

Appendices

Solid Waste Master Plan

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Appendix A

Background Information

A.1 Solid Waste Master Plan Overview of Tasks

On October 21, 2016, Metro issued a request for proposal (RFP) for the development of a long-term Solid Waste Master Plan (Plan). The issuance of the RFP was a collaborative effort between the Metro Public Works Department and the Davidson County Solid Waste Region Board. The CDM Smith team was chosen as the qualified team to contract with Metro for the development of the Plan. The Plan scope of work included six separate tasks consisting of the following:

Task 1 – Research

- Research and assess a myriad of solid waste management options suitable for residential, commercial, industrial, and institutional sectors within the Metro structure of the Urban Services District (USD) and General Services District (GSD). The research covers waste collection, processing, and disposal options for organic materials; construction and demolition (C&D) materials; recyclable materials; and non-recoverable materials.

Task 2 – Evaluation

- Evaluate the solid waste management options identified under Task 1 against various screening criteria; such as landfill diversion potential, commercial viability, costs and benefits, environmental impacts, and implementation.

Task 3 – Public Engagement

- The public engagement task for the project included conducting five public meetings along with separate meetings with the Davidson County Solid Waste Region Board, Solid Waste Master Plan Task Force, members of the Metro Council Public Works Committee, the Tennessee Department of Environmental Conservation (TDEC), and other stakeholders.

Task 4 – Recommendations and Goals

- Develop detailed recommendations, goals, and timeline for achieving Zero Waste. Recommendations for the final Solid Waste Master Plan will be done in consultation with the recommendations from the Livable Nashville Committee, NashvilleNext, TDEC requirements, and any other related plans.

Task 5 – Cost Studies

- Conduct a triple bottom line (3BL) study on the top three recommendations and on the cost to landfill waste. The 3BL on landfilling should include the social, environmental and economic cost to landfill a typical ton of municipal solid waste in a landfill instead of recovering all reusable, recyclable and compostable materials.

Task 6 – Waste and Recycling Characterization Study

- Conduct a comprehensive waste stream analysis of Nashville & Davidson County's waste and recyclables.

A.2 Purpose of Plan

The purpose of the Plan is to evaluate Metro’s existing solid waste management system and provide options to improve and enhance the system and increase waste reduction and diversion with the ultimate goal of zero waste. The Plan will include recommendations on how Nashville & Davidson County can maintain an integrated solid waste management system and includes:

- Evaluation of the current solid waste management system.
- Detailed plan on how Metro can meet and exceed the requirements of the State of Tennessee 2025 Material Management Plan.
- Recommendations on how to increase waste reduction, reuse and recycling.
- Detailed waste reduction and diversion plan with long-term projections on achieving the goal of zero waste.

The Davidson County Solid Waste Region Board identified the need to develop a Solid Waste Master Plan that would serve as an update to the 10-year Solid Waste Plan developed and approved in 2008. Over the years, Metro, community activists, businesses, and other stakeholders have engaged and advocated individually and collectively in an effort to reduce waste, reuse materials, and recover food scraps with the goal of diverting materials, with intrinsic and market value, from being discarded in a landfill. These efforts have been supported by legislation and resources at the various levels of government: local, regional and state.

The creation of a consolidated city-county form of government in 1963 created two taxing districts responsible for the delivery of government-provided services: the Urban Services District (USD) and the General Services District (GSD). The USD comprises the original City of Nashville limits plus annexations while the GSD comprises the rest of Davidson County excluding the satellite cities. Residents within the GSD and USD are taxed at different rates due to the differing levels of services offered by Metro. In addition to the services offered to GSD residents, USD residents receive additional services such as street lighting and garbage collection. This higher-level of service for USD residents is supported by a higher tax rate within that district. One of the challenges for the solid waste system and the goal of achieving zero waste is the structural differences between the USD and GSD regarding the delivery, funding, and consistency of solid waste services. Under the current taxing structure and Charter requirements, the Metro Public Works (MPW) department’s sphere of influence and authority is relegated to the USD; therefore, MPW is “extremely limited” in its ability to affect change throughout the entire Davidson County area. The Plan addresses the structural challenges associated with implementing a countywide zero waste approach with two distinct taxing districts. Even with the structural limitations, MPW has taken steps to initiate services and programs to increase the diversion of materials from landfills. A few examples are identified below:

- In an effort to improve recycling in the downtown area, MPW replaced trash-only containers with containers that accept both trash and recycling.
- In late 2017, Metro Public Works began offering food waste collection services at all four convenience center sites.

- MPW has implemented landfill bans for yard waste, cardboard and electronic waste materials.

While developing this Plan is the beginning of Metro's path to a zero waste goal, it builds on numerous previous and existing initiatives to advance diversion locally. This Plan serves to provide an integrated approach to changing the City and region's thinking about waste materials, methods of managing these materials, and the metrics by which we measure the value and success of recovering materials currently being disposed.

A.3 Organization of Plan

The supporting documentation for this Plan is presented as follows:

- Appendix B – Existing Solid Waste System – includes a background of the Metro solid waste management system including material tonnages, collection programs and facilities; legislative and legal authorities; and Public Works Department equipment and staffing.
- Appendix C – Waste and Recycling Characterization Study – provides a summary of the summer and fall sorts completed for the waste and recycling streams.
- Appendix D – Stakeholder Engagement – includes a discussion on the various stakeholder engagement and public outreach activities conducted during the development of the Plan. The engagement activities included meetings with the Solid Waste Region Board, Task Force, Metro Council Public Works Committee members, and environmental groups. Six public meetings were held throughout the Metro area throughout the development of the Plan.
- Appendix E – Program Research and Evaluation – includes discussions on the research and evaluation of programs and strategies that were considered for inclusion in the Plan. The appendix also discusses how the programs were screened for policies, funding, and effectiveness.
- Appendix F – Step 1: Diversion to 75% - provides a discussion of the strategies included in the Plan that will become the framework for achieving 75% diversion of waste from landfills.
- Appendix G – Step 2: Zero Waste – 90%+ Diversion – This appendix describes the programs and strategies included in the Plan that are associated with increasing diversion efforts from 75% to 90% or higher. Alternative waste conversion technologies are reviewed in this appendix to assess the potential for utilizing new technologies to handle materials that are hard to recycle, reduce, or compost.
- Appendix H – Step 3: Supporting Diversion Infrastructure – This appendix provides a discussion on the additional infrastructure required to collect, transport, and process the significant increase in materials associated with diverting 90% of the waste stream from landfills.

- Appendix I – Step 4: Managing Disposal of Non-Diverted Materials – This part of the Plan addresses the on-going need for disposing of materials that remain in the waste stream after recycling, composting, and waste conversion approaches have been implemented.
- Appendix J – Triple Bottom Line Analysis – This appendix provides a summary of the economic, environmental, and social impacts of the diversion programs identified in the Plan.
- Appendix K – Step 5: Funding and Organization Structure – This appendix provides a discussion on approaches for establishing the mechanisms and sustainable funding required to implement the zero-waste plan.
- Appendix L – Policies Fundamental to Achieving Zero Waste – The final appendix of the Plan will provide a summary of the policies, ordinances, and legislation that are fundamental to achieving “early wins”, establishing the key programs and strategies, and the long-term success of implementing the Plan.

Appendix B

Existing Solid Waste System

B.1 Demographics

Nashville’s borders contain undeveloped and rural land areas, but the urban core of the city is rapidly developing. Nashville’s low cost of living and status as a hub for the music industry has earned it a name among artists and musicians. Named the “It City” by the New York Times in 2013, Nashville has been attracting new residents with its robust healthcare industry and multitude of colleges and universities. As a result, Nashville’s population has exploded with transplants from other regions of the country moving to the Nashville Metropolitan Statistical Area (MSA) at a steady rate of almost 100 people per day for the past seven years.

B.1.1 Nashville Council Districts

Nashville is a metropolitan government, resulting from a consolidation with Davidson County and six smaller municipalities in 1963. Leadership in the consolidated entity is composed of a mayor, vice-mayor, and a 40-member city council including five at-large council members and 35 council members representing the 35 districts shown in **Figure B-1**.

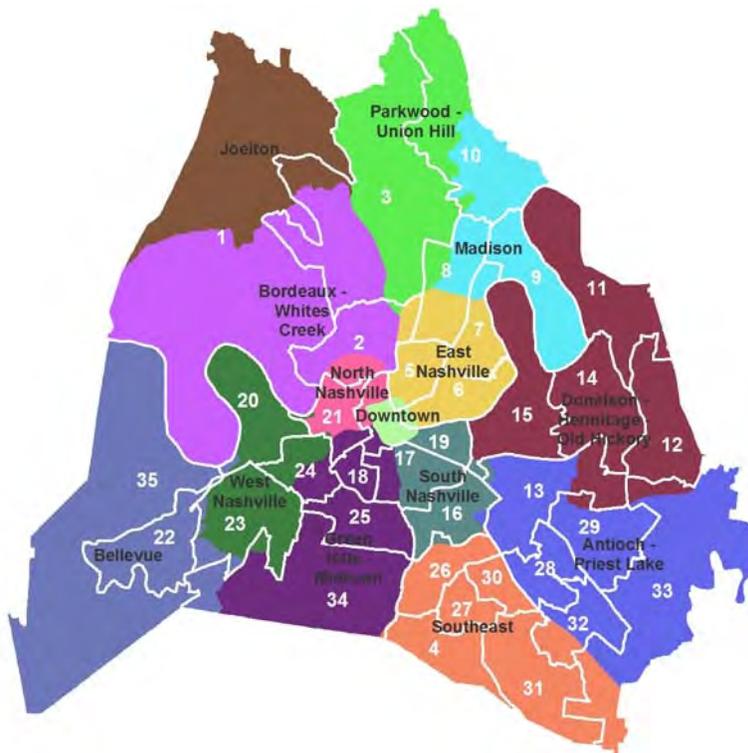


Figure B-1
Nashville Council Districts and Communities

B.1.2 Nashville Urban Services District and General Services District

Nashville has a two-tiered service system composed of the Urban Services District (USD) and General Services District (GSD). The USD, shown as the green shaded area in **Figure B-2**, is roughly the same as the former city boundary and has a population of approximately 496,000. Property owners in the USD pay a higher tax rate and are provided more municipal services (USD \$3.155/\$100 assessed property value vs. GSD \$2.755/\$100 APV in 2017). The GSD, shown in brown shading, includes the largely suburban and rural areas of Nashville and has a population of roughly 195,000. The USD has most of the businesses and institutions in Nashville as shown in **Table B-1**.

The areas represent the satellite cities of Goodlettsville, Berry Hill, Belle Meade, Forest Hills, Ridgetop and Oak Hill. These cities pay taxes at the GSD rate for use of Nashville schools. Other services in the satellite cities are funded through gas and sales taxes and franchise fees.

Table B-1 Distribution of Businesses and Institutions in the USD and GSD

| | | USD | GSD |
|--|-------------------------------------|--------|-------|
| Businesses | | 21,084 | 6,747 |
| Schools | MNPS* | 140 | 31 |
| | Private | 52 | 16 |
| | Universities, Colleges and Voc-Tech | 30 | 1 |
| Religious Institutions | Places of Worship | 577 | 152 |
| Parks | Community Centers | 24 | 4 |
| | Ice Rinks** | 2 | 0 |
| | | | |
| Libraries | Public Libraries | 17 | 4 |
| Convention Centers | Public | 1 | 0 |
| Courthouses | Metro | 5 | 0 |
| | State | 2 | 0 |
| | Fed | 2 | 0 |
| | Satellite Cities | 3 | 0 |
| Total Businesses and Institutions | | 21,939 | 6,955 |
| Percent of Businesses and Institutions | | 76% | 24% |

*Includes PreK, Magnets, Charters, Adult Ed and Special Ed schools, but not Admin.

