a human hair's diameter is about 75 microns on average.

trichlorofluoromethane, CFC-11, where CFC is the acronym for chlorofluorocarbon. CFC-11 is sometimes called R-11. Pollutants that have ozone depletion potential are characterized and referenced by CFC-11 equivalents eCFC-11.

- **Ground level smog formation** – the relative potential for chemical compounds released into the atmosphere to react with sunlight, heat and fine particles to form ozone (O_3). For example, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) released during fuel combustion are some of the chemical compounds that contribute to ground level smog formation. Smog forming pollutants are characterized by ozone equivalents, eO_3.

IV. MEBCalc LCA Accounting Methodology for Climate Changing Carbon Emissions

MEBCalc calculations for climate change impacts count all GHG emissions, including carbon dioxide (CO_2) and other GHGs that have more substantial climate warming impacts than CO_2, such as methane (CH_4), carbon tetrachloride (CFC-10), and dichlorodifluoromethane (CFC-12). MEBCalc does not give credits for previously sequestered carbon that may remain stored for a time, short or long, in biogenic- or fossil-carbon based materials discarded into landfills, processed into composts, or processed into reused or recycled-content products. Nor does MEBCalc count regrowth of plants and trees as an offset for carbon emissions from waste management system activities and facilities.

In addition, MEBCalc tracks the timing of carbon releases from current year handling of wastes. Biogenic materials such as paper products, food scraps, yard maintenance grass clippings and plant prunings buried today in a landfill, for example, release carbon dioxide, methane and other GHGs from their anaerobic biodegradation slowly over many years. Fossil carbon-based materials such as most plastics do not biodegrade in landfills. In contrast, combustion of burnable biogenic- or fossil-carbon based materials releases the carbon in those materials all at once, and virtually all as CO_2 assuming the combustion process is efficient. MEBCalc uses dynamic carbon accounting methods to account for the difference in climate impacts between the GHGs released all at once today versus more slowly over time, for example throughout the typical 100-year LCA timeframe,[11] or the shorter 20-year timeframe.

There are several important reasons for MEBCalc's accounting methodology for biogenic CO_2:

1. Companies that own or manage MSW incinerators often make the claim that their current biogenic CO_2 emissions can be ignored due to those emissions being re-sequestered during future plant and tree growth. However, if these incineration disposal facilities use future plant and tree growth CO_2 sequestration as offsets when calculating their climate footprint, then recycling, composting and landfilling could use that same quantity of future CO_2 sequestration credits when they manage the same quantity and composition of biogenic discards. The result is that an LCA comparison of climate impacts for recycling, composting, landfilling, and incinerating MSW would each be subtracting the same CO_2 credit from their climate impacting carbon emissions. This leaves rankings in terms of climate impacts the same regardless of whether the regrowth credit is applied to all or none. Hence, to avoid unnecessary and complicated tracking and responsibility verification accounting to measure regrowth that may occur in future years to offset today's mix of biogenic materials treated by a waste management method, MEBCalc's analysis instead focuses on tracking all carbon emissions, including both biogenic and fossil CO_2.

   Another way of coming to the same conclusion is to note that according to climate change accounting rules for allocating regrowth credits, if the regrowth will happen ***anyway***, regardless whether the biogenic discards are burned for energy or managed by some other waste management method, then no offset for that regrowth should be awarded to incinerators.[12]

[11] MEBCalc uses DYNCO2 for dynamic carbon accounting, Dynamic Carbon Footprint - Life Cycle Assessment Tool - CIRAIG.
[12] See, for example, the discussion on additionality in Broekhoff *et al*, 2019. *Securing Climate Carbon Offsets*, Stockholm Environmental Institute & Greenhouse Gas Management Institute. Available at https://www.offsetguide.org.

2. Sequestration of carbon into plants and trees from CO_2 in the atmosphere occurs through photosynthesis when plants and trees are growing. Continued storage of biogenic carbon in products and materials produced from those plants and trees is not sequestration. Continued storage of fossil carbon, for example, in fossil-carbon-based plastics buried in landfills, does not accrue CO_2 emissions reduction credits. Why should storage of biogenic carbon be treated differently than storage of fossil carbon in LCA calculations? Counting biogenic carbon storage as a credit against current releases of CO_2 also could double count CO_2 sequestration if that sequestration was already registered in climate accounting when plants and trees were growing or at the time of their harvest.[13]

3. Concentrations of CO_2 in the atmosphere continue to increase. Oceans absorb about 30% of CO_2 released to the atmosphere, and increased CO_2 emissions are likely a substantial cause of currently-observed increases in ocean acidification. Both trends suggest that current plant and tree CO_2 sequestration from the atmosphere may not be keeping up with growth of human-driven emissions. As a result, plant and tree sequestration of CO_2 from the atmosphere to offset CO_2 emissions to the atmosphere may fall short of what is necessary to prevent further climate change. This potential imbalance between regrowth demand needed for offsets and actual regrowth supply necessary to offset planetary GHG emissions means that carbon dioxide polluters cannot legitimately claim that undesignated planetary regrowth automatically offsets their particular carbon emissions. The total supply of undesignated regrowth credits may be insufficient to meet total demand for such credits. Furthermore, credits for continued plant and tree growth and regrowth should go first to those doing the growing – for example, private and public entities that sustainably manage forests and parks.[14]

V. MEBCalc Sources for Pollutant Emissions Over the Life Cycle of Material Discards

Sound Resource Management Group (SRMG) found inspiration, research results, and preliminary data for initial development of MEBCalc from several ground-breaking studies on conservation versus incineration – where incineration is meant to encompass pseudonyms such as combustion, waste-to-energy (WTE), pyrolysis, and gasification. These studies included Tellus Institute's Packaging Study,[15] SRMG's Recycling Versus Incineration,[16] and Washington State Department of Ecology's Issue Paper 10.[17]

For emissions from material and fuel resources extracted and refined from ecosystems, from manufacturing virgin-content products using those refined resources, from manufacturing recycled-content products using recycled materials, and from waste management system facilities and activities, SRMG and MEBCalc initially relied significantly on two waste management LCA models – EPA/Research Triangle Institute's Decision Support Tool (RTI DST)[18] and EPA's WARM tool.[19]

Note also that earlier versions of MEBCalc did not assess the use phase for materials and products handled by waste management systems, just as EPA's RTI DST and WARM decision support tools do not. This was not

[13] EPA's WARM tool is an example of a 100-year timeframe climate impacts accounting tool that gives credit for storage of biogenic carbon in composts and landfills, but no such credit for storage of fossil carbon in landfills or products.

[14] For discussion and references on verification issues even with purchases of carbon offset credits see, Guizar-Coutino, *et al*, 2022, A global evaluation of the effectiveness of voluntary REDD+ projects at reducing deforestation and degradation in the moist tropics. *Conservation Biology*. 36:e13970.

[15] CSG/Tellus Institute, 1992. *Assessing the Impacts of Production and Disposal of Packaging and Public Policy Measures to Alter Its Mix*, prepared for Council of State Governments (CSG), prepared by Tellus Institute, Boston, MA.

[16] Morris, J., Canzoneri, D., 1992. *Recycling Versus Incineration: An Energy Conservation Analysis*, prepared for Pollution Probe (Toronto, Ontario) and Work on Waste USA (Canton, NY), Sept. 1992. Seattle, WA. Also, summarized in Morris, J., 1996. Recycling versus incineration: an energy conservation analysis. *Journal of Hazardous Materials* 47(1-3) 277-293.

[17] Washington State Department of Ecology, 2002. *Beyond Waste Washington State Solid Waste Plan, Issue Paper 10, Solid Waste Costs and Barriers to Recycling.* Publication no. 02-07-030, August 2002. Olympia, WA.

[18] See downloadable resources on the DST at: RTI International.

[19] See U.S. Environmental Protection Agency (EPA) at: Waste Reduction Model (WARM) | US EPA.

because the use phase is not a significant and important part of the life cycle of products and services. Rather, it is because the use phase impacts of recycled-content and virgin-content products or materials typically are assumed to be the same.

Like WARM and RTI DST tools, MEBCalc always has accounted for the upstream impacts for products and materials produced from virgin raw materials and fuels as compared to recycled products and materials. In fact, it is the upstream differences in human and environmental health impacts between virgin- and recycled-content products, materials and services that provide most of recycling's human and environmental health benefits.

In addition, earlier versions of MEBCalc did not account for the upstream differences in human and environmental health impacts between soil amendments produced from composts and their competing products produced from petroleum and other virgin resources. Also, the use phase for soil amendments produced by composting biogenic MSW materials such as yard debris, food scraps and soiled compostable paper products has different impacts than the use phase for virgin resource and petroleum-based soil amendments.

To correct these shortcomings, the current version of MEBCalc, version 7.2, assesses human and environmental health for both upstream and use phase differences between composted biogenic material soil amendments and their virgin resource and petroleum-based counterparts. These differences result in lower upstream impacts for soil amendments produced from composts, lower use phase soil runoffs of nitrates and phosphorus, and enhanced use phase plant growth with its related additional carbon sequestration due to healthier soils.[20]

Furthermore, since developing the first version of MEBCalc, Sound Resource Management Group has continually revised emissions profiles and other LCA input data using updates from EPA's WARM and RTI DST models, as well as substantial new data from a wide variety of peer-reviewed scientific journal articles and other well-regarded sources. These latter sources include publications by organizations such as The Association of Plastic Recyclers (APR), Environmental Paper Network (EPN), Oregon Department of Environmental Quality (DEQ), Washington State Department of Ecology (DOE), National Renewable Energy Laboratory (NREL), and U.S. Department of Energy's Energy Information Administration (EIA). Relevant peer-reviewed scientific articles often appear in journals such as *Environmental Science & Technology* published by the American Chemical Society (ACS), the *Journal of Industrial Ecology* published at Yale University, and *Waste Management* published by Elsevier.[21]

Sources for Input data specific to Delaware County are discussed in the following six subsections.

1. Landfill Emissions

For landfill air emissions from the Fairless and Rolling Hills landfills used for disposal of some Delaware County MSW, MEBCalc relies on EPA's Landfill Gas Emissions Model (LandGEM),[22] and MSW disposal composition estimates from a 2022 report for the Pennsylvania Department of Environmental Protection that provides 2020-2021 data specific to the southeastern region (Philadelphia and its suburbs). The EPA LandGEM model projects anaerobic generation of both GHG and non-GHG pollutants over the subsequent 20 or 100 years.

[20] Morris, J., Flammer, R., and Soylu, T. M., 2022, Environmental Dollars and Sense of Composting in San Diego County. *BioCycle Connect*, January 25, 2022; and Morris, J., 2021, *The Environmental Economics Dollars and Sense of Composting in San Diego County.* Prepared for City of Chula Vista (CA) Economic Development Dept. by SRMG.

[21] For example, De la Cruz, F.B., Barlaz, M.A., 2010, Estimation of waste component-specific decay rates using laboratory-scale decomposition data, *Environmental Science & Technology 44 (12): 4722-4728;* Morris, J., 2017, Recycle, bury, or burn wood waste biomass? LCA answer depends on carbon accounting, emissions controls, displaced fuels, and impact costs, *Journal of Industrial Ecology*, 21 (4) 844-856; and De la Cruz, F. B., *et al*, 2016, Comparison of field measurements to methane emissions models at a new landfill, *Environmental Science & Technology*, 50: 9432-9441.

[22] See U.S. EPA at: Emissions Estimation Tools | US EPA

For landfill water emissions from MSW disposal, MEBCalc relies on RTI DST emission factors. For landfill air and water emissions from disposal of ash outputs from Covanta Delaware Valley and Covanta Plymouth, MEBCalc also relies on RTI DST emissions factors.

2. Incinerator Emissions

For the Covanta Delaware Valley and Covanta Plymouth incinerators used for disposal of MSW from Delaware County in 2020, MEBCalc input data for incineration air emissions rely on Covanta's reports to the Pennsylvania Department of Environmental Protection (DEP). Continuous emissions monitoring at those two incineration facilities is compiled for four pollutants: carbon monoxide, nitrogen oxides, sulfur oxides, and hydrochloric acid. Estimated emissions for other air pollutants are based on annual stack emissions tests for release rates of those pollutants, and estimated total annual emissions are calculated by Covanta for their yearly reporting to DEP. Annual air emissions data for continuously monitored pollutants and pollutants with annual emissions estimates based on periodic tests for emissions rates are both publicly available through PA DEP's website. [23] Data on dioxins/furans and polycyclic aromatic hydrocarbons are not reported in DEP's online air emissions data report. Annual reports for those pollutants had to be requested from DEP.

Solid waste disposal quantities handled at each of the two landfills and two incinerators used for Delaware County MSW disposal in 2020 are also available through PA DEP's website.[24]

SRMG used five-year averages over the years 2017 through 2021 for air emissions per ton handled at Covanta Delaware Valley and Covanta Plymouth incinerators. Use of these averages is for three main reasons:

- Delaware County MSW composition data had to be estimated from the PA DEP waste composition study that was conducted during July 2020 through June 2021 to coincide with the Pennsylvania Commonwealth's fiscal year. This did not coincide exactly with this study's 2020 baseline year.
- The two years 2020 and 2021 seemed unreliable as a basis for typical emissions from each of the two incinerators due to disruptions during the COVID pandemic.
- Averages for disposal tons over the five years 2017-2021 showed substantially lower variation than averages for emissions of many pollutants listed in the PA DEP air emissions database. For example, disposal tons for Covanta Delaware Valley had a five-year standard deviation that was 2.5% of the five-year average for disposal at that incinerator. Annual emissions of the heavy metals cadmium, chromium, lead, mercury, and nickel had standard deviations for 2017-2021 that were between 33% and 78% of their respective 5-year averages for Covanta Delaware Valley disposal emissions. The standard deviation for $PM_{2.5}$ was 80% of its average during 2017-2021. Even the continuously monitored sulfur oxides pollutants had a 5-year standard deviation that was 29% of its average. These results suggested that using one or two years as the basis for air emissions from Covanta Delaware Valley would be an unreliable basis for emissions factors when emissions for many pollutants varied so much from year to year while total tons burned stayed very stable.

There are some exceptions to the five-year average emissions procedure for several pollutants – carbon dioxide, dioxins/furans, and polycyclic aromatic hydrocarbons (PAHs). Carbon dioxide emissions for this study's 2020 baseline waste composition tons are a straight forward calculation from each waste stream material's carbon content and the assumption that each combustible material's carbon content is essentially all converted to carbon dioxide and water vapor when combusted. Hence, 2020 carbon dioxide emissions at each of the two incinerators are based just on Delaware County MSW disposal using the southeast region's waste composition.

[23] Pennsylvania Department of Environmental Protection Air Emissions Report (Detail Report tab) available at: http://cedatareporting.pa.gov/reports/powerbi/Public/DEP/AQ/PBI/Air_Emissions_Report.

[24] Pennsylvania Department of Environmental Protection Solid Waste Disposal Information available at: http://cedatareporting.pa.gov/reports/powerbi/Public/DEP/WM/PBI/Solid_Waste_Disposal_Information.

Note that 81.3% of 2020 MSW disposal for Delaware County was sent to the Covanta Delaware Valley incinerator located in the City of Chester.

Neither dioxins/furans nor polycyclic aromatic hydrocarbons (PAHs) are codified in DEP's online annual air emissions database. That database reports annual tons. Annual emissions for these pollutants are below DEP's reporting threshold. Data for estimating annual emissions of these pollutants was acquired from DEP based on Pennsylvania Right-To-Know Law requests. These data sources are available by contacting the SWMP Update and LCA study team. Emissions for dioxins/furans are represented as 2,3,7,8-TCDD TEQs (2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalents). Emissions of PAHs are represented as benzo(a)pyrene equivalents.

Table C1 in Appendix C lists Covanta Delaware Valley and Covanta Plymouth atmospheric pollutant emission factors per metric ton that are used in MEBCalc to calculate pollution emissions for Delaware County MSW burned at the two incinerators.

3. Disposal Facility Air Emissions Offsets

MEBCalc evaluation of incineration disposal facility human and environmental health impacts includes offsets (i.e., emissions deductions) for emissions from natural-gas-fired power production equal in power output amounts to electricity generated and distributed to the PA electrical grid from Delaware County MSW burned at incinerators in 2020.

MSW disposal managed at the two landfills used for burying Delaware County MSW in 2020 captured landfill gas (LFG) released from this buried MSW. However, captured LFG was not used to generate energy. Instead that captured LFG is burned in flares located at the two landfill sites and does not accrue air emissions offsets for displacing other electricity generation sources.

The emissions profiles for natural gas power production and landfill flares are from EPA AP-42 compilations.[25]

4. Diversion Quantities and Composition

Baseline 2020 diversion quantities are based on actual materials recycled in 2020, as reported by Delaware County in its 2020 Act 101 County Recycling Report.[26] Recommended Zero Waste diversion projections were developed for the 10-year solid waste management plan and added to baseline diversion quantities. Both diversion composition tables are detailed in Table D1 of Appendix D.

5. Disposal Quantities and Composition

Baseline 2020 disposal composition is from the Pennsylvania DEP Waste Characterization Study, prepared by MSW Consultants, September 2022, and is based on data collected in the PA DEP's Southeast Region between November 9, 2020 and May 26, 2021 from three facilities – Covanta Plymouth, and two MSW transfer stations in Philadelphia.[27] Zero Waste Plan disposal projections were calculated by subtracting the Zero Waste Phase 1 and Phase 2 diversion projections from the baseline disposal compositions for each material enumerated in the 2020 composition table. Both disposal composition tables are detailed in Table E1 of Appendix E.

Table E2 in Appendix E summarizes Delaware County actual diversion and disposal tons for 2020, as well as projected diversion and disposal tons after implementation of Phase 1 and Phase 2 of Zero Waste programs recommended for Delaware County.

[25] See U.S. Environmental Protection Agency at: AP-42: Compilation of Air Emissions Factors | US EPA.
[26] See: https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2023/2020_County_Recycling_Data.pdf,
[27] See: https://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/2022/PA_DEP_Report_FINAL_10-04-2022.pdf.

6. *Hauling Distances*

Truck travel distances from garbage collection routes to the midpoint between the Solid Waste Authority's two garbage transfer stations are based on the population center point (i.e., centroid) for Delaware County.[28] Distances to disposal facilities are measured from the midpoint between those two transfer stations.

Shipping distances to recycling markets are based on actual distances from that same Delaware County population center point to known markets. In cases where end markets or an end market are not disclosed by private businesses, an estimate was based on the Northeast Recycling Council (NERC) 2020 report Recycling Businesses in the NERC Region That Process or Use Post-Consumer "Blue Bin" Materials after MRF Processing.[29]

VI. LCA Results from Baseline Delaware County 2020 MSW Management Practices

Disposal of MSW generated in Delaware County in 2020 amounted to 467,770 tons. These disposal tons were almost entirely distributed among four disposal facilities. The proportion of those MSW tons received at each disposal facility is indicated in parentheses – two incinerators: Covanta Delaware Valley (81.3%) and Covanta Plymouth (1.1%); and two landfills: Fairless (17.4%) and Rolling Hills (0.3%).

Delaware County diversion of MSW from disposal that same year to recycling (including wood wastes used as industrial fuels displacing natural gas)[30] and composting totaled 218,599 tons, a diversion from disposal rate of 32%.

Tables A1 and A2, respectively, in Appendix A show LCA results for 2020 Delaware County disposal and diversion. These tables exhibit reference substance indicators for MEBCalc's nine human and environmental health impact categories for total tons disposed and total tons diverted, as well as on a per ton basis for disposal and diversion.[31]

Some of the specific human and environmental health impacts from MSW management choices in Delaware County in 2020 are worth mentioning separately due to their magnitude, especially for local human health impacts and global climate change effects. Their environmental economic value (EEV) benefits and costs are discussed in subsequent sections of this report. Here we focus on the reference substance emissions quantities that summarize the pollutants causing six of the nine human and environmental impacts assessed by MEBCalc: climate change, human health respiratory effects, human health effects from non-carcinogens, human health effects from carcinogens, waterways eutrophication, and ground level smog formation. These emissions quantities are reported separately for disposal and diversion for each of the six human and environmental health impacts discussed in the following subsections of this report. For emissions causing the remaining three impacts – acidification, aquatic ecosystems toxicity, and ozone depletion, reference substance impact indicator quantities are reported separately in Tables A1 and A2 of Appendix A.

---

[28] Census Bureau population centroids for Pennsylvania counties are listed in https://www2.census.gov/geo/docs/reference/cenpop2020/county/CenPop2020_Mean_CO42.txt. Website for converting population centroid latitude and longitude is at https://gps-coordinates.net/gps-coordinates-converter.

[29] See NERC website resource at: Recycling Businesses in NERC Region using Post Consumer Recycled Content Dec 20.pdf

[30] Burning wood wastes in place of natural gas to generate power or heat energy is sometimes referred to as "beneficial use" rather than recycling. This is because the human and environmental health impacts of wood combustion are worse than those impacts from natural gas combustion. At the same time some believe burning wood scraps for energy is a better use than disposal in a landfill or incinerator. Hence, the use of the term "beneficial use" as a descriptor for diversion of a material to a non-recycling use. This is based on the belief that, although the use has negative environmental impacts, it is a use that is somehow not a typical waste disposal method. See Morris, J., 2017: Recycle, Bury or Burn Wood Waste Biomass? LCA Answer Depends on Carbon Accounting, Emissions Controls, Displaced Fuels, and Impact Costs. *Journal of Industrial Ecology* 21(4) 844-856 (available at: (https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12469), for LCA results that illustrate the human and environmental health harms from burning wood instead of natural gas to generate electricity or provide heat energy.

[31] Note that incinerators in the appendices are sometimes denoted as LMWCs, the acronym for large municipal waste combustors, which is one of EPA's categories of incinerators for emissions standards.

1. Climate Change

A. Diversion

Diversion of 218,599 tons of MSW from disposal to recycling and composting in 2020 avoided emissions of 246,000 tons of carbon dioxide equivalents (eCO_2). This metric accounts for the climate impacts of collecting, MRF processing, composting, and hauling and shipping diverted materials. It also accounts for upstream manufacturing of recycled-content products, as well as displacement of virgin-content manufacturing of the same quantities and types of products.

In addition, for biogenic materials diverted to composting, the metric accounts for the upstream displacement of petroleum-based fertilizers and pesticides by soil amendments composted from diverted biogenic materials such as food scraps and yard maintenance debris. The total for avoided carbon dioxide equivalent emissions also includes incremental carbon sequestration due to healthier soils from organic soil supplements enhancing plant growth.

Displacement and avoidance of upstream resource extractions from ecosystems, as well as of virgin-content product and materials manufacturing, enabled by diversion of MSW materials from disposal to recycling and composting provide climate benefits. Collection, hauling, shipping, MRF processing, composting, and diversion-based upstream manufacturing impacts associated with diversion to recycling and composting increase climate changing carbon emissions. These negative upstream and downstream impacts totaled 68,000 tons eCO_2 for recycling and composting. The benefits of diversion amounted to 314,000 tons of eCO_2 avoided through displacement of virgin-content manufacturing by recycled-content products and displacement of petroleum-based fertilizers and pesticides by organic soil amendments, plus the use phase incremental carbon sequestration due to healthier soils resulting in enhanced plant growth.

According to EPA, avoidance of 246,000 tons of carbon dioxide equivalent carbon emissions in 2020 provides the same climate benefit as taking 48,000 gasoline-powered passenger vehicles off the road in that year, or reducing annual miles driven by gasoline-powered passenger cars by 554 million miles.[32]

B. Disposal

Disposal of 467,770 tons of MSW in 2020 at landfills and incinerators, including landfill disposal of ash from incineration of Delaware County MSW, has a carbon footprint of 391,000 tons eCO_2 emitted into the atmosphere and contributing to climate change. This metric is reduced by offsetting credits for displacement of fossil-natural-gas-based power by electricity generated at the incinerators, as well as offsetting credits for recovery and recycling of ferrous and non-ferrous metals from incinerator ash residues. Based on the same EPA GHG equivalence calculator, Delaware County's MSW 2020 disposal climate footprint is equivalent to annual carbon dioxide emissions from 76,000 gas-powered passenger vehicles driving 880 million miles.

2. Human Health Respiratory Particulate Emissions

Small particulates no greater than 2.5 microns in diameter, including the many but very light nanoparticles, cause increases in morbidity and reduced life spans for humans impacted by those emissions. Diversion in Delaware County in 2020 avoided emissions of 294 tons $ePM_{2.5}$, while disposal of MSW that year increased particulate emissions by 12 tons $ePM_{2.5}$. One should note that virtually all particulate emissions avoidance due to recycling and composting is a benefit for households and businesses located outside of Delaware County, while the particulate pollution health costs of 81% of Delaware County's MSW disposal at Covanta Delaware Valley impact local households and businesses, especially in Chester where that incinerator is located.

The disparity in absolute magnitudes between climate changing emissions of eCO_2 and human respiratory disease-causing emissions of $ePM_{2.5}$ may seem to imply that particulate pollution is not a significant issue for Delaware County

[32] U.S. Environmental Protection Agency, Greenhouse Gas Equivalencies Calculator, available at https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

locally. However, particulate emissions have severe acute and long-term medical health effects on those living within the fallout zones of particulate pollutant emissions. The discussion and results for monetization of human health impacts due to respiratory and toxic pollutant emissions in subsequent sections of this report will provide estimates for the human health costs of respiratory and toxic emissions as compared to the environmental health costs of carbon emissions. Furthermore, human health costs of particulate and toxic emissions per ton of pollution for disposal facilities tend to be concentrated locally and occur in the near term, compared to the more globally dispersed and long-term environmental health costs of carbon emissions.

3. Human Health Non-Carcinogenic and Carcinogenic Toxic Emissions

Diversion in 2020 resulted in avoidance of both non-carcinogenic and carcinogenic toxics due to upstream virgin-content materials and products displacements. The specifics are 305,000 tons of toluene equivalent (eT) non-carcinogenic toxic emissions and 465 tons of benzene equivalent (eB) carcinogenic emissions avoided due to diversion programs. Upstream avoidance is greater than the pollution from local collection and management facilities for recyclables and compostables. Yet, as indicated for particulate pollution, the human health benefits from diversion are realized in many cases far from Delaware County, whereas the human health costs of MSW recycling and composting collection and processing activities occur in Delaware County.

Emissions of human health toxics associated with MSW disposal amounted to 47,200 tons eT and 99 tons eB for non-carcinogens and carcinogens, respectively. Due to the reliance on the Covanta Delaware Valley incinerator for disposal of 81% of garbage generated in Delaware County, the vast majority of the human health impacts of garbage management in Delaware County falls on Delaware County residents, especially those living in the fallout zone of pollution released through the Covanta Delaware Valley incinerator's smoke stack in Chester.

4. Eutrophication Emissions Impacts on Waterways

Diversion of Delaware County MSW provided a waterways nutrification avoidance of 3,000 tons of nitrogen equivalents, compared to emissions from MSW disposal amounting to 16 tons nitrogen equivalents (eN). As is the case for all nine human and environmental health impacts assessed by MEBCalc, these estimates for diversion and disposal include all emissions associated with collection, transportation, processing, and disposal, including emission offsets for fossil-gas powered electricity generation displaced on the grid by Covanta Delaware Valley and Covanta Plymouth electricity generation, as well as offsets from recycling of metals recovered from ash residues generated by incineration of Delaware County MSW at both incinerators. For diversion, they also include the net benefits of recycled-content over virgin-content upstream manufacturing, as well as the use phase benefits of lower nutrient runoffs for compost-based soil amendments and incremental carbon sequestration from healthier soils.