**Includes the Ford Ice Center which is owned by Metro and operated by the Nashville Predators.

Urban Services District Metropolitan Nashville & Davidson County

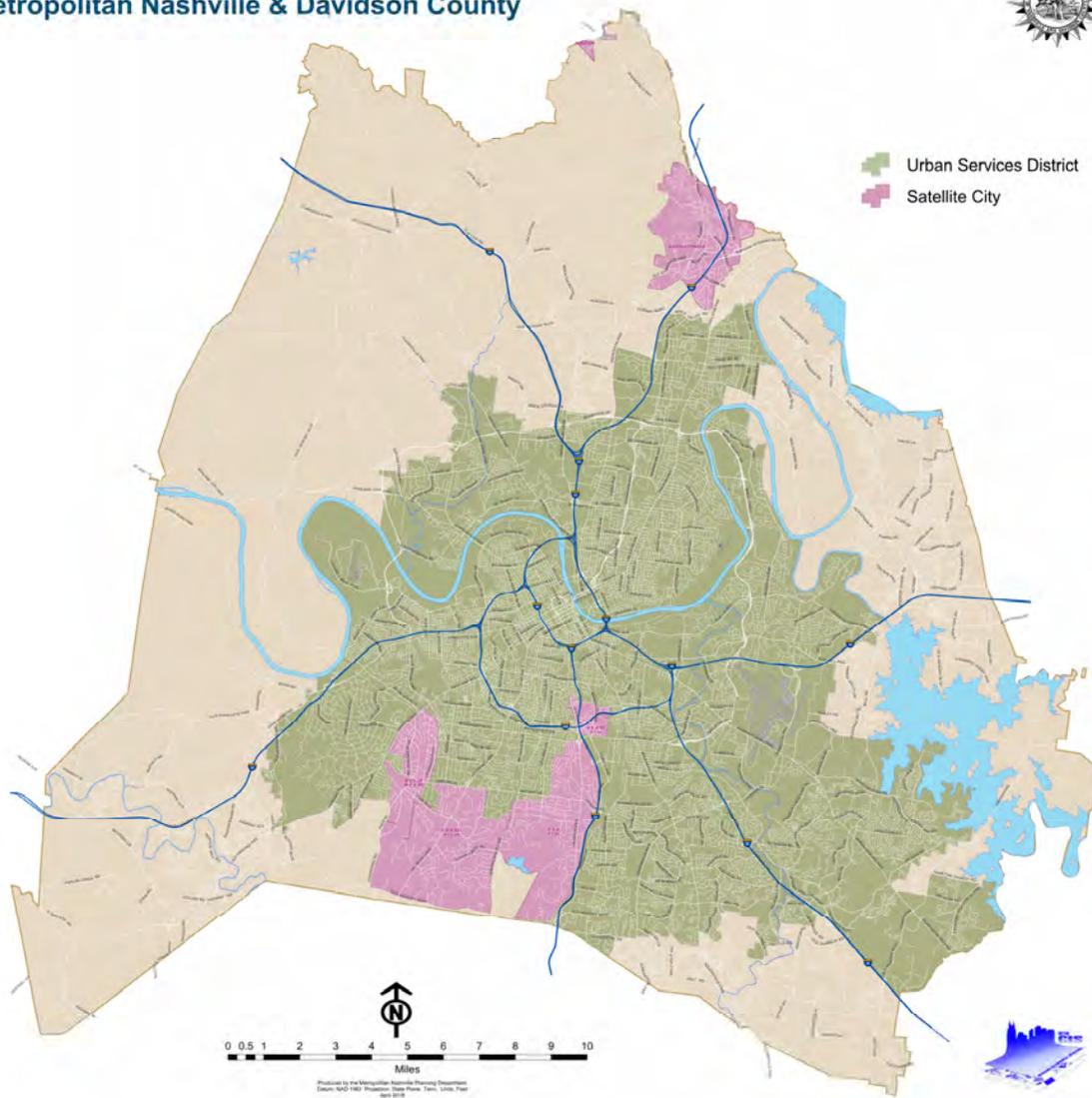


Figure B-2
Services Districts and Satellite Cities (GSD shown in tan)

B.1.3 Nashville Population and Housing

In 2016, Nashville's population was approximately 684,000. The *Greater Nashville Trends, Preferences and Opportunities 2010 to 2025 and to 2040* study, based on data from the 2010 Census, indicated that Nashville's population will rise to 720,000 in 2025 and reach 813,000 in 2040.¹

¹ Nashville.gov, 2013 Greater Nashville Trends, Preferences and Opportunities 2010 to 2025 and to 2040 Study

For the MSA, which includes 13 surrounding counties, the population is expected to reach 2 million by 2020. In 2016, the Nashville MSA added approximately 36,000 people for an annual daily increase of nearly 100 people².

Nashville’s population density varies greatly depending on the area, with much higher population density closer to the urban core. District 19, for example, which includes the downtown business district and several central neighborhoods has a population density of 3,610 people per square mile. District 18, the most populous district contains 7,111 people per square mile, while District 1, the least dense area, has a population density of only 206 people per square mile of land area. The population and density of each district is provided in **Table B-26**.

In 2015, Nashville was home to approximately 260,000 households, and is expected to grow to 304,000 households by 2025 and 336,000 by 2040. The average household income in 2018 was \$50,000. **Table B-2** shows 2015 occupancy estimates for various household types.

Table B-2 2015 American Community Survey Housing and Occupancy Characteristic Estimates

| Subject | Nashville, Tennessee | | | | | |
|--------------------------------------|------------------------|-----------------|------------------------------|-----------------|-------------------------------|-----------------|
| | Occupied housing units | | Owner-occupied housing units | | Renter-occupied housing units | |
| | Estimate | Margin of Error | Estimate | Margin of Error | Estimate | Margin of Error |
| Occupied housing units | 264,211 | +/-1,370 | 143,045 | +/-1,840 | 121,166 | +/-1,779 |
| UNITS IN STRUCTURE | | | | | | |
| 1, detached | 54.6% | +/-0.6 | 82.5% | +/-0.7 | 21.5% | +/-0.7 |
| 1, attached | 7.9% | +/-0.3 | 9.1% | +/-0.5 | 6.6% | +/-0.5 |
| 2 apartments | 5.2% | +/-0.3 | 1.4% | +/-0.2 | 9.6% | +/-0.6 |
| 3 or 4 apartments | 3.6% | +/-0.3 | 1.3% | +/-0.2 | 6.4% | +/-0.5 |
| 5 to 9 apartments | 6.9% | +/-0.4 | 1.4% | +/-0.2 | 13.4% | +/-0.8 |
| 10 or more apartments | 20.4% | +/-0.5 | 3.0% | +/-0.3 | 41.0% | +/-0.9 |
| Mobile home or other type of housing | 1.4% | +/-0.1 | 1.3% | +/-0.2 | 1.5% | +/-0.2 |

The 2013 projections study looked at three housing types as shown in **Table B-3**. They are: attached, small lot and all other. Attached lots include large multi-family complexes, townhomes and duplexes. Small lots represent a trend in Nashville where larger lots are being split into two or three smaller lots to create more urban infill. The “All Other” category, represents larger single unit lots in both urban and rural parts of Nashville.

² TheTennessean.com, <http://www.tennessean.com/story/news/2017/03/28/new-data-nashville-region-still-growing-100-people-day/99733098/>

Table B-3 Household Type According to 2013 Greater Nashville Projection Study

| Household Type | Households | Attached | Small Lot | All Other |
|---|------------|------------|------------|------------|
| 2025 Households and Demand | | | | |
| Households with Children | 279 | 89 | 73 | 117 |
| Non-single person households without children | 397 | 159 | 87 | 151 |
| Single-Person Households | 278 | 147 | 57 | 73 |
| Total | 954 | 395 | 217 | 341 |
| Share | | 41% | 23% | 36% |
| 2040 Households and Demand | | | | |
| Households with Children | 357 | 114 | 93 | 150 |
| Non-single person households without children | 481 | 192 | 106 | 183 |
| Single-Person Households | 353 | 187 | 73 | 93 |
| Total | 1,191 | 494 | 271 | 426 |
| Share | | 41% | 23% | 36% |

B.2 Waste Generation

B.2.1 Municipal Solid Waste (MSW)

Since 2008, municipal solid waste (MSW) generation in Nashville has fluctuated between 881,000 and 1.16 million tons per year as shown in **Figure B-3**. Management of MSW in Nashville is divided into 3 main categories: landfilling, recycling and composting. As shown in **Figure B-4**, more than three quarters of MSW is being landfilled and nearly a quarter of MSW is being recycled or composted.

The breakdown of waste generation between the Residential and Commercial sectors is estimated to be 33% Residential and 67% Commercial based on collection truck surveys performed during the Waste Characterization Study performed in July and October 2018.

The breakdown of waste generation between the USD and the GSD is estimated to 75% USD and 25% GSD based on population and business data for the two districts.

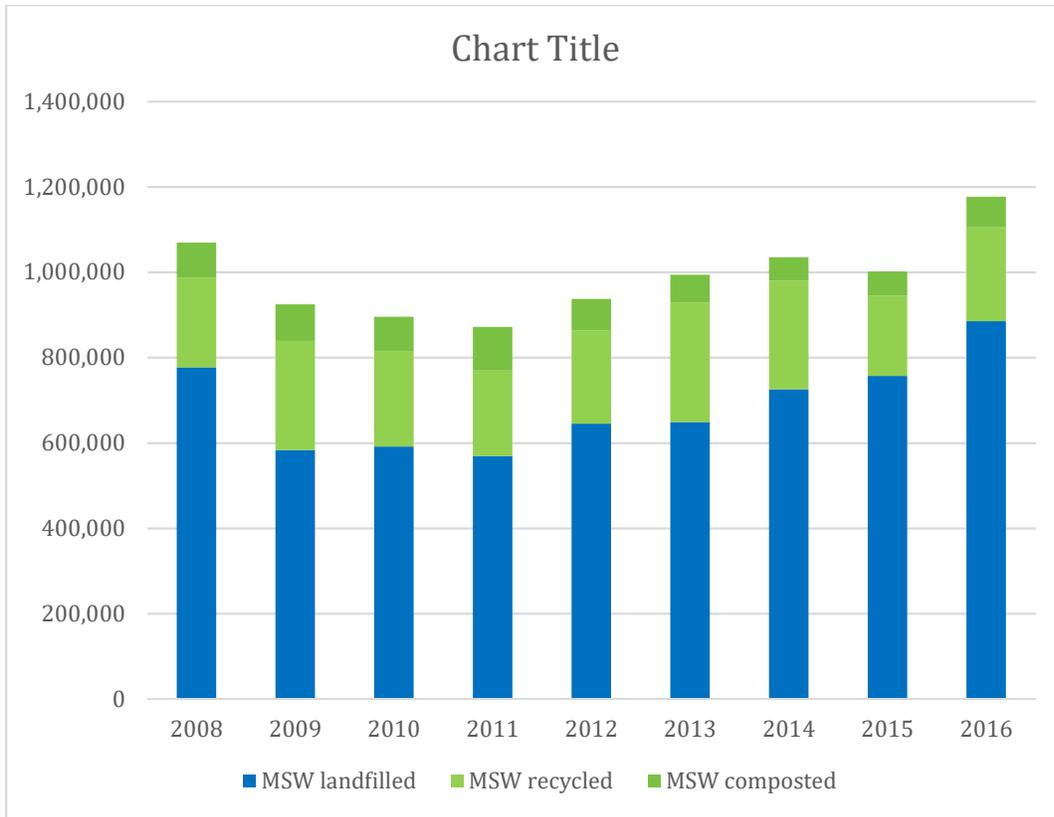


Figure B-3
Nashville MSW Generation from 2008-2016

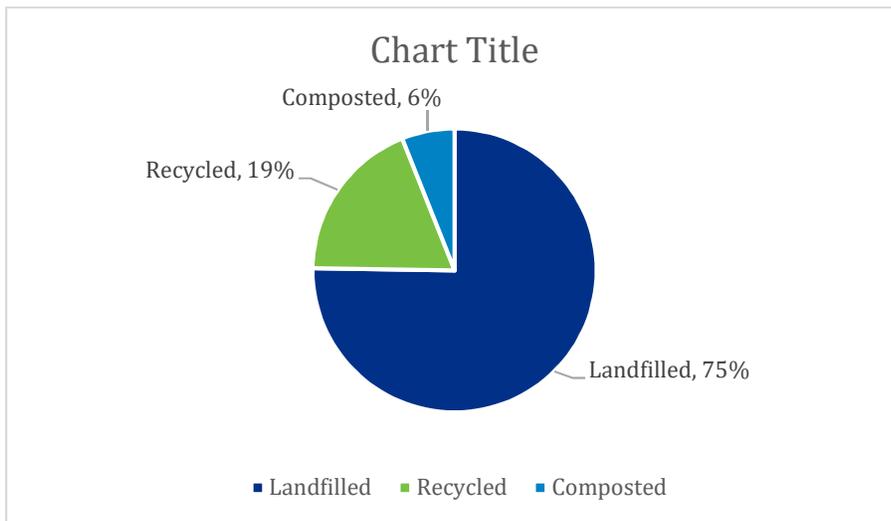


Figure B-4
Management of 2016 MSW in Nashville

B.2.2 Construction and Demolition (C&D) Waste

In 2016, C&D waste was 23% of the total waste stream. Since 2008, C&D waste generation in Nashville has nearly doubled while C&D waste recycling has decreased to minimal levels, as shown in **Figure B-5**.

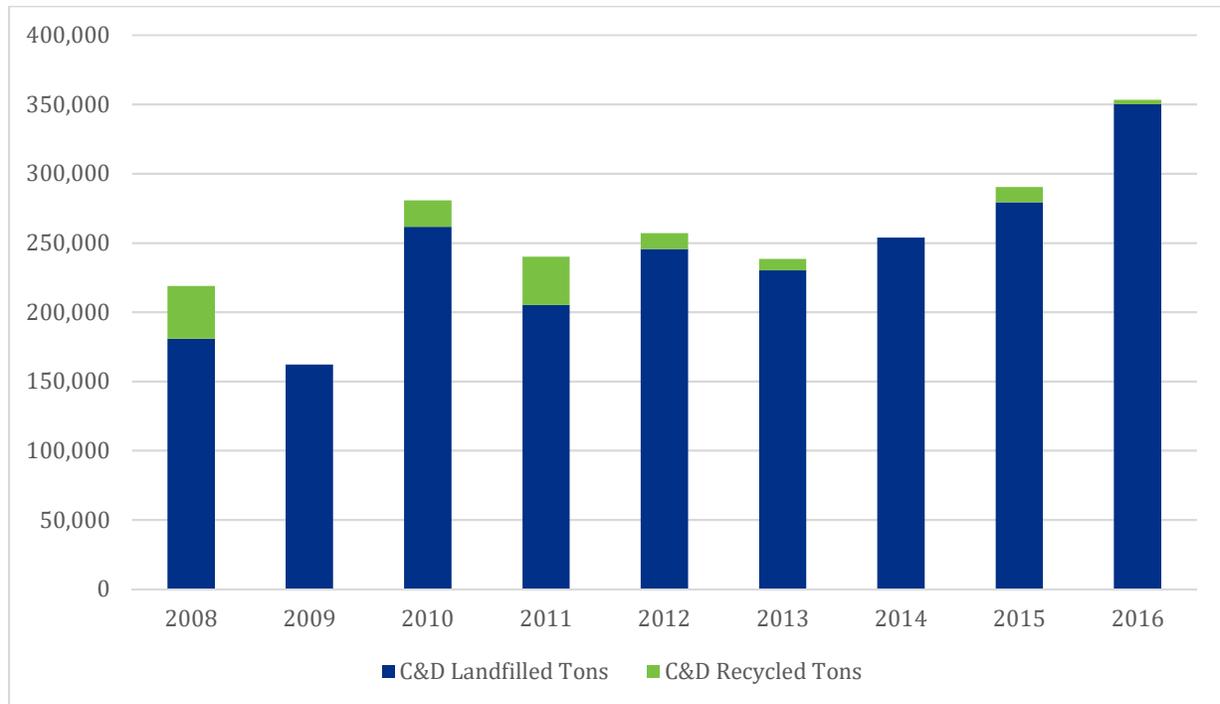


Figure B-5
Nashville C&D Waste Landfilled and Recycled

Tonnages for C&D waste landfilled and recycled are likely underreported for the following reasons:

- Some C&D waste is disposed of in MSW landfills and recorded as MSW tonnage. According to a 2008 Waste Composition Study completed by TSU, approximately 5% of the waste landfilled in the Bi-County and Cedar Ridge Landfills was C&D waste.³
- Some recycling occurs when contractors reuse C&D materials on-site or haul materials, e.g. scrap metal, directly to a recycler, and therefore the amount of C&D waste is not recorded.

B.2.3 Per Capita Waste Generation

In 2016, 1,520,992 tons of MSW, C&D waste and special waste were generated in Nashville. This equate to 2.22 tons per capita. Of that, 1.82 tons were landfilled, 0.32 tons of materials were recycled, and 0.10 tons of organics were diverted through mulching or composting. **Figure B-6** shows the change in tons per capita over time. While waste generation has increased steadily, diversion tonnage has dropped slightly.

³ TDEC, 2008 Tennessee Waste Characterization Study

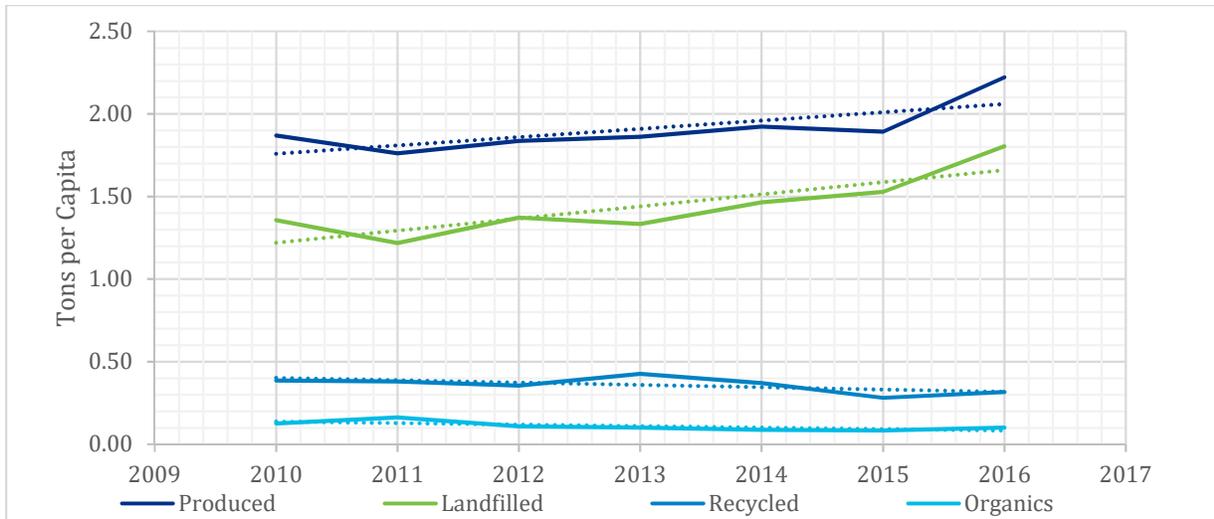


Figure B-6
Waste Generation per Capita 2010-2016 in Nashville

B.3 Collection Services

B.3.1 Service in the Urban Services District (USD)

In the USD, Metro Nashville Public Works (MPW) provides trash collection to single family residences, multifamily residences, Metro-owned buildings, MDHA public housing, and businesses that use a maximum of two trash carts. Multifamily housing with more than four units in the USD supply their own dumpsters. If more service is needed to meet the trash collection requirements of a business or a large multifamily housing building, they contract directly with private haulers. Curbside recycling collection is available to single-family residences, multifamily residents with four attached units or less and small businesses that are Public Works trash collection customers. MPW trash collection is provided once per week and recycling collection is once per month.

Curbside trash collection routes serviced by MPW are performed using rear and side loader trucks. The routes are divided between MPW and MPW’s contracted haulers as shown in **Table B-4**.

Table B-4 USD Curbside Trash Collection Routes Performed by MPW

| Hauler | Routes Serviced | Total Sites Serviced | Average Sites/Route |
|-------------------------------|-----------------|----------------------|---------------------|
| MPW | 32 | 25,146 | 786 |
| Red River ¹ | 91 | 94,167 | 1,035 |
| Waste Industries ¹ | 17 | 11,255 | 662 |
| Total | 140 | 130,568 | 933 |

1. Contracted by MPW

In addition to the rear and side loader routes there are 19 front loader trash collection routes, as detailed in **Table B-5**. These trucks are owned and operated by MPW and service Metro buildings, MDHA and multifamily complexes within the USD.

Table B-5 USD Front Loader Trash Collection Routes Performed by MPW

| Day | Routes | Number of Sites | Average Sites Per Route | Dumpsters Serviced |
|-----------|--------|-----------------|-------------------------|--------------------|
| Monday | 1 | 16 | 16 | 54 |
| Tuesday | 4 | 152 | 38 | 482 |
| Wednesday | 5 | 128 | 26 | 644 |
| Thursday | 5 | 151 | 30 | 518 |
| Friday | 4 | 109 | 27 | 516 |
| Total | 19 | 556 | 29 | 2214 |

Curbside and front loader recycling collection is provided without the use of contracted haulers as shown in **Table B-6 and B-7**. There are 32,629 less sites serviced than trash collection. This is due to requests to have recycling carts removed and habitual use of recycling carts for disposing of trash (in which case the carts are removed).

Table B-6 USD Curbside Recycling Collection Routes Provided by MPW

| Service Metric | Number |
|---------------------------------------|---------|
| Number of Recycling Collection Routes | 148 |
| Total Number of Sites Serviced | 97,939 |
| Average Number of Sites Per Route | 660 |
| Total Number of carts | 122,220 |
| Average number of carts per site | 1.26 |

Table B-7 USD Front Loader Recycling Collection Routes Provided by MPW

| Day | Routes | Number of Sites | Containers per Site |
|---------|--------|-----------------|---------------------|
| Tuesday | 1 | 40 | 56 |
| Friday | 1 | 36 | 52 |

B.3.2 Service in the Downtown Core Area

The Metro Nashville Code, via a subset of regulations called The Downtown Code, delineates the boundary within the Downtown Core Area where MPW is required to collect two trash carts, six days a week from all businesses (refer to **Figure B-7**). However, many of these businesses are restaurants that fill 10 or more carts and require collection two times per day. There is one trash route that services the downtown core area. On this route, there are 209 sites with 447 carts.

Additionally, MPW empties public trash and recycling receptacles, collects cardboard twice a day and glass bottles twice a day from downtown honky tonks.

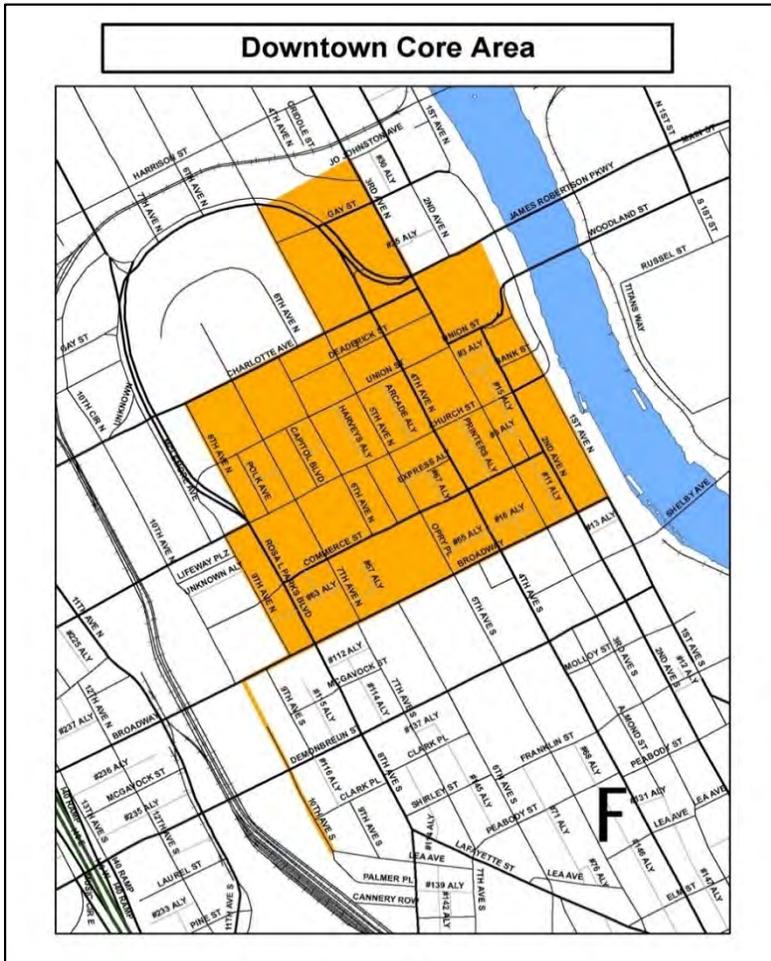


Figure B-7
Downtown Core Area

B.3.3 Service in the General Services District

All waste generators in the GSD must contract with a private hauler for collection services. Some Homeowner’s Associations (HOAs) in the GSD negotiate contracts with private haulers on behalf of their members. Trash haulers are required to be permitted with MPW and to offer recycling service to their customers. To incentivize recycling, MPW does not require recycling haulers or their equipment to be permitted. GSD residents may also self-haul their trash and recyclables to one of the convenience centers or recycling drop-off sites. There is no charge at these sites for small amounts of trash (three bags or less/day).