5. Ground Level Smog Formation

Diversion avoided ground level smog formation from management of 2020 Delaware County MSW for 13,700 tons of ozone equivalents (eO_3). Disposal exacerbated ground level smog by 4,800 tons eO_3. Benefits from avoidance of pollution impacts due to diversion mostly occur elsewhere than in Delaware County. Costs of diverted materials collection and processing activities and most disposal impacts occur locally. The exacerbation of ground level smog formation in Delaware County is likely to fall especially on households and businesses located in and around the environs of the Covanta Delaware Valley incinerator's smoke stack.

VII. Monetizing Physical Emissions Data to Estimate & Summarize Damage Costs for the Nine Impacts

This section's discussion and the following section's graphs illustrate how environmental economic values (EEVs), estimated by monetizing costs for the nine physical human and environmental health reference substance impacts from pollutant emissions, simplify comparisons between diversion and disposal for managing Delaware County discards. Otherwise, the physical quantity estimates themselves for the nine pollution impacts are so disparate in absolute physical quantities and impact severities that they defy readily understandable comparisons of relative importance for physical pollution increases or decreases for those nine impacts.

Another reason for monetizing human and environmental health impacts is to provide dollar costs for pollution impacts that can be compared to solid waste management system accounting revenues and costs. This provides a metric for human and environmental health impact costs of pollution that may help in the ongoing debate about how to balance pocketbook costs, pollution costs, environmental preservation, and conservation costs.

An important aspect of this need for balance arises because facilities, activities and other sources producing pollution may not have to pay for some or all of the damages caused by their releases of pollutants to the environment. In that case, the costs for damages will be reflected in:

- Higher health care costs for humans impacted by those pollutants
- Lower property values
- Lower agricultural productivity
- Damages to wildlife habitats
- Lower plant and tree growth
- Other dis-amenities in the fallout zones of pollutant releases imposed on the more-than-just-human entities within Earth's planetary ecosystems.

From the perspective of economics, the problem for a free-markets-based economy is that, if those producing pollution associated with a good or service do not pay full costs for their pollution, that good or service most of the time will be sold at a price that does not cover these human and environmental health damage costs. That, in turn, may cause more of society's resources to flow toward production and consumption of this good or service than would be the case if the price for that good or service were higher due to inclusion of these damage costs.

One might regard these situations as free disposal of pollutants to air, water and land. Economists refer to these damages as external diseconomies or externalized costs. Research on externalized economic damage costs from releases of pollutants to the environment leads to our ability to assign externality costs, also known as impact monetization factors or environmental economic values (EEVs), to the reference substances for the nine human and environmental health impacts assessed by MEBCalc.

Table 1 lists these damage costs per ton of reference substance emitted for each of MEBCalc's nine human and environmental health impacts. These damage costs are based on more than 30 scientific studies reviewed by Sound Resource Management Group in a 2019-20 study and report for Oregon Department of Environmental Quality (DEQ) and Oregon Metro (Metro).[33]

[33] Morris, J., *Economic Damage Costs for Nine Human Health and Environmental Impacts*, prepared for Oregon Department of Environmental Quality and Oregon Metro, July 2020.

Table 1: Reference Substance Damage Costs Per Ton for Each of the Nine Human & Environmental Health Impacts

Impact Category (Reference Substance)	Damage Costs (2021 $) Per Ton of Reference Substance
Climate Change (CO_2)	$204
Human Health:	
Respiratory Effects from Particulates ($PM_{2.5}$)	$583,449
Non-Carcinogenic Effects from Toxics (T)	$330
Carcinogenic Effects from Toxics (B)	$2,360
Waterways Eutrophication (N)	$23,995
Acidification (SO_2)	$395
Aquatic Ecosystems Toxicity (2,4-D)	$4,021
Ozone Layer Depletion (CFC-11)	$54,673
Ground Level Smog Formation (O_3)	$235

A summary of research for SRMG's report to DEQ and Metro on damage costs follows:

- ***Climate Change*** – Integrated assessment models (IAMs) are used by research agencies, such as the U.S. Interagency Working Group on the Social Cost of Carbon (IWGSCC) and economists including William Nordhaus of Yale University, to estimate economic damage costs from climate change. IAMs, such as the dynamic integrated climate-economy (DICE) model developed by Nordhaus, assess current year carbon emissions and the damages caused by those current year emissions for all future years through at least 2300. This long assessment timeline is because some GHGs, e.g., carbon dioxide, released in the current year remain in the atmosphere for hundreds of years. Current, future and far-future damage costs from GHG emissions in the present are typically stated as present value dollar costs per metric ton of carbon dioxide emissions in the current year. These estimates for a given year of carbon emissions are often called the social cost of carbon (SCC) for that year.

  Long lasting climate impacts from current GHG emissions raise the problem of how to compare climate change damages in the future against the costs of lowering GHG emissions in the present. Economists and others use discount rates to measure the present value of future damages to compare against the current cost of GHG emissions reductions.

  Estimating an appropriate discount rate involves making judgments or having estimates on time preference for income now versus the future, how those preferences change as income grows or declines, expected growth rates for the economy over extended future years, and valuations of probabilities for drastic climate impacts from current year carbon emission levels.

  SCC estimates at any given discount rate have tended to increase since initial studies that estimated them. This is because IAMs have become more accurate and comprehensive, and because of the lack of sufficient actions to limit climate change by countries around the world as yet. The increasing accuracy of IAMs is associated in part with observed data indicating that some effects of climate change – such as the collapse of polar-region ice

sheets and glaciers – are occurring faster and with greater intensity than earlier models predicted. Thus, additional years of observation have persuaded scientists to recalibrate IAMs for increasing damage costs.

- ***Human Health Respiratory Effects from Particulates*** – There are few comprehensive peer-reviewed studies on human health damage costs from emissions of particulates to the atmosphere. An EPA technical support document (TSD) published in 2013 is the most comprehensive and robust of studies reviewed.[34] That reference incorporates U.S. geographic-region-specific damage cost estimates for 17 economic/industrial sectors for the human respiratory health cost of direct PM2.5 emissions.[35] These EPA data enabled SRMG to calculate a 17-sector weighted average cost, using as weights the direct fine particulate emissions from each of those sectors.

  Costs to human health per ton of fine particulate emissions is high for several reasons – (1) fine and ultrafine particulates are very small and light, so that a ton of particulates may be widely dispersed and have serious health impacts for a large population, (2) it doesn't take much particulate matter to have serious health consequences when inhaled, and (3) particulate emissions are widely dispersed due to their generation from combustion of various materials and fuels by sources providing heat, energy and/or transportation services.

  Because the impacts of particulate emissions affect human health in future years as well as the current year, there are issues regarding the ethics of discounting even near-term future human health costs, just as there are for long-term climate change economic damages from current GHG releases. Furthermore, as the economy grows and population increases, the number of impacted people and the fine particulates they breathe both go up. Hence, what seems a very high damage cost for particulates compared with damage costs for the other eight impacts could still underestimate the human health damages from current year particulate emissions.

- ***Human Health Non-Carcinogenic Effects from Toxic Pollutants*** – Most references for non-cancer human health impacts base their cost estimates on mercury emissions to air, some of which deposit in water. Once in water, microbes convert mercury to methylmercury, making it fat soluble, which works its way up the food chain to contaminate fish species that are consumed by people. Hence, human exposures can occur both directly from air emissions and indirectly from the cascading effect of air emission deposits on waterways.

  Mercury impacts on human health are both neurological and cardiovascular. The latter is not as well studied, so the estimates of mercury's cardiovascular impacts are more uncertain. There are also uncertainties in health impact estimates that arise from observed mercury dose-health response data. Observations can measure health responses only down to the lowest level of observed doses. Hence, when extrapolating a dose-response relationship to an entire population exposed to mercury emissions, one must decide whether to project observed dose-response relationships further down to low and very low doses below observed dose levels. The estimate for human non-carcinogenic toxicity cost shown in Table 1 provides a balance between the low cost and more certain neurological health effects and the much higher cost but more uncertain cardiovascular effects of mercury, as well as between the threshold versus no threshold effects of mercury exposure.

- ***Human Health Carcinogenic Effects from Toxic Pollutants*** – Several studies reviewed for cancer damage costs were focused on heavy metals. Some heavy metals have both carcinogenic and non-carcinogenic impacts, and reviewed studies did not always distinguish between these two impacts when estimating human health costs.

[34] U.S. Environmental Protection Agency (EPA), *Technical Support Document: Estimating the Benefit Per Ton of Reducing PM2.5 and PM2.5 Precursors from 17 Sectors,* January 2013.

[35] Indirect particulate emissions are caused by gaseous emissions of pollutants such as nitrogen oxides (NO_x) and sulfur dioxide (SO_2) that react with other compounds in the atmosphere to form particulate matter. Such gaseous emissions are often termed particulate precursors.

It is also worth noting the substantial increase in carcinogenic damage costs for arsenic and cadmium between estimates published in 2000 and estimates published in 2016. Both studies had the same scientist as one of the two co-authors for each study. This is another example of the tendency for damage costs for environmental impacts to increase over time due to better and more comprehensive emissions data, better modeling of dispersion and exposure from emissions sources to impacted populations, better data on health effects of exposure, and economic and demographic growth that tend to increase fugitive emissions quantities and numbers of people exposed to emissions. To reflect this uptrend in cost estimates, The Table 1 2021-dollar figure for benzene damage costs from cancers uses the midpoint between the sample mean and the upper end of a 90% confidence interval for estimates given in studies reviewed for the Oregon DEQ and Metro project.

- ***Waterways Eutrophication*** – Damage costs for deposition of nitrogen in surface waters depend on costs for, among other effects, algae blooms in freshwaters or coastal waters from nitrogen loadings to surface waters either from direct emissions of nitrogen to water or of cascading nitrogen emissions to water from releases to air or land. Algae blooms and other impacts of nitrogen loadings can cause fisheries decline due to eutrophication of surface waters. An example is the annual dead zone in the Gulf of Mexico at the mouth of the Mississippi River.

- ***Acidification*** – Sulfur dioxide (SO_2) emissions were one target of the 1970 Clean Air Act (CAA), and more especially of the Acid Rain Program established under Title IV of the CAA Amendments of 1990. Under Title IV, EPA has regulated SO_2 emissions since 1993 using a cap-and-trade system of tradable emissions allowance permits, and facilitates annual auctions for those permits. EPA publishes the spot clearing price reached during those auctions.

  Average prices in the spot auctions have recently dropped below $1 per metric ton of SO_2 emissions compared with nearly $400/MT in earlier years. Causes for this decrease likely include:
  - The decline in demand for coal-fired power,
  - The Great Recession (2008-2009) which substantially reduced overall demand for energy in general,
  - The availability of cheap natural gas due to fracking technology and the consequent decline in costs of natural gas-fired power, and,
  - The continued growth of solar and wind power and their falling prices.

  The EPA auction spot clearing prices may represent abatement costs more closely than damage costs. Yet abatement costs also may reflect damage costs. Their decline may be indicative of a decrease in SO_2 emissions. At the same time, estimates in the reviewed scientific literature provide scant information on damage costs for SO_2 releases onto agriculture and forest lands. Considering the possibility of either decline or increase in future damage costs for sulfur dioxide, the Table 1 estimate reflects the midpoint of the low and high ends of a 65% confidence interval for the sample mean of auction prices (excluding the high average auction prices during 2001-2010). The high end may help account for the lack of estimates in much of the literature for damage costs from forestry and agriculture impacts of SO_2 emissions.[36]

[36] A 65% confidence interval around the sample mean provides the low- and high-end costs for those environmental impact categories where there appear to be trends in emissions and damage costs that in future years could move in either direction from the sample mean. In order to maintain some similarity to the 0.65 probability width of those 65% confidence intervals, for some impact categories SRMG used the upper end of a 90% confidence interval to stretch the probability width to 0.45 for an interval stretching from the sample mean to the high-end cost calculated using the upper end for a 90% confidence interval. The midpoint between the reviewed studies' sample mean and the upper end of a 90% confidence interval for that sample mean provides damage costs for impact categories where there appears to be a substantial likelihood of continuing increases in damage costs, and little probability of decreases.

- ***Aquatic Ecosystems Toxicity*** – The Table 1 estimate for aquatic ecosystem toxicity damages from 2,4-D deposition on freshwater represents the midpoint between low and high ends of a 65% confidence interval about the sample mean for estimates in reviewed studies. With very few studies in this sample, the 65% confidence interval may mitigate against underestimating or overestimating aquatic toxicity impacts, while also providing mitigation against the lack of data on aquatic ecosystem costs from pollutant releases.

- ***Ozone Layer Depletion*** – Only four studies were found that provide damage costs for stratospheric ozone layer depletion. Two are based on the same source. The highest estimate is based on politically developed ecotaxes in Sweden. Hence, the midpoint of the range between the 65% confidence interval low end and the sample average may prevent overestimating ozone layer depletion impact costs, while also recognizing the lack of data on ozone layer depletion costs from ozone depleting pollutant releases.

- ***Ground Level Smog Formation*** – The damage cost estimate for ozone in Table 1 is the midpoint between the mean of reviewed studies and the upper end of a 65% confidence interval. The prevalence of NO_x emissions in some geographic areas combined with the likelihood of higher temperatures and sunny skies during certain weeks or months of the year as our climate warms justifies using the high end of the 65% confidence interval.

VIII. LCA Monetization Results for the Nine Human and Environmental Health Impacts

In addition to physical quantity impacts for reference substances, Tables A1 and A2 in Appendix A provide monetized total and per ton LCA damage benefits and costs. Benefits in Tables A1 and A2 are displayed as positive values. Damage cost increases are displayed as negative values. These values are presented in 2021 dollars.

One of the advantages of monetizing physical impacts is that monetized results for each of the nine impacts can be added together to produce an overall environmental economic value (EEV) benefit/(cost) score for 2020 diversion and disposal. Figure 1 graphically displays EEV totals (millions of 2021$) for Delaware County 2020 diversion and disposal from the nine human and environmental health impacts.