Table B-8 shows the collection services provided for the various service areas and customer sectors in Nashville.

Table B-8 Collection Services in Nashville

| Collection Type | Collection Container ¹ | Containers Issued by MPW | Maximum Additional Containers | Metro Collection Frequency | Collection Times | Notes |
|--|---|--------------------------|-------------------------------|----------------------------|------------------|--|
| Trash Collection | | | | | | |
| USD Residential | 96 gal. Carts | 1/unit | 1/unit | 1/week | 7AM-5PM | Additional containers cost \$65/each |
| USD Commercial | 96 gal. Carts | 1/unit | 1/unit | 1/week | 7AM-5PM | Businesses needing more than 2 carts must contract privately for collection. |
| Downtown Core Area Residential <4 attached Units | 96 gal. Carts | 1/unit | 1/unit | 1/week | 7PM-7AM | If more than 4 units must use private hauler. |
| Downtown Core Area Commercial | 96 gal. Carts | As needed | As needed | Daily | 24/7 | New construction or expansion must submit a waste management plan. |
| USD Multi-Family <4 attached Units | 96 gal. Carts | 1/unit | 1/unit | 1/week | 7AM-5PM | |
| USD Multi-Family > 4 attached Units | Dumpster or Compactor | n/a | n/a | 1/week | 7AM-11PM | Provide own dumpster. Public Works will empty dumpsters once/week (no compactors). Must contract privately for additional service. |
| USD Mixed Use | Dumpster or Compactor | n/a | n/a | n/a | 7AM-11PM | Contract privately for collection |
| GSD Residential and Commercial | Must contract with a private hauler or self-haul to a convenience center. | | | | | |
| Recycling Collection | | | | | | |
| USD Residential | 96 gal. Carts | 1/unit | n/a | 1/month | 7AM-5PM | |
| USD Commercial | 96 gal. Carts | 1/unit | n/a | 1/month | 7AM-5PM | Businesses with PW trash collection only. Other businesses must contract privately for collection. |
| USD Multi-Family <4 attached Units | 96 gal. Carts | 1/unit | n/a | 1/month | 7AM-5PM | |
| USD Multi-Family > 4 attached Units | Dumpster | n/a | | | 7AM-5PM | Contract privately for collection |
| USD Mixed Use | Dumpster | n/a | | | 7AM-5PM | Contract privately for collection |
| GSD Residential and Business | Must contract with a private hauler or self-haul to a convenience center or drop-off center. Since July 1, 2013, all waste haulers in the GSD are required to offer recycling collection. There is an additional cost to the customer for this service. | | | | | |

1. 96-gallon carts are provided by MPW

B.3.4 Private Haulers Operating in Nashville

Haulers providing collection services in Nashville are required to have a Private Collection Permit and all private dumpsters, roll-offs and trucks must be permitted. There are currently 35 haulers permitted in Nashville with 15,277 permitted containers and 636 permitted hauling vehicles. The complete list of haulers is provided in **Table B-28**. Containers under two cubic yards are not required to be permitted, so the list of permitted containers does not include residential carts.

B.3.5 Distribution of Collection Services Between MPW and Private Haulers

All the information presented in this appendix is from MPW Monthly Materials by Facility Reports and TDEC APR Reports (for Private Haulers). All MPW tonnages throughout the report are from MPW Monthly Materials by Facility Report. A summary of material tonnages reported to TDEC in the APR reports is provided in **Table B-27**.

From 2008 to 2016, MPW managed an average of 23% of the landfilled waste and 20% of recyclables and organics collected in Nashville. The other 77% and 80% is landfilled or recycled/composted through direct contracts with private haulers, or by contracts administered by one of the six satellite cities. **Table B-9** shows waste and recycling tonnage from MPW and Non-MPW haulers.

Table B-9 MPW and Private Hauler Collection Quantities 2008-2016 (tons)

| Year | MPW Collection Landfilled | MPW Collection Recyclables | MPW Collection Organics | Private Collection Landfilled | Private Collection Recyclables | Private Collection Organics |
|------|---------------------------|----------------------------|-------------------------|-------------------------------|--------------------------------|-----------------------------|
| 2008 | 152,397 | 32,080 | 30,892 | 624,597 | 166,915 | 60,451 |
| 2009 | 150,212 | 30,233 | 34,319 | 433,105 | 245,362 | 46,307 |
| 2010 | 151,591 | 30,426 | 26,250 | 439,697 | 193,233 | 52,603 |
| 2011 | 149,250 | 28,442 | 43,259 | 419,860 | 178,377 | 60,338 |
| 2012 | 149,229 | 27,486 | 28,442 | 495,997 | 191,627 | 41,917 |
| 2013 | 154,300 | 27,527 | 26,530 | 494,808 | 245,698 | 40,438 |
| 2014 | 153,941 | 27,400 | 24,706 | 571,929 | 219,950 | 34,013 |
| 2015 | 159,544 | 27,333 | 24,601 | 597,788 | 152,536 | 31,867 |
| 2016 | 161,622 | 30,105 | 27,831 | 723,425 | 183,420 | 41,320 |

A breakdown of the MPW collected quantities per source is provided in **Tables B-10** and **B-11**.

Table B-10 MPW Collected Recyclables by Source (tons)

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Curbside Recycling | 13,504 | 12,507 | 12,620 | 12,690 | 12,383 | 12,606 | 12,580 | 12,165 | 12,184 |
| Downtown Core Area Recycling | 16 | 17 | 20 | 19 | 14 | 33 | 16 | 51 | 510 |
| Metro Building Recycling | 421 | 382 | 456 | 489 | 466 | 434 | 492 | 419 | 458 |
| Convenience Centers | 1,522 | 1,717 | 1,793 | 1,825 | 1,825 | 1,651 | 1,623 | 1,870 | 2,078 |
| Drop Off Recycling Sites | 8,349 | 7,837 | 7,582 | 7,096 | 6,762 | 6,726 | 6,378 | 6,516 | 6,487 |
| Tires | 8,269 | 7,772 | 7,955 | 6,323 | 6,036 | 6,078 | 6,311 | 6,312 | 8,388 |
| Total | 32,080 | 30,233 | 30,426 | 28,442 | 27,486 | 27,527 | 27,400 | 27,333 | 30,105 |

Table B-11 MPW Collected Trash by Source (tons)

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|-------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Curbside Collection | 110,992 | 109,733 | 108,109 | 105,937 | 105,408 | 107,807 | 106,165 | 110,120 | 110,988 |
| Front Loader Collection | 26,847 | 26,134 | 25,891 | 25,864 | 25,102 | 26,267 | 25,418 | 25,339 | 24,732 |
| Downtown Core Area Collection | 3,252 | 3,514 | 3,648 | 4,099 | 4,806 | 5,615 | 5,979 | 6,657 | 6,789 |
| Convenience Centers | 11,205 | 10,765 | 13,930 | 13,349 | 13,912 | 14,610 | 16,380 | 17,428 | 19,113 |
| Water Services | 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Alley Cleanup | 61 | 75 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 152,397 | 150,221 | 151,591 | 149,250 | 149,229 | 154,300 | 153,941 | 159,544 | 161,622 |

B.3.6 C&D Waste Collection

All C&D waste collection is performed by private haulers. There are 71 permitted C&D waste haulers in Nashville using 1,269 permitted C&D collection containers and 160 permitted C&D collection vehicles. These totals include both entities contracting with others to collect and haul waste and individuals or companies hauling their own waste from their worksites. A complete list of C&D waste haulers and other information is provided in **Table B-29**.

B.3.7 Special Waste Collection

Brush and Yard Waste

MPW collects brush, grass and leaves four times per year. Metro's contractor, Living Earth, receives the material at their two facilities for processing into mulch or compost. Residents may self-haul brush and yard waste to the Ezell Pike Convenience Center (limited to a level pickup truck load) or to one of Living Earth's facilities (larger amounts are allowed) at no cost. Scheduled brush collection is also available through the Sheriff's office at no cost. **Table B-12** shows the quantity of brush and yard waste that has been collected over the past nine years.

Table B-12 MPW Brush and Yard Waste Collection 2008-2016

| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Brush and Yard Waste Collection | 32,995 | 39,627 | 32,524 | 47,571 | 31,965 | 31,004 | 27,983 | 32,141 | 37,622 |

Compost Nashville and The Compost Company offer food waste collection services for residents and businesses. Food waste can also be taken to the Omohundro and East Convenience Centers free of charge.

Bulky Waste

Bulky waste collection is offered by the Sheriff's office through their inmate work program. Pick-ups are done by appointment. Bulky waste collected by the Sheriff's office is hauled either a scrap metal recycler or the Republic waste transfer station depending on the material. Tonnages for the last five years are provided in **Table B-13**.

Table B-13 Sheriff’s Office Bulky Waste Service Collection FY13-FY17

| Fiscal Year | Tons | Service Requests |
|-------------|-------|------------------|
| FY 13 | 2,035 | 14,702 |
| FY 14 | 2,098 | 18,894 |
| FY 15 | 2,379 | 16,310 |
| FY 16 | 2,530 | 16,826 |
| FY 17 | 2,181 | 17,096 |

Household Hazardous Waste (HHW) and Electronic Waste

The Ezell Pike and East Convenience Centers accept household hazardous waste. Both facilities are open seven days a week and staffed by MPW. Both facilities, in addition to the Omohundro Convenience Center, accept electronic waste. **Figures B-8** and **B-9** show the percentage of HHW and electronic waste accepted at each of these facilities in 2016. **Table B-14** shows the breakdown of tonnages for HHW and each type of HHW collected by MPW in 2016.

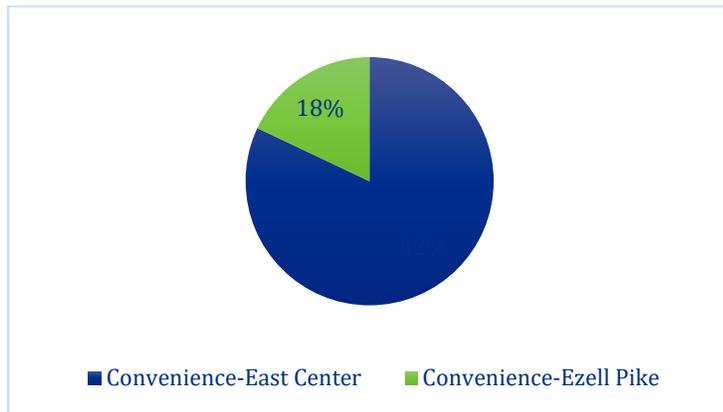


Figure B-8
Percent of HHW Collected per Facility in 2016

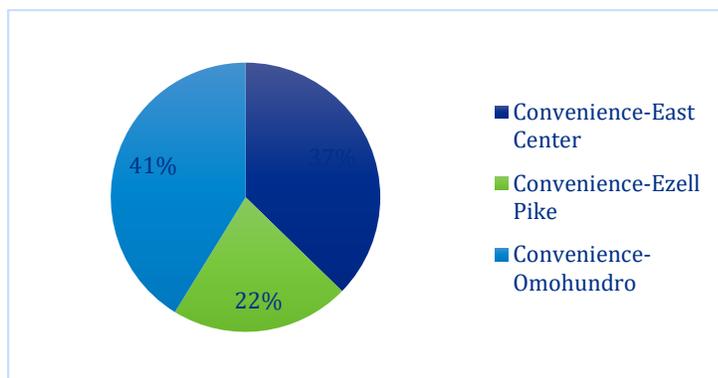


Figure B-9
Percent of Electronic Waste Collected per Facility in 2016

Table B-14 HHW and Electronic Waste Collected 2008-2016 (tons)

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|-------------------------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|
| Electronic Waste | 46 | 208 | 236 | 247 | 231 | 232 | 155 | 111 | 218 |
| HHW | | | | | | | | | |
| Antifreeze | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 13 |
| Car Batteries | 13 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Tanks | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Used Motor Oil | 30 | 38 | 35 | 35 | 36 | 26 | 30 | 19 | 25 |
| Other HHW | 42 | 25 | 35 | 17 | 38 | 29 | 29 | 32 | 33 |
| Total HHW | 88 | 67 | 71 | 52 | 74 | 55 | 59 | 68 | 72 |

B.3.8 Waste Flow Diagrams

The waste flow diagrams provided in **Figures B-10 and B-11** provide a comprehensive overview of waste management in Nashville by waste type, public vs. private collection, and processing facilities for C&D waste, MSW recyclables, organic wastes and special wastes. Special waste in this context includes electronics, pharmaceuticals, and household hazardous wastes.

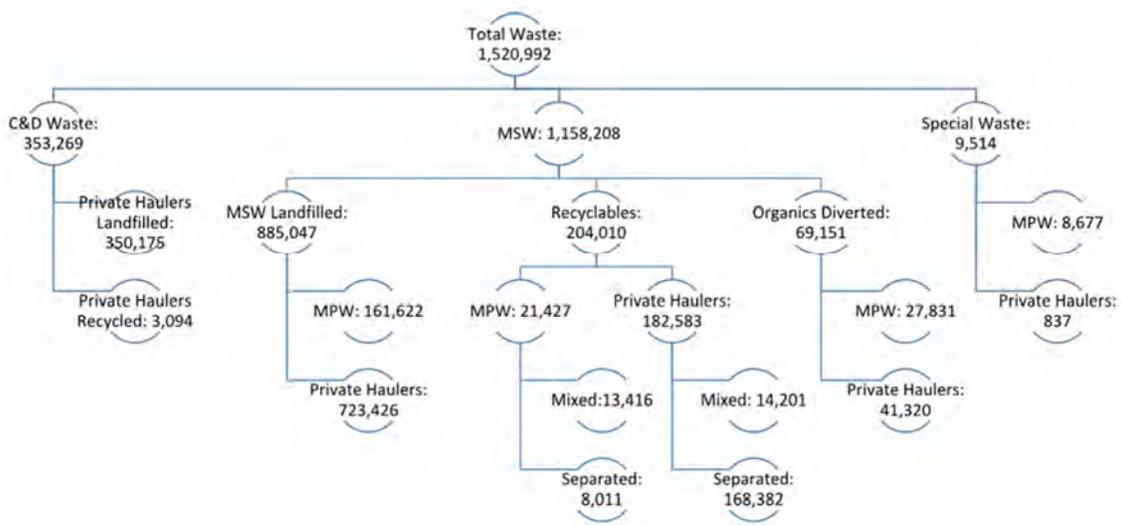


Figure B-10
Flow Diagram of Waste Collected in Davidson County (2016 Tons)

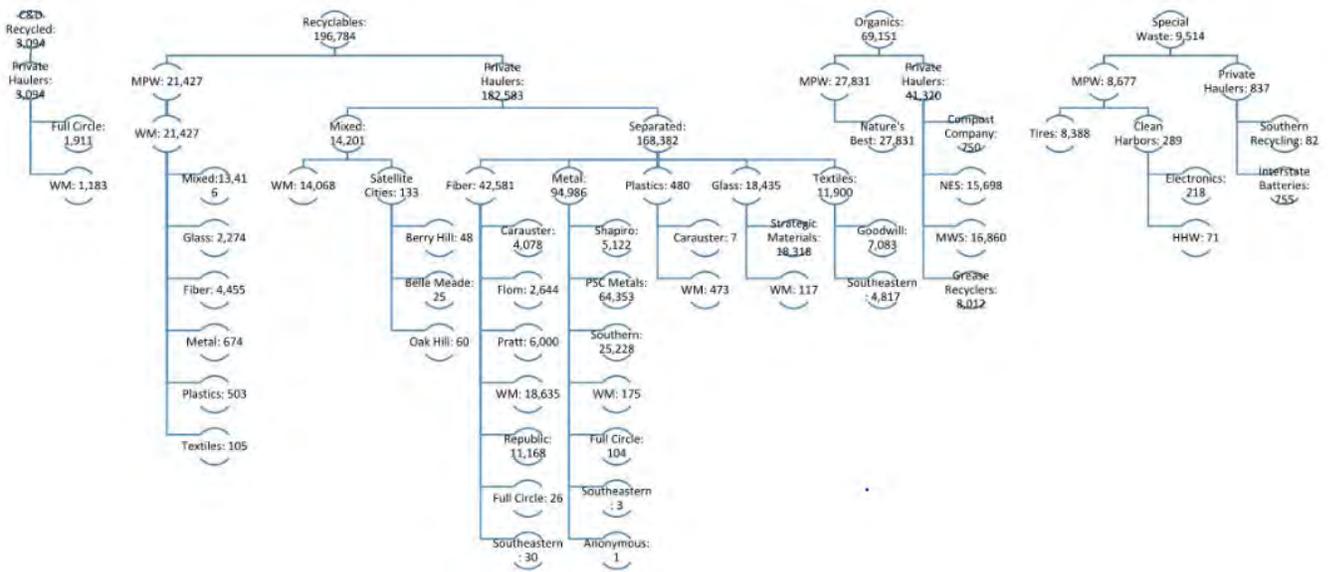


Figure B-11
Detailed Flow Diagram of Diverted Materials for Landfilling (2016 Tons)

B.4 Facilities

B.4.1 Metro Facilities

Convenience Centers

MPW has four convenience centers that accept trash and recyclables from Nashville residents as shown in **Table B-15**. The convenience centers accept household trash, furniture, and appliances as well as recyclables including: aluminum, ferrous cans, plastics #1-#7, cardboard, newspaper, mixed paper and glass bottles. The exact list of accepted materials varies slightly by center. Current and up-to-date lists can be found at MPW’s website.

The Ezell Pike, Anderson Lane and East Convenience Centers are all located on Metro Property, while the Omohundro Recycling Convenience Center is on a site that is leased by Republic Services, Inc. and provided to Metro Public Works as part of the waste transfer station contract.

Table B-15 MPW Convenience Centers

| Facility Name | Hours of Operation | Address |
|---------------|--|---|
| Omohundro | Tue. – Sat. 7:30 a.m. – 4:30 p.m., closed for lunch 12 p.m. – 1 p.m. | 1019 Omohundro Place Nashville, TN 37210 |
| Ezell Pike | Mon., Wed. – Sat. 7:30 a.m. – 4:30 p.m., closed for lunch 11 a.m. – 12 p.m. | 3254 Ezell Pike Nashville, TN 37115 |
| Anderson Lane | Tue. – Sat. 7:30 a.m. – 4:30 p.m., closed for lunch 11:30 a.m. – 12:30 p.m. | 939A Anderson Lane Madison, TN 37115 |
| East Center | Mon. – Tue., Thu. – Sat. 7:30 a.m. – 4:30 p.m., closed for lunch 11:30 a.m. – 12:30 p.m. | 943A Doctor Richard G. Adams Drive Nashville, TN 37207 |

Recycling Drop-Off Sites

There are 10 recycling drop-off sites throughout Nashville that accept recyclables from residents as shown in **Table B-16**. Most of the drop-off sites are on Metro property (primarily Metro Public School property). The recycling drop-off sites accept the same recycling materials as the convenience centers except for the Old Ben West Library Building Recycling Drop-off which does not accept glass.

MPW does all the hauling from the recycling drop-off sites. While the drop-off sites are not staffed by Metro employees, most have a community sponsor group that are provided funding by MPW.

Because these sites are on property maintained by another department or a private entity, they are all subject to potential closure or relocation depending on the future needs of the landowner.

Table B-16 MPW Recycling Drop-Off Sites

| Facility Name | Hours of Operation | Address |
|--|--|--|
| Bellevue Metro Transit Authority's Park & Ride | Open 24 hours | Coley Davis Road and Hwy 70 S Nashville, TN 37221 |
| Old Ben West Library Building | Open 24 hours | Polk Avenue & Union Street Nashville, TN 37219 |
| Tennessee State University | Daily 7:00 a.m.-7:00 p.m. | 38th Ave N and Albion Street Nashville, TN 37209 |
| Granbery Elementary School | Sat 9:00 a.m.- Noon | 5501 Hill Road Brentwood, TN 37027 |
| Lakewood City Hall | Open 24 hours | 3401 Old Hickory Blvd Old Hickory, TN 37138 |
| Whites Creek High School | Open 24 hours | 7277 Old Hickory Blvd Nashville, TN 37189 |
| Joelton Middle School | Open 24 hours | 3500 Old Clarksville Highway Joelton , TN 37080 |
| Hillsboro High School | Mon.–Sat. 9:00 a.m.- 5:00 p.m. Sun.Noon- 5:00 p.m. | 3812 Hillsboro Pike. Nashville, TN 37215 |
| Cane Ridge High School | Open 24 hours | 12848 Old Hickory Blvd Antioch, TN 37013 |
| McGavock High School | Open 24 hours | 3150 McGavock Pike Nashville, TN 37214 |

B.4.2 Private Facilities

Transfer Stations

There are no active MSW landfills in Nashville since the closing of the Bordeaux Landfill in 1996. Two MSW transfer stations operate in Nashville, one is owned and operated by Republic Services and is located 2 miles east of the Downtown Business District on Freightliner Drive. The other transfer station is the Waste Management Antioch Transfer Station located just south of the Nashville International Airport off of Antioch Pike. Both transfer stations haul waste to various MSW landfills in the region, primarily the Middle Point Landfill in Murfreesboro.

Materials Recovery Facilities

The Waste Management River Hills Materials Recovery Facility (MRF) is the only facility that accepts single stream recyclables. In addition to this MRF, there are a number of other privately owned and operated recycling processing facilities that accept source separated recyclables.

Table B-17 lists the known facilities in the region that accept recyclables generated in Nashville.

Table B-17 Materials Recovery Facilities

| Facility | Confirmed Materials Accepted | 2016 Tons Reported to TDEC Tons/Yr | Operating Capacity Tons/Yr |
|--|----------------------------------|------------------------------------|----------------------------|
| WM River Hills Recycling Center | Fiber, Plastic and Metals | 33,342 | 48,000 |
| WM Rivergate Recycling Center | Fiber, Plastic, Metals and Glass | N/A | 30,000 |
| Southeastern Recycling | Textiles, Aluminum, Fiber | 4,849 | X |
| Carastar Recycling | Fiber, Plastic | 4,084 | X |
| Southern Recycling | Metal | 25,310 | X |
| Flom Corporation | Fiber | 2,643 | X |
| Pratt Industries | Fiber, C&D | 6,000 | 29,000 |
| West Rock | Fiber, Plastic | 11,168 | 51,600 |
| Combined Resources | Paper, Plastic | N/A | 21,000 |
| Dynamic Recycling TN, LLC | Electronics | N/A | 1,250 |
| Interstate Batteries of Middle Tennessee | Batteries | 754 | 38 |
| Shapiro Recycling Systems | Metal | 5,122 | 5,123 |
| Strategic Materials | Glass | 18,318 | X |
| PSC Metals | Metal | 64,353 | 252,420 |

Organic Waste Processing Facilities

In addition to the two facilities owned and operated by Living Earth, which has the exclusive contract with Metro to take all brush and yard waste collected by MPW, there are a number of other facilities that take organic waste generated in Nashville. **Table B-18** lists the facilities that process organic waste, including wood waste, brush, yard waste, and food waste. In addition to the tonnage reported in the table below, a total of 8,012 tons of recycled fats, oils and grease (FOG) was reported by Metro Water Services for FOG processed by private grease recyclers.

Table B-18 Compost and Mulch Facilities in the Region that Accept Materials from Nashville

| Facility | Confirmed Materials Accepted | 2016 Tons Reported to TDEC | Current Operating Rate Tons/Yr | Operating Capacity Tons/Yr | Capacity with Facility Expansion Tons/Yr |
|--------------------------|-------------------------------|----------------------------|--------------------------------|----------------------------|--|
| Ground Up Recycling | Tires & Wood Pallets | N/A | 21,000 | 30,000 | N/A |
| AEP Inc | Wood | N/A | 13,505 | unknown | N/A |
| The Compost Company, LLC | Food Waste, Yard Waste, Brush | 750 | 6,000 | 22,500 ¹ | 75,000 (max. for site) ² |

Notes: 1. 22,500 tpy comprises 7,500 tpy of food scraps and 15,000 tpy of woody waste.
2. 75,000 tpy comprises 25,000 tpy of food scraps and 50,000 tpy of woody waste.