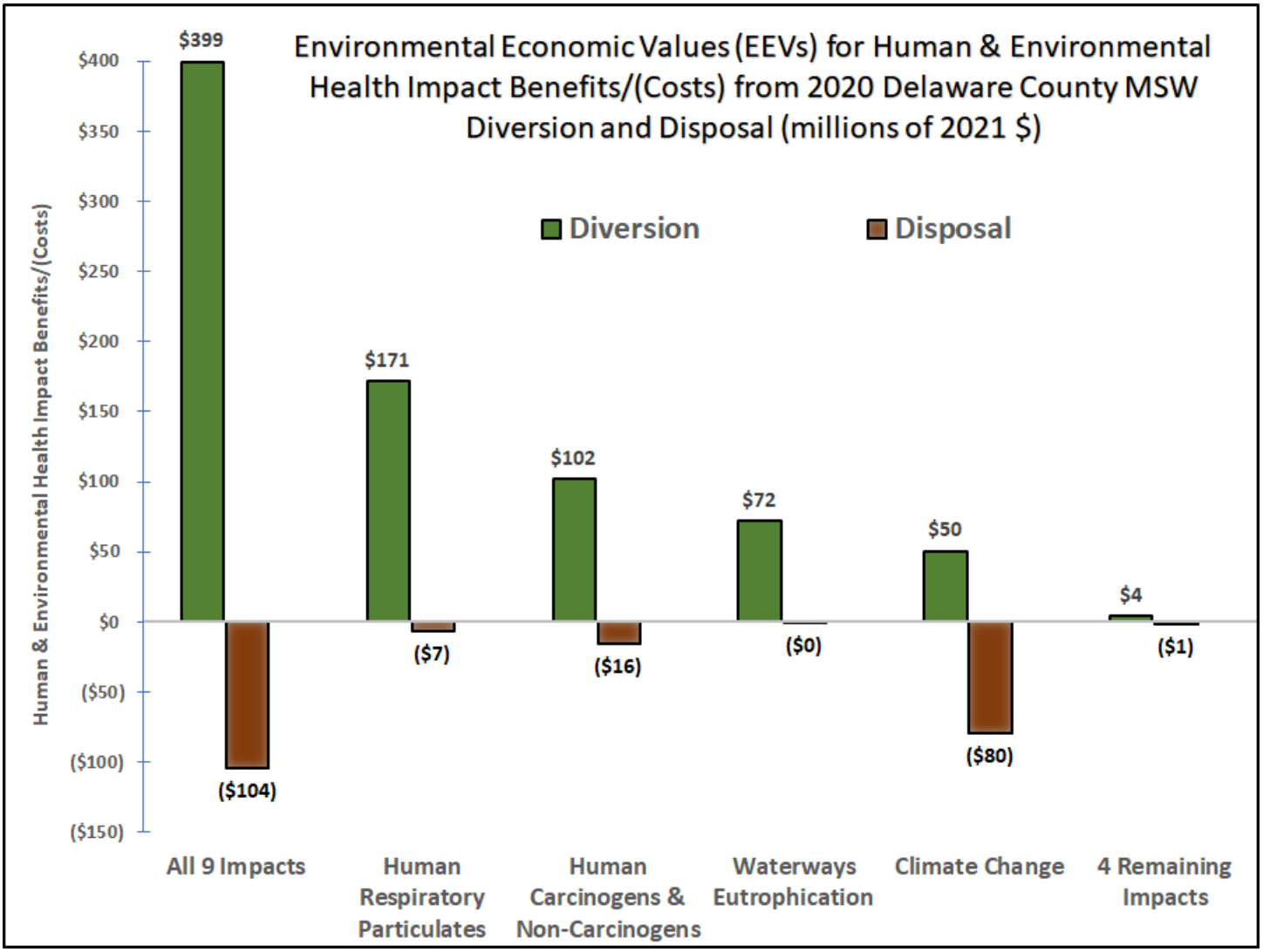
Figure 1 indicates that diversion avoids a substantial amount of EEV costs for human and environmental health emissions by substituting upstream production using diverted materials for upstream production based on extracting virgin resources from ecosystems. The margin between EEV costs from using diverted materials versus EEV costs from using virgin resources outweighs damage costs for collection, transfer and hauling/shipping activities, and composting or material recovery facility (MRF) processing of diverted MSW materials. The net human and environmental health monetized benefits of diverting 2020 MSW in Delaware County to recycling and composting total $399 million.

By contrast Delaware County MSW disposal has substantial human and environmental health EEV costs. These costs for 2020 total $104 million (2021 $), as indicated on Figure 1.

In addition to total benefits and costs for diversion and disposal, Figure 1 also exhibits EEV diversion and disposal details for human health respiratory, human health non-carcinogenic plus carcinogenic toxicity, waterways eutrophication, and climate change. These details show that the same preferential relationship for diversion over disposal holds for these separate impacts. Furthermore, Tables A1 and A2 in Appendix A exhibit the same preferential outcomes for diversion versus disposal for acidification, aquatic ecosystems toxicity, ozone depletion, and ground level smog formation. In other words, diversion has better outcomes in total, and for all nine separate human and environmental health impacts, versus disposal for managing Delaware County MSW in 2020.

Furthermore, the only impact for which diversion EEV benefits are less than EEV disposal costs is climate change. There the $50 million in EEV benefits from diversion are outweighed by $80 million in EEV costs for disposal. Diversion EEV benefits in total exceeds disposal's overall EEV costs by $296 million. This despite Delaware County MSW disposal in 2020 totaling 467,770 tons, more than twice times as much as 2020 diversion of 218,599 tons.

Figure 1: EEVs for Benefits/(Costs) of All Nine Impacts and Separate EEVs for Climate Change, Human Respiratory Particulates, Human Carcinogens + Non-Carcinogens, Waterways Eutrophication, & the Remaining Four Impacts



However, these totals for human and environmental impact net monetized benefits from diversion and monetized costs for disposal don't exactly illuminate many important aspects of the story regarding human and environmental health impacts from choices made by Delaware County in managing MSW in 2020. The next section delves more deeply into LCA results by dissecting and discussing local versus global human and environmental health impacts of MSW management outcomes for Delaware County during 2020.

IX. Comparison of EEVs for Incineration vs. Landfilling for Disposal of Delaware County MSW

Table A3 in Appendix A exhibits human and environmental health costs per ton of Delaware County MSW disposal in 2020 for the Covanta Delaware Valley incinerator and for the Rolling Hills Landfill. EEV costs shown in Table A3 include impacts from MSW hauling from transfer stations to these disposal facilities, hauling of incinerator ash from Covanta Delaware Valley to landfill disposal, ash landfilling, disposal facility operations, and impact offsets for electricity generation from MSW incineration and metals recycling from combustion ash. That table indicates that the net human and environmental health costs total $234 per ton of MSW disposal at the Covanta Delaware Valley incinerator versus $131 per ton of MSW disposal at the Rolling Hills Landfill. For both disposal facilities, the costs for climate change per ton of MSW disposal account for the largest share of their human and environmental health impact EEV costs.

Figure 2: Stacked EEVs for Human and Environmental Health Costs Per Ton of 2020 MSW Hauling and Disposal: Covanta Delaware Valley Incinerator vs. Rolling Hills Landfill exhibits the disparity in EEV costs (in 2021 dollars) between incineration and landfilling for Delaware County in 2020. Covanta Delaware Valley incineration's total EEV cost, shown on the stacked bar labeled Covanta Delaware Valley in Figure 2, was $234 per ton. This total EEV cost for MSW disposal is 78% higher than Rolling Hills Landfill's total EEV cost per ton of $131 for Delaware County MSW disposal, shown on the stacked bar labeled Rolling Hills (LCA 100) on Figure 2.

The stacked bars for EEV costs indicate that global climate change costs account for 74% of total human and environmental health economic costs for Covanta Delaware Valley incineration, compared with 96% for Rolling Hills Landfill. Yet Rolling Hills Landfill's climate cost itself at $126 per ton is 27% lower than the climate cost of $172 per ton for MSW disposal at the Covanta Delaware Valley incinerator.

The remaining eight human and environmental health EEV costs total $61 per ton of MSW disposal at Covanta Delaware Valley incinerator and $5 per ton of MSW disposal at Rolling Hills Landfill. In other words, Rolling Hills EEV cost for the eight non-climate changing human and environmental health impacts is 91% lower than Covanta Delaware Valley EEV cost.

Another way to look at these EEV cost disparities is that the Covanta Delaware Valley incinerator's global climate change impact EEV cost is 37% greater than the Rolling Hills Landfill's global climate change EEV cost. In addition, Covanta Delaware Valley's other eight human and environmental health EEV costs are 11.6 times higher than Rolling Hills Landfill's other eight EEV costs. That is, incineration is worse for the global climate than landfilling. Furthermore, the Covanta Delaware Valley incinerator in Chester is dramatically much worse than landfilling at Rolling Hills in terms of local impacts, most of which are for increased human health morbidities and mortalities from disposal of Delaware County MSW, even after accounting for longer hauling distances to reach the Rolling Hills Landfill.

1. *20-Year LCA Result for Rolling Hills Landfill*

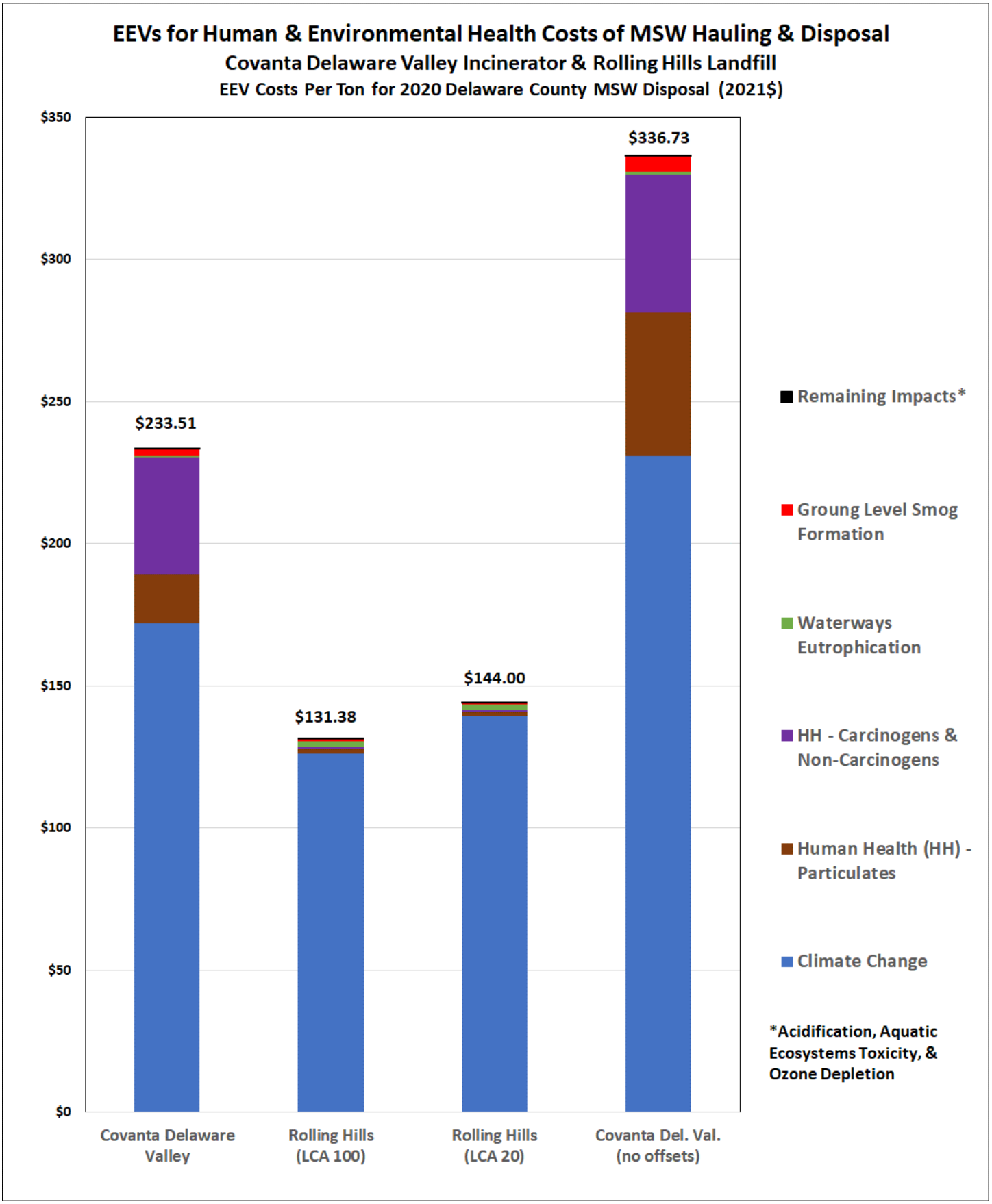
Figure 2 also displays LCA EEV cost results for Rolling Hills Landfill's 20-year impacts on the stacked bar labeled Rolling Hills (LCA 20). The 20-year human and environmental health LCA for Rolling Hills results in a 9.6% higher total EEV at $144 per ton landfilled compared against the 100-year LCA EEV of $131 per ton shown on Figure 2. This increase is due to an increase of more than $13 in EEV costs for Rolling Hills Landfill's 20-year climate impacts.

Total EEV for the other eight human and environmental health impacts decreased by less than a dollar. The fact that EEV costs decrease for the 20-year LCA is not surprising. All impact characterization factors for pollutants driving these eight impacts are the same for both 20- and 100-year LCAs. Landfills continue generating and then releasing non-captured (also known as, "fugitive") pollutants for many years beyond the 20 years following burial of wastes. Hence, cumulative impacts and their EEV costs are lower for the 20-year LCA for non-climate impacts versus the 100-year LCA.