C&D Waste Landfills and Processing Facilities

There is one dedicated C&D waste landfill and one mixed C&D waste processing facility operating in Nashville as provided in **Table B-19**. C&D waste is also accepted at the Republic Transfer Station and the Waste Management Antioch Pike Transfer Station. A number of facilities accept source-separated C&D material for recycling as provided online in the C&D Recycling Directory.

Table B-19 C&D Waste Processing Facility

| Facility | Materials Accepted | Current Operating Capacity Tons/Yr | Available Operating Capacity Tons/Yr | Capacity After Facility Expansion Tons/Yr |
|--|--------------------|------------------------------------|--------------------------------------|---|
| C&D Waste Processing: Atomic Resource Recovery, LLC | Mixed C&D | 78,000 | 89,700 | 260,000 |
| C&D Waste Landfill: Waste Management Inc. Southern Services C&D LF | Mixed C&D | 327,000 | Expected to reach capacity in 2024 | None |

Previous WTE Processing Facility

In 2002, Nashville closed the Nashville Thermal Transfer Corporation (NTTC) Waste to Energy facility that resided on riverfront property in the city’s downtown core. The facility, which began operation in 1974, burned 1,000 tons of trash per day, providing steam and chilled water to heat and cool 39 buildings in the city’s core.⁴

In July of 2000, due to the aging facility’s need for updates Mayor Purcell’s administration commissioned a study to evaluate options for the future of thermal and waste management. Results of the study found that the least-cost scenario for waste management would be to landfill waste outside of the county.

In December of 2001, in response to concerns over the facility’s ability to meet pollution restrictions and remain economically viable, Metro Council voted to close the NTTC facility by 2004. In May of 2002, a major fire occurred at the WTE facility, accelerating the transition to a natural-gas fired facility.

B.5 MPW Solid Waste Financial Data

The following appendix summarizes financial data provided by MPW staff including revenue collected and expenses paid by fiscal year for the solid waste activities of Public Works, with only a few exceptions described in the Operational Expense subsection. To normalize for population growth, annual estimates from the U.S. Census Bureau were used to generate per capita comparisons of revenue and costs throughout this appendix. All references to the “period” are for the six fiscal years continuously listed.

⁴ Nashville.gov, <http://www.nashville.gov/District-Energy-System/About/History-of-Metro-DES.aspx>

B.5.1 Income Statement View of MPW Solid Waste

Using an income statement format, **Table B-20** shows revenue and expenses. Disposal fees are assessed at \$6/ton for MSW and \$1/cubic yard for C&D waste collected by private haulers.

Table B-20 Income Statement View of MPW Solid Waste (\$000s)

| | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2017 |
|---|----------|----------|----------|----------|----------|----------|
| <i>Non-Fund Revenue</i> | | | | | | |
| Disposal Fees | \$4,645 | \$4,945 | \$4,868 | \$5,422 | \$5,641 | \$6,296 |
| Grants | \$137 | \$132 | \$136 | \$763 | \$629 | \$962 |
| <i>Operational Expense</i> | | | | | | |
| Professional & Purchased Services | \$12,757 | \$12,907 | \$12,922 | \$13,617 | \$14,245 | \$15,080 |
| Personal Services | \$4,673 | \$5,177 | \$5,019 | \$5,336 | \$5,489 | \$5,612 |
| Internal Service Fees | \$997 | \$1,358 | \$1,225 | \$1,500 | \$2,136 | \$2,317 |
| Repairs & Maintenance Services | \$640 | \$756 | \$378 | \$442 | \$484 | \$542 |
| Communications, Advertising and Promotion | \$111 | \$88 | \$133 | \$104 | \$137 | \$163 |
| Supplies & Materials | \$202 | \$212 | \$732 | \$483 | \$479 | \$109 |
| Other | \$120 | \$113 | \$122 | \$119 | \$120 | \$94 |
| Utilities | \$60 | \$53 | \$56 | \$49 | \$97 | \$55 |
| Travel, Tuition and Dues | \$4 | \$12 | \$9 | \$8 | \$8 | \$9 |

B.5.2 Program Revenue

When MPW operated the Bordeaux Landfill tipping fees were used to offset recycling and brush pick-up program expenses. Since the closure of the landfill in 1994, MPW relies on revenue from disposal and recycling fees, mulch sales, grants (all of which this report refers to as Non-Fund Revenue), and government funds.

One government funding source is the Metro General Fund. A portion of this fund is allocated to MPW for solid waste services. A second funding source is the State-specified Solid Waste Fund which is used to fill funding gaps. **Figure B-12** shows Non-Fund revenue from **Table B-20** on a per capita basis.

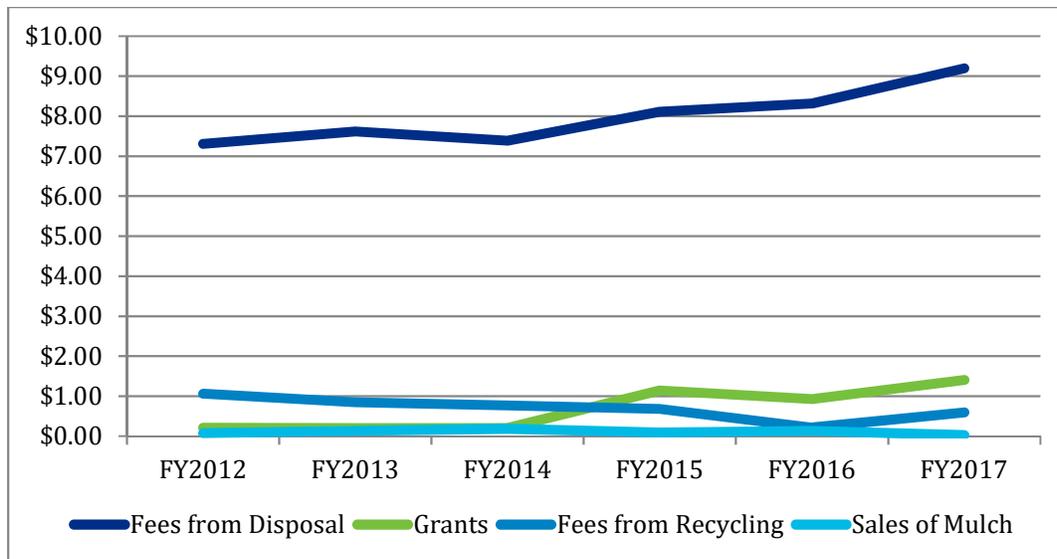


Figure B-12
Non-Fund Revenues Sources per Capita

While revenue from disposal fees and grants has increased, recycling revenue has decreased. The drop-in revenue from recyclables is due to the fee terms of the renegotiated contract with Waste Management, Inc. that began in November 2015. The fee terms changed from a “price per ton” model (\$10/ton) to a model where the vendor sells recyclables on the open market and passes on any sales proceeds that exceed their processing fee to Solid Waste. During late 2015 and 2016, lower market prices for recyclables resulted in no excess sales proceeds going to Solid Waste.

A more detailed view of Non-Fund Revenue by Business Unit is provided in **Table B-30**.

Table B-21 lists the grants that MPW has received and are pending for the FY18 funding cycle.

Table B-21 Solid Waste Grants for FY18

| Grant | Total | Match | Status |
|--|-----------|-------|-----------------------|
| TDEC Recycling Rebate Grant | \$120,422 | N/A | Received |
| TDEC HHW Operations | \$85,000 | N/A | Received |
| TDEC HHW East Center Building Renovation | \$286,540 | N/A | Received |
| TDOT Litter Grant | \$63,105 | N/A | Received |
| TDEC Organics Management Grant | \$60,000 | 50% | Received |
| TDEC Education & Outreach | \$100,000 | 50% | Received |
| TDOT Special Litter Grant | \$200,000 | N/A | Received |
| TDEC Waste Reduction Grant | \$100,000 | 50% | Application Submitted |

B.5.3 Operational Expenses

The operational expense categories are described below:

- *Professional and Purchased Services (P&PS)*: These amounts represent services provided by outside contractors and, expectedly, align closely with the vendors' totals in the following appendix, Existing Contract Expense.
- *Personnel Services (PS)*: Direct personnel costs allocated to Solid Waste business units (Metro Collection, Convenience Centers, Curbside Recycling, etc.) Expenses from some management-level employees cannot easily be allocated at the business unit level. Further, support from other departments within Metro Governments (Legal, Public Relations, etc.,) and even some MPW management staff can be carried on other payrolls. Metro Nashville performs an annual survey of these costs to provide an overhead percentage for other Metro departments and agencies. These non-allocated costs are not included.
- *Internal Service Fees (ISF)*: These fees represent direct non-labor costs of providing Solid Waste functions that are not easily allocated to business units. For example, of the \$2.3M in FY17, approximately \$2.2M was from costs of acquisition, repair, fuel, maintenance and related costs of Solid Waste's fleet of trucks, trailers, and other equipment. FY17 amounts show that Internal Service Fees are about 95% fleet. This should only indicate to the reader that almost half of the \$2.3M could be stripped out and applied to business units, although over 50% of the \$2.3M is not easily allocated to business units. Lastly, many of these charges come over to Solid Waste from other departments within MPW on from annual estimates, with any true-ups happening in the following fiscal year. As such, Internal Service Fees and their large fleet component is a trailing indicator of actual costs.
- *Repairs & Maintenance Services*: These amounts are direct repair and maintenance costs that could be allocated to business units rather than coming in from Internal Service Fee estimates.
- *Communications, Advertising and Promotion*: Over 80% of these costs are from non-personnel Recycling Education costs (\$477,724 for non-personnel costs for the period). The remainder of Recycling Education is mostly personnel (\$404,558 for the period).

A detailed view of Operational Expense by Business Unit (excluding overhead percentage discussed above) is provided in **Table B-31**.

To normalize for population growth, **Figure B-13** shows operational expense per capita.

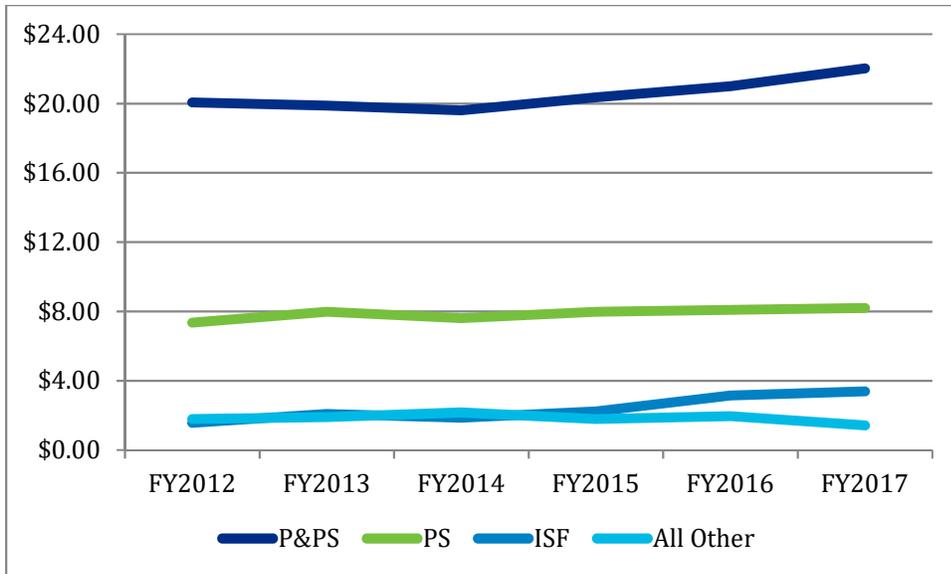


Figure B-13
Operational Expense per Capita

Figure B-13 shows that the per capita costs of the Professional & Purchased Services and Internal Service Fees categories are increasing. MPW financial staff indicated that several pieces of equipment (e.g., knuckle booms) have been replaced, and some routes have been taken back by MPW in the last few years. Personal Services and All Other costs remain on par with population growth.