However, the 10.6% increase of $13 for the climate EEV per ton landfilled could seem surprising since landfilled biogenic wastes have a 20-year global warming potential (GWP) characterization factor for methane emissions of 81.2 versus 27.9 for their 100-year GWP, a 2.9 multiple for climate impacts per ton of methane landfill emissions when evaluated over just the 20-year interval. Methane is the most concerning of near-term landfill pollutant releases because of its high generation amounts relative to most GHGs other than carbon dioxide, and the much higher climate impacts over 20 years for methane emissions to the atmosphere versus methane emission impacts over the longer 100-year time horizon.

One reason for the disparity in 20- versus 100-year climate impacts for methane is that, once released to the atmosphere, methane oxidizes to carbon dioxide within about 12 years. This tends to make its average climate impact over 100 years lower, depending on the time profile of methane emissions from the landfill.

Figure 2: Stacked EEVs for Human and Environmental Costs Per Ton of 2020 MSW Hauling and Disposal: Covanta Delaware Valley Incinerator vs. Rolling Hills Landfill



Moreover, the actual increase in climate impacts is driven by important additional factors. For one, not all carbon in MSW is biogenic. Some, for example carbon content in most plastics wastes, is of ancient fossil origin and does not biodegrade to methane under the anaerobic conditions of landfills. For Delaware County MSW in 2020, about 43% of carbon in materials in the County's disposal stream was fossil carbon.

In addition, methane generation inside a landfill sometimes comes quickly after burial of a material and sometimes quite slowly, as exhibited in Figure 3. Carbon in landfilled food scraps biodegrades to methane much faster than carbon in landfilled wood discards. In fact, carbon in landfilled wood biodegrades to methane so slowly that methane generation in a landfill in years 1 through 20 following burial of wood amounts to only about 10% of wood's potential lifetime methane generation. This contrasts with about 40% of lifetime potential generation over the first 100 years following burial. That means that the climate impact of methane releases from landfilled wood discards is less over 20 years than its climate impact over 100 years, assuming the same rate of capture versus non-capture for landfill gases over those years.[37]

Compare this LCA result for wood discards to LCA results for methane's generation over time from landfilled food scraps. As portrayed by Figure 3, about 85% of lifetime methane generation potential for food scraps occurs in the first 20 years following burial in an anaerobic landfill. 100% of potential methane generation occurs within less than 35 years. This makes the average potential climate impact of methane emissions from food scraps over 20 years almost 2.5 times greater than its average potential impact over 100 years.

Figure 3: Cumulative Percentage of Life Cycle Methane Generated Since Material Landfilled

Sources: U. S. Environmental Protection Agency, 2005. *Landfill Gas Emissions Model (LandGEM) Version 3.02 User's Guide.* EPA-600/R-05/047, EPA: Washington, DC; De La Cruz, F. B., Barlaz, M. A., 2010. Estimation of waste component-specific landfill decay rates using laboratory-scale decomposition data. *Environmental Science & Technology* 44 (12): 4722-4728; Morris, J., 2010. Bury or burn North American MSW? LCAs provide answers for climate impacts & carbon neutral power potential. *Environmental Science & Technology* 44 (20): 7944-7949; Wang, X., Padgett, J. M., De la Cruz, F. B., Barlaz, M. B., 2011. Wood biodegradation in laboratory-scale landfills. *Environmental Science & Technology* 45: 6864-6871, and Morris, J., 2017. Recycle, bury, or burn wood waste biomass? LCA answer depends on carbon accounting, emissions controls, displaced fuels, and impact costs. *Journal of Industrial Ecology*, 21 (4) 844-856.

[37] The 20-year methane release is only 25% pf the 100-year release. So even though the 20-year GWP for wood discards is almost 3 times the 100-year GWP, the impact over 20 years is less than 0.25 * 3 = 0.75 as a proportion of the 100-year impact.

Other materials such as mechanically pulped paper products like newsprint and catalog paper have landfill methane generation profiles that resemble the Figure 3 profile of wood discards. Leaves are more like wood than food in their landfill methane generation behavior. On the other hand, chemically pulped virgin-content paper products such as printing and writing papers, and the linerboard inside and outside parts of corrugated cardboard boxes behave more like food scraps than wood. This is because chemical pulping removes the lignin from tree wood. Lignin inhibits the generation of methane from mechanically-pulped paper and paperboard products. Based on composition of disposed MSW in 2020, Delaware County garbage has more biogenic materials that behave like wood scraps than it does materials behaving like food scraps.

Lastly, notice that the 20-year LCA total EEV cost for Rolling Hills is $144 per ton MSW landfilled, less than the EEV cost of $234 per ton MSW incinerated at Covanta Delaware Valley. Municipal waste combustion is not sensitive to whether emissions are evaluated by a 20-year or 100-year LCA. One reason is that Covanta Delaware Valley stack emissions all occur as MSW is fed into the incinerator in year one of the 20-year or 100-year LCA time frame. The other reason is that incinerator atmospheric emissions contain only trace amounts of short-run climate sensitive GHGs such as methane. Virtually all incinerator GHG emissions are carbon dioxide with its GWP characterization factor of 1 over both 20 and 100 years. Hence, there is no significant difference in climate impacts over a 20- or 100-year LCA time frame for the Covanta Delaware Valley incinerator.

Although not portrayed on Figure 2, we also calculated EEVs for Rolling Hills at landfill gas (LFG) capture rates less than the 70% capture rate used to evaluate landfill disposal for Delaware County MSW in Figures 1 and 2. More about those LCA monetization results in Subsection 3. First, we discuss local versus global impacts for the Covanta Delaware Valley incinerator in the next subsection to showcase implications of dividing Covanta Delaware Valley human and environmental health impacts into local versus global amounts.

2. LCA Results for Incineration Without Offsets for Natural Gas-Fueled Electricity and Metals Recycled from Ash

Figure 2 also shows LCA results for the Covanta Delaware Valley incinerator without emissions offsets (i.e., deductions) for fossil natural gas electricity generation displaced by electricity generated from burning Delaware County MSW, and without emissions avoidance credits from recycling metals recovered from that incinerator's bottom ash. These results are portrayed by the stacked bar labeled Covanta Del. Val. (no offsets).

One possible scenario yielding vastly reduced offsets is that solar and wind energy sources could at some point in the future become predominant generators of power for the Pennsylvania power grid. At the same time, Delaware County's implementation of Zero Waste programs could become highly effective at diverting metals from disposal. In that case, the no offsets scenario could approximate human and environmental health EEV costs for Covanta Delaware Valley.

Perhaps a more important reason for examining this no offsets scenario is that it facilitates dissecting local versus global pollution impacts from Covanta Delaware Valley stack emissions by eliminating offsets for upstream metals recycling and power offsets from displacing natural-gas-fueled electricity generation. These two pollution sources likely occur mostly outside of the City of Chester where Covanta Delaware Valley is located. Hence, avoiding these two outside of Delaware County pollution sources by burning MSW at Covanta Delaware Valley does not actually change human and environmental health costs in Chester and nearby areas of Delaware County.

There are two large natural gas power plants in nearby boroughs. There is no guarantee that one of these would not be the source for replacement power when Covanta Delaware Valley shuts down for either routine maintenance or unanticipated upsets. Whether one or both of these plants are used for meeting short-term peaking electricity demand on the Pennsylvania power grid, or whether such peaking power needs are met by more distant natural-gas-fired power plants that come on and off the grid on a regular basis, is unknown. At the same time, the no offsets scenario for Covanta Delaware Valley may approximate improvements in local pollution impacts in the future should Delaware County MSW no longer be sent to the Covanta Delaware Valley incinerator for disposal due to the typically lower human health impacts of natural-gas-fired power versus MSW-fired power.

As shown on Figure 2 Covanta Delaware Valley's human and environmental health impacts, absent offsets, have EEV costs totaling $337 per ton of Delaware County MSW burned at that facility. $99 per ton burned of this no offsets EEV total are costs for human health respiratory, non-carcinogenic toxicity and carcinogenic toxicity impacts that fall in large part on the health and lifespans of persons in households and workplaces in Delaware County, especially in the City of Chester where the Covanta Delaware Valley incinerator's smoke stack is located.

Human and environmental health costs for waterways eutrophication and smog formation amount to $6 per ton from Covanta Delaware Valley emissions. These impacts also are mostly incurred by residents and workers in Chester and nearby neighborhoods in Delaware County. Added to human health costs of $99 per ton, LCA and monetization results from this study suggest that local EEV costs from burning MSW at Covanta Delaware Valley amount to $105 per MSW ton disposed at that incinerator.

The majority of Delaware County MSW EEV impacts costs associated with the Covanta Delaware Valley incinerator are related to climate changing carbon emissions. Excluding offsets, climate change EEV cost is $231 per ton of MSW combusted at the Covanta Delaware Valley incinerator. EEV costs for stratospheric ozone depletion emissions from the Covanta Delaware Valley incinerator are not substantially different from zero. Climate change and ozone depletion together account for what might be termed the global impacts of emissions from disposal facilities used for Delaware County MSW. Keep in mind that this global EEV costs figure of $231 per ton ignores upstream climate change and ozone depletion benefits related to Covanta Delaware Valley's offsets for its electricity generation and metals recycling.

The above discussion supports using $105 per ton for incineration's local Delaware County human and environmental health EEV costs plus $231 per ton for global EEV costs. Acid rain, aquatic ecosystems toxicity, and rounding account for the missing dollar from the total $337 EEV cost for Covanta Delaware Valley absent any EEV credits for offsets.

Covanta Delaware Valley incinerated somewhat over 380,000 tons of Delaware County MSW in 2020. At $105 for local human and environmental costs per ton, local EEV costs for disposal at Covanta Delaware Valley imposed nearly $40 million of human and environmental health costs on Chester City and nearby residents and workers, of which nearly $38 million is human health costs.

It should also be mentioned that Delaware County MSW tons burned at the Covanta Delaware Valley incinerator made up less than 31% of tons incinerated at that incinerator in 2020. Hence, the total local human health impact costs of $38 million from burning Delaware County MSW at Covanta Delaware Valley underestimates total local human health costs by a factor larger than three. Local human health costs imposed on Chester City and environs for all wastes burned at Covanta Delaware Valley in 2020 total $123 million.

Importantly, there could be additional local impacts as a result of Covanta Delaware Valley's CO_2 emissions. There is peer-reviewed research suggesting that carbon dioxide emissions can form CO_2 domes over cities and other geographic areas having high levels of carbon emissions.[38] Such an occurrence would result in additional local human morbidity and mortalities from enhanced impacts of particulate emissions and smog formation. This means that local human health impacts of the Covanta Delaware Valley incinerator could well be higher than $123 million.

3. Rolling Hills Landfill EEV Cost Sensitivity to Landfill Gas (LFG) Capture Rate

As far as we are aware there has never been an actual tracking of landfill gas (LFG) generation and emissions to the atmosphere over 20 years or 100 years following burial of one year's MSW in a landfill. Most empirical data on landfill emissions comes from various methods for measuring those emissions on a spot check basis periodically over the years as new batches of MSW continue to be buried on top of previous batches. This makes it essentially impossible to track landfill emissions from any single year of MSW burial. Changing compositions and burial quantities for MSW over the years compound difficulties in tracking emissions from MSW buried in a particular year.

[38] Jacobson, Mark Z, 2010, Enhancement of Local Air Pollution by Urban CO_2 Domes. *Environmental Science & Technology 44(7) 94305-94020.*

Generation of landfill gases (LFGs), including methane, from biodegradation of biogenic carbon containing materials buried in the landfill has, to our knowledge, not been empirically measured at all. What has been done is to track and evaluate methane generation under laboratory simulations of landfill conditions for individual materials commonly found in MSW.[39] That research yields models of LFG methane generation over time such as those shown in Figure 3 for wood and food scraps. This research supports modeling of MSW LFG generation in software such as EPA's LandGEM model used in MEBCalc.[40]

For this LCA study we needed to know what the LFG capture rate was for just the particular cohort of Delaware County MSW disposal buried at Rolling Hills and Fairless landfills in 2020. Delaware County MSW disposal composition for 2020 was estimated from the Pennsylvania composition study completed in 2022. Carbon content for major biogenic materials is available in literature on MSW management. EPA's LandGEM model provided projections for LFG generation in each future year based on the composition of MSW landfilled in 2020.

However, we were still left with the problem of projecting the LFG capture rate in each future year for the 100-years following MSW burial in 2020. Hence, we assumed a capture rate of 70%, which is somewhat less than the 75% capture rate widely used in LCA studies on landfill emissions.

Figure 2 compared human and environmental health impact costs for Rolling Hills Landfill versus the Covanta Delaware Valley incinerator. The discussion in the previous subsection on EEV costs for these two disposal facilities also delved into human and environmental health impacts incurred locally in the environs around each disposal facility from its emissions of particulates, toxics and smog forming compounds. The costs for these local human and environmental health impacts can be distinguished to a reasonable extent from the more global human and environmental health costs from emissions of pollutants causing climate change and stratospheric ozone depletion. The discussion of results portrayed by Figure 2 along with the uncertainties regarding whether the actual LFG weighted average capture rate that will be achieved at Rolling Hills in the 100 years between 2020 and 2119 will approximate 70% mandates an analysis of Rolling Hills EEV costs for human and environmental health impacts at LFG capture rates lower than 70%.

Figure 4: Stacked EEVs for Human & Environmental Health Costs Per Ton of MSW Collection, Hauling and Disposal: Rolling Hills Landfill vs. Covanta Delaware Valley Incinerator addresses this uncertainty on Rolling Hills LFG capture rates. Figure 4 portrays Rolling Hills EEV costs at 70%, 30% and 0% capture rates, along with the Covanta Delaware Valley no offsets EEV costs scenario. The figure shows stacked bars of EEV costs for MSW collection, MSW and ash hauling, and disposal facility impacts, with the disposal facility human and environmental health impacts separated into mostly local impacts versus mostly global impacts.

What Figure 4 clearly shows is that regardless of LFG capture rate, landfilling at Rolling Hills is less costly for human and environmental health than incineration at Covanta Delaware Valley when looking at direct impacts without granting offsets for metals recycling and displaced electricity generation. This result is mainly due to the much greater local human health costs of incineration compared to those local human health costs for landfilling. Those local human health costs for incineration outweigh the greater climate changing costs of landfill methane and carbon dioxide emissions even when the landfill gas capture rate is zero.

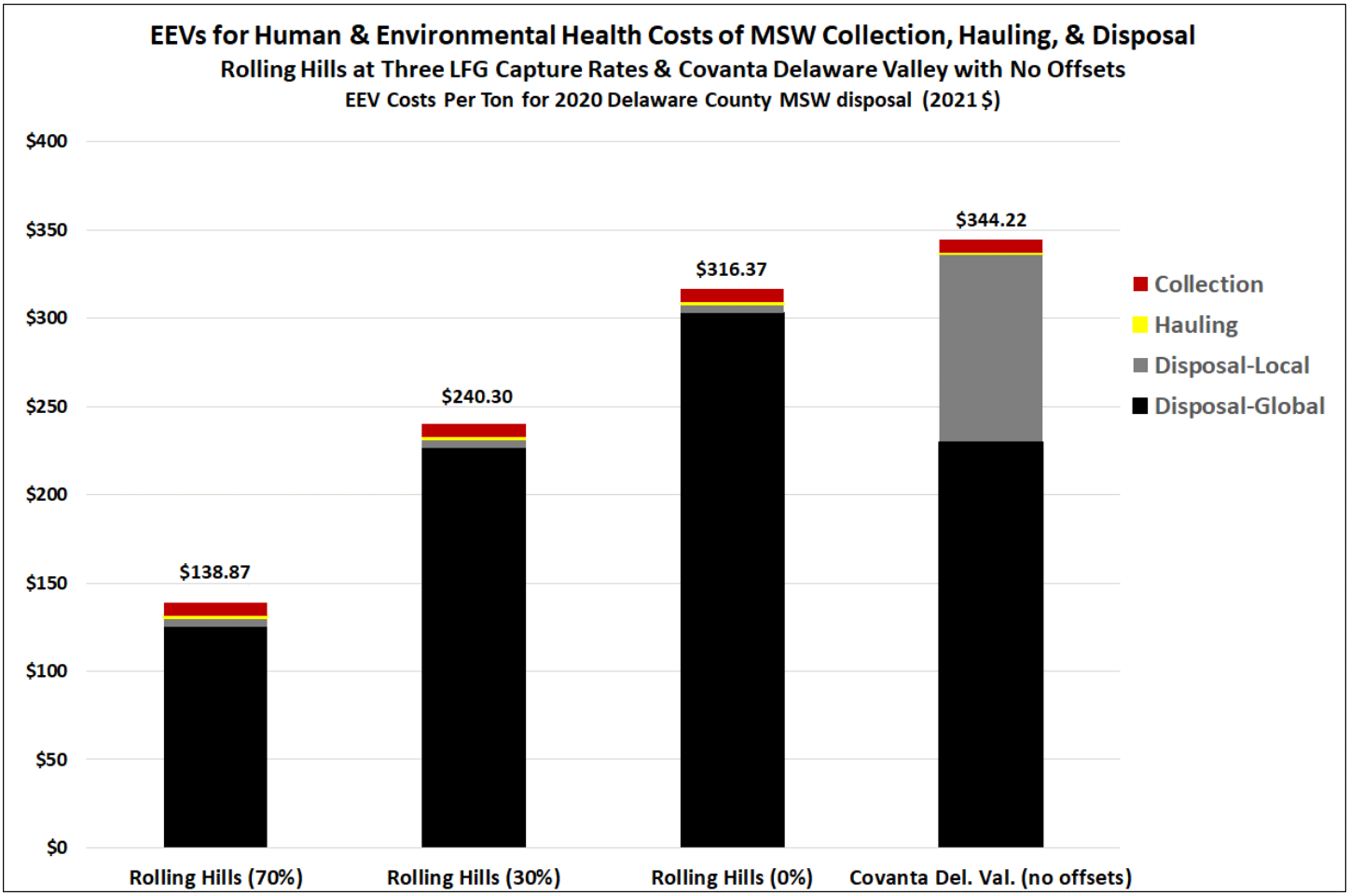
Adding Covanta Delaware Valley offsets back into the comparison, incineration's total EEV costs drop to $241 per ton compared to the $344 per ton shown on Figure 4 for Covanta Delaware Valley excluding those offsets.[41] Rolling Hills LFG capture rate needs to be at least 30% to reduce its total EEV costs to $240.

[39] De la Cruz, F. B., *et al*, 2010, *op. cit.*

[40] There has been recent peer-reviewed work measuring methane emissions from a new landfill without any LFG capture equipment in place for the first few years of MSW burial. For example, De la Cruz, F. B., *et al*, 2016, *op. cit.* suggests currently in-use models of LFG generation likely overestimate emissions during the first few years after initial burial.

[41] Note that the no offset per ton EEV cost for Covanta Delaware Valley shown in Figure 2 is $337. Figure 4 shows the higher cost of $344 because Figure 4 includes human and environmental health costs of $7.49 for MSW collection. These MSW collection costs are

Figure 4: Stacked EEVs for Human & Environmental Health Costs Per Ton for MSW Collection, Hauling and Disposal: Rolling Hills Landfill vs. Covanta Delaware Valley Incinerator



At 30% LFG capture, EEV landfilling costs for climate change, exceed climate costs for incineration. Rolling Hills LFG capture needs to be in the 50% neighborhood for its climate changing EEV costs to be lower than Covanta Delaware Valley's EEV climate costs that include offsets for electricity generation and metals recycling.

These differences between global and local human and environmental health impacts and between climate and human health impacts emphasize the importance of looking beyond climate change at other impacts from pollution emissions when evaluating incineration versus landfilling choices for disposal of MSW.

4. Comparison of Impact EEV Costs for Hauling MSW to Rolling Hills Landfill and Covanta Delaware Valley

There are concerns that shipping Delaware County MSW to an out-of-county landfill such as Rolling Hills Landfill for disposal would increase human and environmental health costs substantially versus continuing to use the Covanta Delaware Valley incinerator for disposal of most Delaware County MSW. However, studies on human and environmental health costs for managing MSW show that hauling/shipping amounts to a small fraction, typically less than 5%, of human and environmental health EEV costs for collecting, shipping and disposal of MSW.[42]

excluded from Figure 2 which portrayed just hauling and disposal EEV costs. They are included on Figure 4 to support the brief discussion on hauling costs in Subsection 4.

[42] See, for example: Morris, J., 2020, A triple win: Decreased trash generation, reduced costs & lower environmental impacts for Seattle, *Resource Recycling*, pp. 24-29; and Morris, J., 2005, Comparative LCAs for curbside recycling versus either landfilling or incineration with energy recovery. *International Journal of Life Cycle Assessment*, 10(4) 273-284.

Figure 4 confirms this general result specifically for disposal of Delaware County MSW at the Rolling Hills Landfill compared with disposal at the Covanta Delaware Valley incinerator plus transportation of ash to Rolling Hills Landfill. In fact, the EEV costs of human and environmental health impacts for hauling MSW by truck to Rolling Hills Landfill or Covanta Delaware Valley for disposal are 1% or less of total EEV costs for MSW collection, hauling and disposal, regardless of which facility is used for disposal. Hauling EEV costs for MSW disposal at Rolling Hills are $1.56 per ton compared with $0.76 per ton for hauling MSW to Covanta Delaware Valley. These estimates account for round-trip mileage by truck to Rolling Hills compared with the round trip to Covanta Delaware Valley plus the round trip for hauling ash from Covanta Delaware Valley to disposal at Rolling Hills Landfill.

The conclusion here is that, although hauling MSW by truck to a disposal facility has higher human and environmental health costs the further one transports MSW for disposal, the by far more important aspect of EEV costs is the emissions from disposal of MSW at a particular disposal facility. Figures 2 and 4 illustrate that Rolling Hills Landfill is the better human and environmental health choice for disposal of MSW despite the landfill being more than five times farther away for hauling MSW from Delaware County's transfer stations than the Covanta Delaware Valley incinerator.

X. LCA & Monetization Results for Delaware County's Recommended Zero Waste Management Programs

Tables B1 and B2 in Appendix B show LCA results for the recommended Zero Waste Plan for Delaware County disposal and diversion to recycling & composting, respectively. Following successful implementation of Zero Waste diversion and disposal programs for MSW generated in Delaware County, diversion from disposal to recycling and composting would total 522,126 tons. Source reduction from potential waste generation would total 51,613 tons. Disposal would be reduced from 467,700 tons in 2020, to 112,697 tons.

Potential municipal waste generation (including materials source reduced under the Zero Waste Plan as well as materials recycled and composted under that recommended plan) would remain about the same as in the 2020 baseline at 686,400 tons. However, actual discards requiring management by Delaware County Solid Waste Authority or private haulers would decrease to 634,800 tons. The County's diversion rate would increase to 82.2% for MSW actually generated in Delaware County.

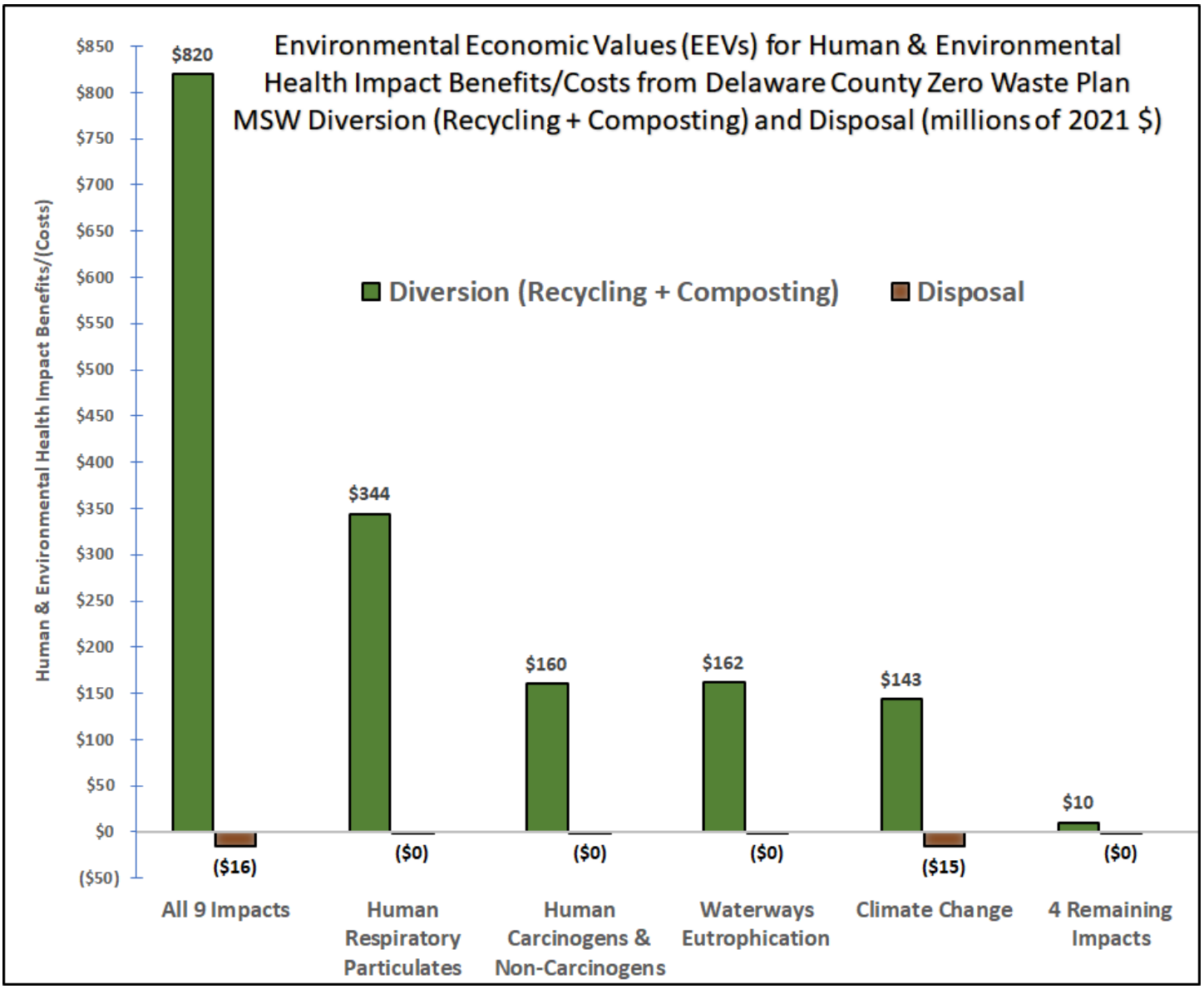
In addition, Tables B1 and B2 in Appendix B provide monetized total and per ton LCA damage benefits or costs. Benefits in Tables B1 and B2 are displayed as positive values. Damage costs are displayed as negative values. These values are presented in 2021 dollars

One of the advantages of monetizing physical impacts is that results for each of the nine impacts can be added together to produce an overall environmental economic value (EEV) benefit/(cost) score for diversion and disposal. Figure 5 graphically displays overall projected EEVs in millions of dollars for diversion and disposal from the nine human and environmental health impacts for Delaware County after full implementation of Phases 1 and 2 of Delaware County's Zero Waste Plan.

Figure 5 indicates that diversion avoids substantial human and environmental health emissions by substituting upstream production using diverted materials for upstream production based on extracting virgin resources form ecosystems. The margin between EEV costs from using diverted materials versus EEV costs from using virgin resources outweighs damage costs for collection, transfer and hauling/shipping activities, and composting or material recovery facility (MRF) processing of diverted MSW materials.

Figure 5 also exhibits the Zero Waste Plan's beneficial results for human health respiratory, human health non-carcinogenic plus carcinogenic toxicity, waterways eutrophication, and climate change. Tables B1 and B2 in Appendix B indicate that the same beneficial relationship for diversion over disposal also holds for acidification, aquatic ecosystems toxicity, ozone depletion, and ground level smog formation as summarized by the Figure 5 relationship for total EEVs for those four impacts.