B.5.4 MPW Solid Waste Full-time Employees

MPW has 166 full-time positions in Solid Waste. Two positions are dedicated to GSD programs, while the remaining positions pertain to the overall Solid Waste. **Table B-22** shows the number of employees for each position.

Table B-22 MPW Solid Waste Positions

| Business Unit | Fund | Position Title | Number of Employees |
|------------------------------------|------|--------------------------------------|---------------------|
| PW Director | | | 1 |
| Assistant Director | | | 1 |
| Engineer | WM | Engineer 2 | 1 |
| Part-time | WM | Part-time | 5 |
| Special Projects Manager | WM | Special Projects Manager | 1 |
| Recycling Coordinator | | | 1 |
| Operators | | | 37 |
| Sanitation Workers | | | 5 |
| Technical Specialist | | | 1 |
| Administration-42861110 | WM | Administrative Services Officer 3 | 1 |
| Household Hazardous Waste-42804800 | WM | Compliance Inspector 1 | 1 |
| Household Hazardous Waste-42804800 | WM | Compliance Inspector 2 | 1 |
| Convenience/Recycle Ctrs-42804520 | WM | Customer Field Representative Senior | 1 |
| Curbside Recycling-42804300 | WM | Customer Service Representative | 1 |
| Operations-42142110 | GSD | Maintenance and Repair Leader | 1 |
| Operations-42142110 | GSD | Maintenance and Repair Worker | 1 |
| Dead Animal Collection-42803600 | WM | Maintenance and Repair Worker Senior | 2 |
| Convenience/Recycle Ctrs-42804520 | WM | Sanitation Supervisor | 1 |
| Curbside Recycling-42804300 | WM | Technical Specialist 2 | 2 |
| Management | WM | Waste Management Superintendent | 1 |
| Metro Collection-42803100 | WM | Waste Management Supervisor | 1 |
| Tire Program-42804900 | WM | Customer Field Representative | 7 |
| Metro Collection-42803100 | WM | Sanitation Worker | 17 |
| Metro Collection-42803100 | WM | Equipment Operator Senior | 75 |
| | | Total | 166 |

B.5.5 MPW Vendor Contracts

MPW has contracts with multiple vendors to provide an array of waste management functions as shown in **Table B-23**.

Table B-23 MPW Vendor Contracts

| Contract Type | Company | Contract Value | Contract Length | Expiration date |
|--|--|------------------------------|---|-----------------|
| Carpet Recycling | Southeastern Recycling, LLC | \$500,000 | 60 months from date of filing (5/9/16) | 5/9/21 |
| Trash and Recycling Rollout Carts | Rehrig Pacific | \$5,000,000 | 60 months from date of filing | 07/17/23 |
| Solid Waste Collection | Waste Industries of TN, LLC | \$500,000 | 10 years starting 1/2/05 with two 5-year extensions | 12/31/24 |
| Solid Waste Collection | Red River Service Corp. | \$1,000,000 | 10 years starting 8/9/04 with two 5-year extensions | 8/9/24 |
| Waste Disposal | BFI Waste Services (now Republic Services, Inc.) | Annual settlement statements | 20 years starting 1/16/02 | 1/16/22 |
| Dumpster Rental & Service | Republic Services, Inc. | \$15,000,000 | 5 years starting 11/13/15 | 11/12/20 |
| E-Waste | Dynamic Recycling, Inc. | \$2,000,000 | 5 years starting 2/16/16 | 2/15/21 |
| Engineering Services | TriAD Environmental Consultants, Inc. | \$5,000,000 | 5 years starting 5/25/16 | 5/24/21 |
| Fluorescent tubes & ballasts recycling | American Compactor, Inc. | \$50,000 | 5 years starting 11/1/15 | 10/31/20 |
| HHW | Clean Harbors Environmental Services | \$750,000 | 5 years starting 8/30/16 | 8/29/21 |
| Mattresses | Spring Back Recycling | \$100,000 | 5 years starting 12/1/13 | 12/1/18 |
| Recycling Processing | Waste Management, Inc. | \$0 ¹ | 10 years starting 11/1/15 | 11/1/25 |
| Rolloff and Dumpster | Stringfellow, Inc. | \$1,000,000 | 5 years starting 9/27/13 | 9/27/18 |
| Tire Recycling | Liberty Tire Recycling Holdco, LLC | \$3,000,000 | 5 years starting 9/1/15 | 8/31/20 |
| Wood Grinding | Natures Best Organics of TN, LLC | \$10,000,000 | 10 years starting 12/1/16 | 1/31/21 |

Note: 1. Metro does not pay to take recyclables to the MRF. WM shares revenue from sales with Metro when there is revenue in excess of processing fees and support group payments.

Table B-24 shows vendor contract expenses organized in descending order of expense and as a percentage of total expense to MPW. The Metro Collection business unit incurs the majority of contract expenses.

Table B-24 Vendor Contract Expenses by Fiscal Year (\$000s)

| MPW Business Unit/ Vendor | FY 12 | FY 13 | FY 14 | FY 15 | FY 16 | FY 17 | % of FY 17 Total |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------|
| Metro Collection | \$11,768 | \$12,295 | \$11,826 | \$12,285 | \$12,753 | \$13,107 | 88% |
| Red River Waste | \$6,204 | \$6,359 | \$6,141 | \$6,338 | \$6,479 | \$6,662 | |
| Republic/BFI (transfer and disposal) | \$4,326 | \$4,561 | \$4,643 | \$4,824 | \$5,089 | \$5,165 | |
| Waste Industries | \$810 | \$826 | \$848 | \$839 | \$830 | \$914 | |
| Toter | \$426 | \$547 | \$191 | \$247 | \$254 | \$243 | |
| Dynamic Recycling | | | | | \$71 | \$111 | |
| American Compactor | | | | | \$1 | \$11 | |
| Southeast Recycling | \$1 | \$2 | \$3 | \$2 | \$2 | \$0 | |
| Global Environ Svcs | | | | \$35 | \$26 | | |
| Convenience Centers | \$438 | \$473 | \$522 | \$658 | \$721 | \$831 | 6% |
| Republic/BFI | \$429 | \$462 | \$513 | \$570 | \$635 | \$717 | |
| Spring Back Recycling | | | | \$77 | \$85 | \$115 | |
| Southeast Recycling | \$9 | \$11 | \$9 | \$11 | \$2 | -\$1 | |
| Compost Program | \$510 | \$357 | \$347 | \$289 | \$417 | \$680 | 4% |
| Nature's Organic Best | | | | | | \$452 | |
| Red River Ranch | \$510 | \$357 | \$347 | \$289 | \$417 | \$228 | |
| Curbside | \$192 | \$200 | \$183 | \$186 | \$207 | \$198 | 1% |
| Toter | \$192 | \$200 | \$183 | \$186 | \$207 | \$198 | |
| Household Haz. Waste | \$2 | \$103 | \$7 | \$78 | \$4 | \$51 | <1% |
| Clean Harbors | \$2 | \$103 | \$7 | \$78 | \$4 | \$51 | |
| Recycling Drop-off Sites | | | | | \$4 | \$5 | <1% |
| Republic/BFI | | | | | \$4 | \$5 | |
| Total Expense from Vendor Contracts | \$12,910 | \$13,428 | \$12,886 | \$13,497 | \$14,107 | \$14,873 | |

New Contract

MPW recently contracted with The Compost Company to begin a food waste collection pilot program. The pilot program offers food waste collection at Metro Buildings and at the Omohundro and East convenience centers.

B.6 Education

MPW offers a number of recycling education programs to schools and the community as listed in **Table B-25**.

Table B-25 Recycling and Litter Prevention Education Programs Offered to Schools and the Community

| Program | Purpose | Description |
|--|--|---|
| Curby’s Recycling Roadshow | How to reduce, reuse and recycle | Learn how to put these practices in place at home and at school. |
| Field Trip to Recycling Education Station | Litter Prevention, and Recycling Program | See a MRF in action and learn first-hand how materials are separated and recycled. See consumer products that are made from our recycled materials and learn how to take personal responsibility to stop littering and start recycling. |
| Reducing Food Waste | Food Waste Prevention | Students conduct a food waste audit at their school and conduct food waste composting as a science project. |
| Music City Students Pick-up | Litter Prevention | Students watch an interactive presentation and conduct a litter pick-up on school grounds. |
| Waste Reduction 101 | Waste Reduction | Learn how to reduce landfilled waste and the resources available for reuse and recycling. |
| The Dirt on Composting | Backyard Composting | Learn composting methods suitable for backyards and schools. |
| Nashville Beautiful Art Contest and Rolling Art Museum | Recycling Awareness | Students prepare art that addresses the contest theme. Cash prizes are awarded to the winning school’s art department. Winning entries are displayed on waste collection trucks and displayed in the Piedmont Gas Christmas Parade. |
| Composting and Recycling Classes | Recycling and Composting Education | Compost classes are offered weekly. Each attendee receives a free composting bin. Recycling classes are offered every other week. |

Enforcement

MPW has a number of regulations set forth by the Metro Code, including regulations of haulers and their equipment, and three landfill material bans: yard waste, corrugated cardboard and electronics. MPW has one inspector to enforce all MPW regulations.

Important Policies Pertaining to Waste Management

TCA 68-211-835

This Tennessee Code requires that disposal fees (or what Metro Code calls the “Solid Waste Generator Fee” only be used to fund solid waste services and that those services be made available to all residents. The fees should roughly match the cost of the services they are funding:

In addition to any power authorized by title 5, a county, municipality or solid waste authority is authorized to impose and collect a solid waste disposal fee. Funds generated from such fees may only be used to establish and maintain solid waste collection and disposal services, including, but not limited to, convenience centers. All residents of the county shall have access to these services. The amount of the fee shall bear a reasonable relationship to the cost of providing the solid waste disposal services. Such fees shall be segregated from the general fund and shall be used only for the purposes for which they were collected.

TCA 68-211-701-4 “The Jackson Law”

The Jackson Law - enacted by Metro Council in May of 2017 – requires approval of a county legislative body for any new landfill or waste processing facility construction unless the landfill only accepts waste generated by its owner and all waste is generated in the same county as the landfill. Additionally, if the construction is in an incorporated area, the governing body of the

municipality must also approve construction. The Jackson Law requires public notice and public hearings prior to voting and provides specific criteria to be evaluated for the approval process.

Metro Code 10.20.360

This Metro Code requires entities collecting, hauling or disposing of waste originating or produced in Davidson County to pay the Metro government a solid waste generator fee of \$6 per ton of MSW and \$1 per cubic yard of C&D waste.

TDEC Reporting Rule for Materials Processing Facilities

To improve reporting, the Tennessee Department of Conservation (TDEC) amended TDEC Rule, Chapter 0400-11-01, Section 9, Waste Reduction and Planning in February of 2015 (effective May 2015) to include the following requirement:

Recovered Materials Processing Facilities (RMPF) that manage over 100 tons per year of reclaimed, recovered or recycled materials or are publicly owned shall report to the Department, on forms provided by the Department, the county of origin and tonnage by commodity type processed by March 1 of each calendar year. Material Processing Facilities may optionally report this information on a quarterly basis on forms provided by the Department.

For the purposes of this paragraph, RMPF shall not include end processors of materials or secondary/intermediate collectors of recycled materials. Only RMPFs that initially receive recycled materials directly from the public (including commercial collections, contracted collections, etc.,) and process and market these materials to secondary, intermediate or end users are required to report under this paragraph.