Figure 5: EEVs for Zero Waste Plan Projected Benefits/(Costs) of All Nine Impacts and Separate EEVs for Climate Change, Human Respiratory Particulates, Human Carcinogens + Non-Carcinogens, Waterways Eutrophication, & the Remaining Four Impacts



Diversion of 522,126 tons of MSW from disposal to recycling and composting as projected under the Delaware County Zero Waste Plan would avoid emissions of almost 703,000 tons of carbon dioxide equivalents (eCO_2). This metric accounts for the climate impacts of collecting recyclables and compostables, MRF processing, composting, and hauling and shipping diverted materials. It also accounts for upstream manufacturing of recycled-content products, as well as displacement of virgin-content manufacturing of the same quantities and types of products. In addition, for biogenic materials diverted to composting, the metric accounts for the upstream displacement of petroleum-based fertilizers and pesticides by soil amendments composted from diverted biogenic materials such as food scraps and yard maintenance debris. The total for avoided carbon dioxide equivalent emissions also includes incremental carbon sequestration due to healthier soils from organic soil supplements enhancing plant growth.

According to EPA, avoidance of 703,000 tons of carbon dioxide equivalent carbon emissions provides the same climate benefit as taking 142,000 gasoline-powered passenger vehicles off the road each year following completion of the

Delaware County Zero Waste Plan, or reducing annual miles driven by gasoline-powered passenger cars by 1.6 billion miles.[43]

Under the Delaware County Zero Waste Plan, disposal of 112,697 tons of MSW at the Rolling Hills Landfill has a carbon footprint of 73,000 tons eCO_2 emitted into the atmosphere and contributing to climate change. Based on the same EPA GHG equivalence calculator, Delaware County's MSW ZW Plan projected disposal climate footprint is equivalent to annual carbon dioxide emissions from 15,000 gas-powered passenger vehicles driving 170 million miles.

[43] U.S. EPA, Greenhouse Gas Equivalencies Calculator, *op. cit.*

XI. APPENDIX A

Table A1: LCA RESULTS FOR 2020 BASELINE DELAWARE COUNTY DISPOSAL OF 467,770 TONS MSW (TOP) AND PER MSW TON (BOTTOM)

Life Cycle Assessment for 467,770 Tons MSW Disposal	Ten Indicators of 2020 Human & Environmental Health Benefits(+) / Costs(-) from Delco Disposal : Impact Tons and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-15,243	-0.38	-293.50	-0.19	-0.30	-10.51	-0.03	-0.0004	-262.43	($3,503,915)
Haul	-1,716	-0.07	-1.54	0.00	-0.10	-1.96	0.00	0.0000	-76.36	($412,348)
Disposal	-389,024	-25.12	-48,458.07	-101.97	-17.16	-172.77	0.56	-0.2069	-5,300.47	($112,034,683)
LMWCs Metals Recycling	15,038	13.79	1,586.05	3.03	1.63	89.85	0.05	0.0000	828.57	$11,912,831
LCA Impact Total	-390,945	-11.78	-47,167.06	-99.13	-15.93	-95.39	0.58	-0.2072	-4,810.70	($104,038,115)
EEV for Impact Total (2021 $)	($79,815,787)	($6,875,589)	($15,555,636)	($233,941)	($382,280)	($37,650)	$2,317	($11,328)	($1,128,221)	
EEVs (millions of 2021 $)	($79.8)	($6.9)	($15.6)	($0.2)	($0.4)	($0.0)	$0.0	($0.0)	($1.1)	($104.0)

Life Cycle Assessment Per Ton for MSW Disposal	Ten Indicators of 2020 Human & Environmental Health Benefits(+) / Costs(-) Per Ton Delaware County MSW Collected for Disposal Human & Environmental Health Impact Pounds and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-65.17	0.00	-1.25	0.00	0.00	-0.04	0.00	0.00	-1.12	($7.49)
Haul	-7.34	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.33	($0.88)
Disposal	-1,663.31	-0.11	-207.19	-0.44	-0.07	-0.74	0.00	0.00	-22.66	($239.51)
LMWCs Metals Recycling	64.30	0.06	6.78	0.01	0.01	0.38	0.00	0.00	3.54	$25.47
LCA Impact Per Ton Disposed	-1,671.53	-0.05	-201.67	-0.42	-0.07	-0.41	0.00	0.00	-20.57	($222.41)
EEVs Per Ton (2021 $)	($170.63)	($14.70)	($33.25)	($0.50)	($0.82)	($0.08)	$0.00	($0.02)	($2.41)	

Table A2: LCA RESULTS FOR 2020 BASELINE DELAWARE COUNTY DIVERSION OF 218,599 TONS MSW (TOP) AND PER MSW TON (BOTTOM)

Life Cycle Assessment for 218,599 Tons MSW Diversion	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) from 2020 Delco Diversion : Impact Tons and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-9,073	-0.23	-174.70	-0.11	-0.18	-6.26	-0.02	-0.0002	-156.20	($2,085,607)
Process	-58,119	-2.78	-69.89	-0.02	86.52	-100.15	-0.15	0.0000	-1,169.09	($11,746,283)
Ship	-582	-0.02	-0.52	0.00	-0.04	-0.66	0.00	0.0000	-25.91	($139,905)
Manufacture	313,957	296.83	305,404.20	465.20	2,918.88	1,711.72	16.63	-0.0002	15,011.56	$413,404,154
LCA Impact Total	246,183	293.81	305,159.10	465.06	3,005.19	1,604.65	16.47	-0.0005	13,660.36	$399,432,359
EEV for Impact Total (2021 $)	$50,261,082	$171,420,933	$100,641,074	$1,097,502	$72,108,528	$633,375	$66,214	-$25	$3,203,676	
EEVs (millions of 2021 $)	$50.3	$171.4	$100.6	$1.1	$72.1	$0.6	$0.1	$0.0	$3.2	$399.4

Life Cycle Assessment Per Ton for MSW Diversion	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) Per Ton Delaware County MSW Diverted in 2020 Human & Environmental Health Impact Pounds and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-83.01	0.00	-1.60	0.00	0.00	-0.06	0.00	0.00	-1.43	($9.54)
Process	-531.74	-0.03	-0.64	0.00	0.79	-0.92	0.00	0.00	-10.70	($53.73)
Ship	-5.33	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	-0.24	($0.64)
Manufacture	2,872.45	2.72	2,794.20	4.26	26.71	15.66	0.15	0.00	137.34	$1,891.15
LCA Impact Per Ton Diverted	2,252.38	2.69	2,791.95	4.25	27.49	14.68	0.15	0.00	124.98	$1,827.24
EEVs Per Ton (2021 $)	$229.92	$784.18	$460.39	$5.02	$329.87	$2.90	$0.30	($0.00)	$14.66	

Table A3: LCA RESULTS PER MSW TON FOR 2020 MSW DISPOSAL AT COVANTA DELAWARE VALLEY INCINERATOR AND ROLLING HILLS LANDFILL

LCA Results Per MSW Ton for LMWC and LF Used for Delaware County MSW Disposal	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) Per Ton of 2020 MSW Disposal at Delaware Valley LMWC and Rolling Hills LF Human & Environmental Health Impact Pounds and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health- Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Covanta Delaware Valley LMWC										
MSW & Ash Hauling	-6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	($0.76)
MSW & Ash Disposal	-1757.8	-0.1	-252.9	-0.5	-0.1	-0.8	0.0	0.0	-26.2	($263.68)
Metals Recycling	78.1	0.1	8.2	0.0	0.0	0.5	0.0	0.0	4.3	$30.93
LCA Impact Per Ton Disposed	-1686.1	-0.1	-244.7	-0.5	0.0	-0.4	0.0	0.0	-22.1	($233.51)
EEVs Per Ton (2021 $)	($172.12)	($17.24)	($40.35)	($0.59)	($0.54)	($0.08)	$0.01	$0.00	($2.60)	
Rolling Hills Landfill										
MSW Hauling	-12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	($1.52)
MSW Disposal	-1222.3	0.0	-5.3	-0.1	-0.2	-0.2	0.0	0.0	-4.7	($129.86)
LCA Impact Per Ton Disposed	-1,235.0	0.0	-5.3	-0.1	-0.2	-0.2	0.0	0.0	-5.3	($131.38)
EEVs Per Ton (2021 $)	($126.07)	($1.60)	($0.88)	($0.06)	($1.98)	($0.04)	($0.00)	($0.14)	($0.62)	

XII. APPENDIX B

TABLE B1 - LCA RESULTS FOR ZERO WASTE PLAN DISPOSAL OF 112,697 TONS MSW (TOP) AND PER MSW TON (BOTTOM)

Life Cycle Assesment for 112,697 Tons MSW Disposal	Ten Indicators of ZW Plan Human & Environmental Health Benefits(+) / Costs(-) from Delco Disposal : Impact Tons and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health- Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-3,672	-0.09	-70.71	-0.04	-0.07	-2.53	-0.01	0.00	-63.22	($844,174)
Haul	-714	-0.03	-0.64	0.00	-0.04	-0.81	0.00	0.00	-31.79	($171,683)
Disposal	-68,876	-0.28	-300.18	-2.94	-9.26	-9.97	0.00	-0.28	-264.31	($14,634,871)
LCA Impact Total	-73,263	-0.40	-371.54	-2.99	-9.38	-13.31	-0.01	-0.28	-359.33	($15,650,728)
EEV for Impact Total (2021 $)	($14,957,365)	($233,638)	($122,533)	($7,056)	($225,077)	($5,255)	($43)	($15,491)	($84,271)	
EEVs (millions of 2021 $)	($15.0)	($0.2)	($0.1)	($0.0)	($0.2)	($0.0)	($0.0)	($0.0)	($0.1)	($15.7)

Life Cycle Assessment Per Ton for MSW Disposal	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) Per Ton Delaware County MSW Collected Under Zero Waste Plan for Disposal Human & Environmental Health Impact Pounds and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health- Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-65.17	0.00	-1.25	0.00	0.00	-0.04	0.00	0.00	-1.12	($7.49)
Haul	-12.68	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.56	($1.52)
Disposal	-1,222.32	0.00	-5.33	-0.05	-0.16	-0.18	0.00	-0.01	-4.69	($129.86)
Totals Per Ton Disposed	-1,300.17	-0.01	-6.59	-0.05	-0.17	-0.24	0.00	-0.01	-6.38	($138.88)
EEVs Per Ton (2021 $)	($132.72)	($2.07)	($1.09)	($0.06)	($2.00)	($0.05)	($0.00)	($0.14)	($0.75)	

TABLE B2 - LCA RESULTS FOR ZERO WASTE PLAN DIVERSION OF 522,126 TONS (TOP) AND PER MSW TON (BOTTOM)

Life Cycle Assessment for 522,126 Tons MSW Diversion	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) for Delco ZW Plan Recycling + Composting : Impact Tons and EEVs									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-20,505	-0.51	-394.83	-0.25	-0.41	-14.14	-0.04	-0.0005	-353.04	($4,713,727)
Process	-158,131	-6.13	-193.98	-0.04	332.18	-216.71	-0.51	0.0000	-2,810.93	($28,704,002)
Ship	-1,850	-0.07	-1.66	0.00	-0.11	-2.11	0.00	0.0000	-82.34	($444,623)
Manufacture	883,335	596.63	476,969.84	1,268.74	6,416.50	4,233.31	38.26	0.0453	38,417.94	$853,542,150
LCA Impact Total	702,848	589.91	476,379.36	1,268.44	6,748.17	4,000.35	37.71	0.0448	35,171.63	$819,679,798
EEV for Impact Total (2021 $)	$143,494,252	$344,181,048	$157,109,293	$2,993,385	$161,920,164	$1,578,984	$151,647	$2,450	$8,248,575	
EEVs (millions of 2021 $)	$143.5	$344.2	$157.1	$3.0	$161.9	$1.6	$0.2	$0.0	$8.2	$819.7

Life Cycle Assessment Per Ton for MSW Diversion	Ten Indicators of Human & Environmental Health Benefits(+) / Costs(-) Per Ton for ZW Plan Recycling + Composting in Delaware County, PA Human & Environmental Health Impact Pounds and Environmental Economic Values (EEVs)									
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health-Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity	Ozone Depletion	Smog Formation	EEVs
MSW System Component	eCO_2	$ePM_{2.5}$	eToluene	eBenzene	eN	eSO_2	e2,4-D	eCFC-11	eO_3	2021 $
Collect	-78.55	0.00	-1.51	0.00	0.00	-0.05	0.00	0.00	-1.35	($9.03)
Process	-605.72	-0.02	-0.74	0.00	1.27	-0.83	0.00	0.00	-10.77	($54.98)
Ship	-7.09	0.00	-0.01	0.00	0.00	-0.01	0.00	0.00	-0.32	($0.85)
Manufacture	3,383.61	2.29	1,827.03	4.86	24.58	16.22	0.15	0.00	147.16	$1,634.74
LCA Impact Per Ton Diverted	2,692.25	2.26	1,824.77	4.86	25.85	15.32	0.14	0.00	134.72	$1,569.89
EEVs Per Ton (2021 $)	$274.83	$659.19	$300.90	$5.73	$310.12	$3.02	$0.29	$0.00	$15.80	

XIII. APPENDIX C

Table C1: Air Emission Factors for Covanta Delaware Valley and Covanta Plymouth Incinerators Used for Disposal of Delaware County MSW in 2020

Air Emissions (kilograms per metric ton MSW burned)		Covanta MSW Incinerator	
TRACI CAS#	***Pollutant Name***	***Delaware Valley***	***Plymouth***
7664417	ammonia	***	4.27E-03
7440382	arsenic	2.01E-06	9.47E-07
50328	benzo(a)pyrene*	9.22E-09	9.32E-07
7440417	beryllium	1.81E-07	***
7440439	cadmium	1.46E-06	2.39E-06
124389	carbon dioxide	1.22E+03	1.22E+03
630080	carbon monoxide	2.93E-01	1.53E-01
97440473	chromium (hexavalent)	1.81E-06	1.17E-05
1746016	dioxins/furans indexed as 2,3,7,8-TCDD TEQs**	1.28E-10	3.91E-10
VOC	hydrocarbons (NMOC when methane reported separately)	7.18E-03	7.62E-03
7647010	hydrochloric acid (aka hydrogen chloride)	8.34E-03	1.71E-01
7439921	lead	1.13E-05	1.69E-05
7439976	mercury	1.67E-05	5.68E-06
74828	methane	2.74E-01	3.21E-01
7440020	nickel	1.77E-05	1.27E-05
NOX	nitrogen oxides (NO_x)	9.23E-01	1.48E+00
10024972	nitrous oxide (N_2O)	3.60E-02	4.22E-02
PM2.5	$PM_{2.5}$ (includes condensable PM)	6.38E-02	2.63E-02
PM10	PM_{10} (excludes condensable and $PM_{2.5}$ filterable particulates)	4.09E-02	8.08E-03
7446095	sulfur dioxide	1.20E-01	1.24E-01
	*Polycyclic aromatic hydrocarbons (PAHs) indexed as benzo(a)pyrene emissions		
	**2,3,7,8-TCDD TEQs = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxicity equivalents		
	***No emissions data reported in PA DEP database		

XIV. APPENDIX D

Table D1: Diversion Materials Composition for 2020 Baseline and Post Zero Waste Programs Implementation

	Baseline Diversion Composition (Tons)			Zero Waste Diversion Composition (Tons)		
	Residential	Commercial	Combined	Residential	Commercial	Combined
Material						
Corrugated Cardboard (OCC)	8,179	24,876	**33,055**	16,264	45,893	**62,157**
Newspaper (ONP)	177	29	**206**	1,839	744	**2,583**
Office Paper	188	2,425	**2,613**	811	3,318	**4,130**
Mixed Paper	12,988	8,517	**21,505**	45,525	37,623	**83,148**
Textiles	123	9	**132**	9,154	2,498	**11,652**
Plastics #1 (PET)	1,069	589	**1,658**	4,131	2,293	**6,424**
Plastics #2 (HDPE)	878	474	**1,352**	2,153	1,758	**3,910**
Plastics #5 (PP)	38	31	**69**	38	31	**69**
Plastics #4 (LDPE) Film	0	160	**160**	6,281	14,585	**20,866**
Glass Containers	4,660	2,382	**7,042**	9,263	4,380	**13,643**
Aluminum	250	433	**684**	2,376	1,560	**3,936**
Copper/Other Non-ferrous	4	13,476	**13,480**	1,279	14,291	**15,569**
Tinned Cans	808	430	**1,238**	1,894	1,571	**3,465**
Other Ferrous	241	80,181	**80,422**	3,641	83,439	**87,081**
Electronics	0	0	**0**	826	407	**1,233**
Carpet	0		**0**	3,188	2,962	**6,150**
Household Batteries – Alkaline	0	0	**0**	72	0	**72**
Gypsum Wallboard	0		**0**	1,014	871	**1,886**
Masonry/Asphalt/Concrete	0	84	**84**	906	675	**1,581**
Asphalt Roofing Shingles	0	0	**0**	338	1,303	**1,642**
Wood Waste	122	24,084	**24,205**	4,121	37,117	**41,238**
Yard Debris	22,763	4,351	**27,114**	39,088	9,696	**48,784**
Food Scraps	0	3,580	**3,580**	33,597	53,624	**87,220**
Disposable Diapers	0	0	**0**	2,355	1,140	**3,495**
Animal By-products	0	0	**0**	2,801	326	**3,127**
Durable Plastic Products	0	0	**0**	2,000	1,991	**3,991**
Single-Use Food Service	0	0	**0**	6,004	10,316	**16,320**
Flat/Other Non-container Glass	0	0	**0**	1,739	591	**2,329**
Painted Wood	0	0	**0**	8,887	3,258	**12,145**
Mixed Construction & Demolition Debris	0	0	**0**	3,973	2,614	**6,586**
Sand/Soil/Dirt	0	0	**0**	1,328	1,629	**2,957**
Miscellaneous Organics	0	0	**0**	1,681	1,303	**2,984**
Miscellaneous Inorganics	0	0	**0**	555	724	**1,280**
Bulky Materials	0	0	**0**	9,177	1,086	**10,263**
Totals	**52,487**	**166,112**	**218,599**	**228,296**	**345,618**	**573,914**

Table D2: New Post Zero Waste Programs Implementation Diversion Materials Composition

	Residential Diversion Composition (Tons)			Commercial Diversion Composition (Tons)		
	Source Reduction	Recycling	Compost	Source Reduction	Recycling	Compost
Material						
Corrugated Cardboard (OCC)	174	7,905	0	489	20,528	0
Newspaper (ONP)	0	1,657	0	0	715	0
Office Paper	0	619	0	0	894	0
Mixed Paper	717	31,794	0	631	28,475	0
Textiles	4,104	0	4,925	283	0	2,206
Plastics #1 (PET)	145	2,488	0	91	1,430	0
Plastics #2 (HDPE)	29	1,238	0	32	1,251	0
Plastics #5 (PP)	0	0	0	5	115	0
Plastics #4 (LDPE) Film	60	6,218	0	57	14,369	0
Glass Containers	34	4,557	0	32	1,966	0
Aluminum	14	2,102	0	14	1,113	0
Copper/Other Non-ferrous	0	1,271	0	0	815	0
Tinned Cans	12	1,070	0	27	1,113	0
Other Ferrous	0	3,396	0	0	3,258	0
Electronics	65	757	0	27	380	0
Carpet	796	2,389	0	769	2,193	0
Household Batteries – Alkaline	0	72	0	0	0	0
Gypsum Wallboard	253	759	0	226	645	0
Masonry/Asphalt/Concrete	421	650	0	204	387	0
Asphalt Roofing Shingles	120	215	0	272	1,032	0
Wood Waste	2,388	0	1,607	6,109	0	6,924
Yard Debris	0	0	16,314	0	0	5,345
Food Scraps	0	0	33,590	5,159	0	44,884
Disposable Diapers	2,353	0	0	1,140	0	0
Animal By-products	0	0	2,800	0	0	326
Durable Plastic Products	820	3,679	0	1,946	6,856	0
Single-Use Food Service	1,343	2,571	0	1,134	2,435	0
Flat/Other Non-container Glass	43	1,692	0	14	577	0
Painted Wood	8,882	0	0	3,258	0	0
Mixed Construction & Demolition Debris	1,520	2,280	0	679	1,935	0
Sand/Soil/Dirt	0	1,326	0	0	1,629	0
Miscellaneous Organics	0	0	1,679	0	0	1,303
Miscellaneous Inorganics	0	361	0	0	145	0
Bulky Materials	4,343	4,826	0	380	706	0
Medical Wastes, Personal Protective Equipment, & Household Hazardous Wastes	0	193	0	0	579	0
Totals	**28,637**	**86,084**	**60,914**	**22,976**	**95,541**	**60,988**

Table D3: New Post Zero Waste Programs Implementation Diversion Plus Baseline Diversion Materials Composition

	Residential Diversion Composition (Tons)				Commercial Diversion Composition (Tons			
	Source Reduction	Recycling	Compost	Combined	Source Reduction	Recycling	Compost	Combined
Material								
Corrugated Cardboard (OCC)	174	16,084	0	**16,257**	489	45,404	0	**45,893**
Newspaper (ONP)	0	1,834	0	**1,834**	0	744	0	**744**
Office Paper	0	807	0	**807**	0	3,319	0	**3,319**
Mixed Paper	717	44,782	0	**45,499**	631	36,992	0	**37,623**
Textiles	4,104	123	4,925	**9,152**	283	9	2,206	**2,498**
Plastics #1 (PET)	145	3,557	0	**3,702**	91	2,019	0	**2,110**
Plastics #2 (HDPE)	29	2,116	0	**2,145**	32	1,725	0	**1,757**
Plastics #5 (PP)	0	38	0	**38**	5	146	0	**151**
Plastics #4 (LDPE) Film	60	6,218	0	**6,278**	57	14,529	0	**14,585**
Glass Containers	34	9,217	0	**9,250**	32	4,348	0	**4,380**
Aluminum	14	2,352	0	**2,367**	14	1,546	0	**1,560**
Copper/Other Non-ferrous	0	1,275	0	**1,275**	0	14,291	0	**14,291**
Tinned Cans	12	1,878	0	**1,890**	27	1,543	0	**1,570**
Other Ferrous	0	3,637	0	**3,637**	0	83,439	0	**83,439**
Electronics	65	757	0	**822**	27	380	0	**407**
Carpet	796	2,389	0	**3,185**	769	2,193	0	**2,962**
Household Batteries – Alkaline	0	72	0	**72**	0	0	0	**0**
Gypsum Wallboard	253	759	0	**1,011**	226	645	0	**871**
Masonry/Asphalt/Concrete	421	650	0	**1,071**	204	471	0	**675**
Asphalt Roofing Shingles	120	215	0	**335**	272	1,032	0	**1,303**
Wood Waste	2,388	0	1,729	**4,117**	6,109	0	31,008	**37,118**
Yard Debris	0	0	39,077	**39,077**	0	0	9,696	**9,696**
Food Scraps	0	0	33,590	**33,590**	5,159	0	48,464	**53,623**
Disposable Diapers	2,353	0	0	**2,353**	1,140	0	0	**1,140**
Animal By-products	0	0	2,800	**2,800**	0	0	326	**326**
Durable Plastic Products	820	3,679	0	**4,499**	1,946	6,856	0	**8,802**
Single-Use Food Service	1,343	2,571	0	**3,913**	1,134	2,435	0	**3,568**
Flat/Other Non-container Glass	43	1,692	0	**1,735**	14	577	0	**591**
Painted Wood	8,882	0	0	**8,882**	3,258	0	0	**3,258**
Mixed Construction & Demolition Debris	1,520	2,280	0	**3,800**	679	1,935	0	**2,613**
Sand/Soil/Dirt	0	1,326	0	**1,326**	0	1,629	0	**1,629**
Miscellaneous Organics	0	0	1,679	**1,679**	0	0	1,303	**1,303**
Miscellaneous Inorganics	0	361	0	**361**	0	145	0	**145**
Bulky Materials	4,343	4,826	0	**9,169**	380	706	0	**1,086**
Medical Wastes, Personal Protective Equipment, and Household Hazardous Wastes	0	193	0	**193**	0	579	0	**579**
Totals	**28,637**	**115,687**	**83,799**	**228,123**	**22,976**	**229,637**	**93,003**	**345,617**

XV. APPENDIX E

Table E1: Disposal Materials Composition for 2020 Baseline and Post Zero Waste Programs Implementation

	Baseline Disposal Composition (Tons)			Zero Waste Disposal Composition (Tons)		
	Residential	Commercial	**Combined**	Residential	Commercial	**Combined**
Material						
Corrugated Cardboard (OCC)	8,687	24,438	**33,125**	2,093	5,888	**7,981**
Newspaper (ONP)	1,927	905	**2,832**	464	218	**682**
Office Paper	720	1,131	**1,851**	173	273	**446**
Mixed Paper	37,641	36,204	**73,845**	9,069	8,722	**17,791**
Textiles	16,417	5,657	**22,074**	3,955	1,363	**5,318**
Plastics #1 (PET)	3,371	2,037	**5,408**	812	491	**1,303**
Plastics #2 (HDPE)	1,439	1,584	**3,023**	347	382	**728**
Plastics #4 (LDPE) Film	13,515	23,985	**37,500**	3,256	5,779	**9,035**
Glass Containers	7,467	3,168	**10,635**	1,799	763	**2,562**
Aluminum	2,405	1,358	**3,763**	579	327	**907**
Copper/Other Non-ferrous	1,444	905	**2,349**	348	218	**566**
Tinned Cans	1,203	1,358	**2,561**	290	327	**617**
Other Ferrous	3,859	3,620	**7,479**	930	872	**1,802**
Electronics	2,164	905	**3,069**	521	218	**739**
Carpet	5,308	3,847	**9,155**	1,279	927	**2,206**
Household Batteries – Alkaline	241	0	**241**	58	0	**58**
Gypsum Wallboard	1,686	1,131	**2,817**	406	273	**679**
Masonry/Asphalt/Concrete	1,203	679	**1,882**	290	164	**453**
Asphalt Roofing Shingles	478	1,810	**2,288**	115	436	**551**
Wood Waste	13,997	16,971	**30,968**	3,372	4,089	**7,461**
Yard Debris	17,375	5,883	**23,259**	4,186	1,417	**5,604**
Food Scraps	35,734	51,591	**87,325**	8,609	12,430	**21,039**
Disposable Diapers	9,413	3,168	**12,581**	2,268	763	**3,031**
Sand/Soil/Dirt	5,306	4,526	**9,832**	1,278	1,090	**2,369**
Miscellaneous Organics	15,446	4,526	**19,972**	3,721	1,090	**4,812**
Miscellaneous Inorganics	20,981	23,533	**44,514**	5,055	5,670	**10,724**
Bulky Materials	12,065	1,358	**13,423**	2,907	327	**3,234**
Totals	**241,493**	**226,277**	**467,770**	**58,181**	**54,515**	**112,697**

Source: PA_DEP_Report_FINAL_10-04-2022.pdf (state.pa.us)

Table E2: Diversion and Disposal Tons for 2020 Baseline and Post Zero Waste Programs Implementation

Delaware County Diversion and Disposal Tons		
	2020 Baseline	Zero Waste
Diversion	218,599	573,739
Memo: Diversion Detail		
Source Reduction	0	51,613
Recycling	163,699	345,324
Composting	54,900*	176,802
Disposal	467,770	112,697
Total Generation	686,369	686,436

*Includes 4,841 wood waste beneficial use as fuel.