Table B-26 Davidson County Population Density by District

| Geographic area | Population | Housing units | Area in square miles | | | Density per square mile of land area | |
|--|------------|---------------|----------------------|------------|-----------|--------------------------------------|---------------|
| | | | Total area | Water area | Land area | Population | Housing units |
| Davidson County | 626,681 | 283,978 | 525.94 | 21.91 | 504.03 | 1,243.3 | 563.4 |
| COUNTY SUBDIVISION AND PLACE | | | | | | | |
| District 1 | 16,419 | 6,300 | 80.97 | 1.47 | 79.50 | 206.5 | 79.2 |
| District 2 | 16,163 | 7,040 | 10.77 | 0.36 | 10.41 | 1,552.6 | 676.3 |
| District 3 | 17,192 | 7,080 | 46.94 | 0.05 | 46.90 | 366.6 | 151.0 |
| Nashville-Davidson metropolitan government | 17,186 | 7,078 | 46.94 | 0.05 | 46.89 | 366.5 | 150.9 |
| Ridgetop city | 6 | 2 | 0.01 | 0.00 | 0.01 | 1,174.0 | 391.3 |
| District 4 | 15,505 | 7,750 | 8.33 | 0.05 | 8.28 | 1,872.5 | 936.0 |
| District 5 | 14,281 | 5,819 | 3.93 | 0.08 | 3.85 | 3,709.1 | 1,511.3 |
| District 6 | 16,617 | 8,512 | 4.46 | 0.23 | 4.22 | 3,933.0 | 2,014.7 |
| District 7 | 13,557 | 6,447 | 5.99 | 0.18 | 5.81 | 2,331.4 | 1,108.7 |
| District 8 | 15,106 | 6,927 | 6.27 | 0.05 | 6.22 | 2,428.7 | 1,113.7 |
| District 9 | 17,006 | 7,502 | 10.73 | 0.47 | 10.26 | 1,657.5 | 731.2 |
| District 10 | 18,165 | 8,590 | 25.11 | 0.18 | 24.93 | 728.6 | 344.5 |
| Goodlettsville city | 10,319 | 4,916 | 6.62 | 0.07 | 6.55 | 1,574.4 | 750.1 |
| Nashville-Davidson metropolitan government | 7,804 | 3,653 | 18.20 | 0.11 | 18.09 | 431.4 | 201.9 |
| Ridgetop city | 42 | 21 | 0.29 | 0.00 | 0.29 | 145.6 | 72.8 |
| District 11 | 16,649 | 7,813 | 15.80 | 2.13 | 13.67 | 1,217.6 | 571.4 |
| Lakewood city | 2,302 | 1,041 | 1.01 | 0.00 | 1.01 | 2,281.3 | 1,031.6 |
| Nashville-Davidson metropolitan government | 14,347 | 6,772 | 14.79 | 2.13 | 12.66 | 1,132.9 | 534.7 |
| District 12 | 20,753 | 9,161 | 11.50 | 0.29 | 11.21 | 1,851.4 | 817.2 |
| District 13 | 19,426 | 9,105 | 21.67 | 7.93 | 13.74 | 1,413.6 | 662.5 |
| District 14 | 17,802 | 9,266 | 12.06 | 0.07 | 12.00 | 1,483.7 | 772.3 |
| District 15 | 17,435 | 8,223 | 16.14 | 0.56 | 15.57 | 1,119.5 | 528.0 |
| District 16 | 17,660 | 8,099 | 7.89 | 0.00 | 7.89 | 2,238.3 | 1,026.5 |
| District 17 | 15,838 | 7,855 | 6.42 | 0.00 | 6.41 | 2,469.1 | 1,224.6 |
| Berry Hill city | 537 | 422 | 0.91 | 0.00 | 0.91 | 592.8 | 465.8 |
| Nashville-Davidson metropolitan government | 15,301 | 7,433 | 5.51 | 0.00 | 5.51 | 2,777.7 | 1,349.4 |
| District 18 | 17,194 | 6,290 | 2.42 | 0.00 | 2.42 | 7,111.8 | 2,601.7 |
| District 19 | 18,162 | 8,963 | 5.13 | 0.10 | 5.03 | 3,610.7 | 1,781.9 |
| District 20 | 15,642 | 6,232 | 9.99 | 0.52 | 9.47 | 1,651.5 | 658.0 |
| District 21 | 13,568 | 6,174 | 4.34 | 0.08 | 4.25 | 3,191.4 | 1,452.2 |
| District 22 | 17,264 | 9,245 | 9.86 | 0.01 | 9.85 | 1,752.0 | 938.2 |
| District 23 | 17,546 | 8,553 | 13.27 | 0.00 | 13.27 | 1,322.2 | 644.5 |
| Belle Meade city | 2,912 | 1,162 | 3.08 | 0.00 | 3.08 | 944.2 | 376.8 |
| Nashville-Davidson metropolitan government | 14,634 | 7,391 | 10.19 | 0.00 | 10.19 | 1,436.7 | 725.6 |
| District 24 | 16,635 | 9,543 | 5.68 | 0.00 | 5.68 | 2,927.6 | 1,679.5 |
| District 25 | 17,460 | 9,005 | 5.55 | 0.00 | 5.55 | 3,146.2 | 1,622.7 |
| District 26 | 18,804 | 8,341 | 6.24 | 0.00 | 6.24 | 3,015.3 | 1,337.5 |
| District 27 | 16,799 | 7,916 | 3.58 | 0.00 | 3.58 | 4,696.7 | 2,213.2 |
| District 28 | 18,711 | 6,105 | 7.61 | 0.00 | 7.61 | 2,458.4 | 802.1 |

Table B-27 TDEC Recycling Data Broken Down by Source and Material Type

| Year | Source | Mixed | Grease | Scrap Tires | Batteries | Glass | Plastics | Fiber | Metal | Auto Fluids | Electronics | Pallets | Textiles | Mulch | Compost | Other Diversion |
|------|--------------|--------|--------|-------------|-----------|--------|----------|--------|---------|-------------|-------------|---------|----------|---------|---------|-----------------|
| 2007 | Non-MPW | 6,469 | 0 | 0 | 605 | 23,256 | 902 | 77,043 | 152,682 | 0 | 0 | 3,000 | 6,655 | 49,000 | 0 | 0 |
| | MPW (TDEC) | 13,826 | 0 | 12,528 | 21 | 1,342 | 291 | 5,439 | 759 | 23 | 39 | 0 | 0 | 26,404 | 0 | 0 |
| | Total (TDEC) | 20,295 | 0 | 12,528 | 626 | 24,598 | 1,193 | 82,483 | 153,441 | 23 | 39 | 3,000 | 6,655 | 75,404 | 0 | 0 |
| 2008 | Non-MPW | 6,296 | 11,251 | 0 | 750 | 15,755 | 1,045 | 60,854 | 76,882 | 0 | 198 | | 5,135 | 49,200 | 0 | 0 |
| | MPW (TDEC) | 14,675 | 0 | 8,493 | 13 | 1,928 | 400 | 6,042 | 688 | 33 | 39 | | | 32,995 | 0 | 0 |
| | Total (TDEC) | 20,971 | 11,251 | 8,493 | 763 | 17,682 | 1,445 | 66,897 | 77,569 | 33 | 237 | 0 | 5,135 | 82,195 | 0 | 0 |
| 2009 | Non-MPW | 30,487 | 0 | 0 | 557 | 31,873 | 1,678 | 64,593 | 116,049 | 0 | 126 | 0 | 0 | 46,000 | 0 | 307 |
| | MPW (TDEC) | 4,571 | 0 | 5,963 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39,627 | 0 | 0 |
| | Total (TDEC) | 35,058 | 0 | 5,963 | 557 | 31,873 | 1,678 | 64,593 | 116,049 | 0 | 126 | 0 | 0 | 85,627 | 0 | 307 |
| 2010 | Non-MPW | 12,870 | 4,983 | 0 | 2,100 | 29,126 | 2,129 | 40,715 | 98,314 | 0 | 363 | 1,946 | 5,670 | 47,620 | 0 | 0 |
| | MPW (TDEC) | 13,639 | 0 | 3,501 | 1 | 2,140 | 547 | 5,073 | 519 | 35 | 226 | 0 | 260 | 32,524 | 0 | 0 |
| | Total (TDEC) | 26,509 | 4,983 | 3,501 | 2,101 | 31,266 | 2,677 | 45,788 | 98,832 | 35 | 589 | 1,946 | 5,930 | 80,143 | 0 | 0 |
| 2011 | Non-MPW | 7,468 | 0 | 6,626 | 1,130 | 25,785 | 571 | 24,686 | 101,535 | 0 | 431 | 0 | 10,146 | 54,972 | 0 | 5,366 |
| | MPW (TDEC) | 13,639 | 0 | 0 | 0 | 2,230 | 543 | 4,682 | 447 | 35 | 248 | 0 | 298 | 47,571 | 0 | 0 |
| | Total (TDEC) | 21,107 | 0 | 6,626 | 1,130 | 28,015 | 1,114 | 29,367 | 101,982 | 35 | 678 | 0 | 10,444 | 102,543 | 0 | 5,366 |
| 2012 | Non-MPW | 13,803 | 0 | 0 | 1,703 | 32,864 | 494 | 36,318 | 95,465 | 107 | 711 | 0 | 10,162 | 40,875 | 1,042 | 0 |
| | MPW (TDEC) | 13,265 | 0 | 5,664 | 0 | 2,234 | 507 | 4,340 | 410 | 36 | 231 | 0 | 369 | 31,965 | 0 | 38 |
| | Total (TDEC) | 27,068 | 0 | 5,664 | 1,703 | 35,098 | 1,001 | 40,658 | 95,875 | 143 | 942 | 0 | 10,531 | 72,840 | 1,042 | 38 |
| 2013 | Non-MPW | 19,265 | 6,738 | 0 | 876 | 30,068 | 813 | 44,891 | 136,913 | 0 | 351 | 0 | 12,522 | 33,700 | 0 | 0 |
| | MPW (TDEC) | 13,462 | 0 | 6,062 | 0 | 2,202 | 483 | 4,422 | 252 | 55 | 232 | 0 | 350 | 31,004 | 0 | 0 |
| | Total (TDEC) | 32,728 | 6,738 | 6,062 | 876 | 32,270 | 1,296 | 49,313 | 137,165 | 55 | 582 | 0 | 12,872 | 64,704 | 0 | 0 |
| 2014 | Non-MPW | 24,221 | 7,025 | 0 | 680 | 25,618 | 7,921 | 24,324 | 126,387 | 0 | 0 | 0 | 10,799 | 26,988 | 0 | 0 |
| | MPW (TDEC) | 13,430 | 0 | 6,254 | 0 | 2,095 | 482 | 4,296 | 247 | 60 | 155 | 0 | 318 | 27,983 | 0 | 0 |
| | Total (TDEC) | 37,651 | 7,025 | 6,254 | 680 | 27,714 | 8,403 | 28,620 | 126,634 | 60 | 155 | 0 | 11,118 | 54,971 | 0 | 0 |
| 2015 | Non-MPW | 4,272 | 7,113 | 394 | 766 | 35,409 | 18,382 | 33,340 | 48,745 | 129 | 6 | 0 | 11,092 | 18,000 | 6,754 | 0 |
| | MPW (TDEC) | 13,619 | 0 | 6,761 | 0 | 2,237 | 0 | 4,269 | 460 | 68 | 111 | 0 | 264 | 32,141 | 0 | 0 |
| | Total (TDEC) | 17,891 | 7,113 | 7,155 | 766 | 37,646 | 18,382 | 37,609 | 49,205 | 197 | 118 | 0 | 11,356 | 50,141 | 6,754 | 0 |
| 2016 | Non-MPW | 14,200 | 8,012 | 0 | 837 | 18,435 | 480 | 42,582 | 94,986 | 0 | 0 | 0 | 11,900 | 15,698 | 17,610 | 0 |
| | MPW (TDEC) | 13,926 | 0 | 7,328 | 0 | 2,282 | 0 | 4,450 | 674 | 38 | 219 | 0 | 107 | 37,622 | 0 | 33 |
| | Total (TDEC) | 28,127 | 8,012 | 7,328 | 837 | 20,718 | 480 | 47,031 | 95,660 | 38 | 219 | 0 | 12,007 | 53,320 | 17,610 | 33 |

Source: TDEC APR Reports

*Tonnage reported by for MPW in TDEC APR reports differs slightly from tonnage reported by MPW Monthly Materials by Facility Reports

Table B-28 List of Permitted MSW Haulers, Associated Containers and Trucks

| Hauler | Containers | Trucks |
|---|------------|--------|
| 100-HEARTHSTONE GROUP, LLC | 0 | 19 |
| 105-HUDGINS DISPOSAL, INC | 0 | 27 |
| 106-ACTION ENVIRONMENTAL | 1 | 4 |
| 118-JC DISPOSAL | 0 | 2 |
| 119-JE MCMURTRY DISPOSAL | 0 | 11 |
| 134-KLEEN-WAY DISPOSAL | 7 | 9 |
| 15-ALLIED/REPUBLIC SERVICES, INC. | 4,214 | 98 |
| 154-MARTY SULLIVAN DISPOSAL | 0 | 2 |
| 163-MIDDLE TENNESSEE STATE UNIVERSITY | 0 | 1 |
| 164-MIDDLE TENNESSEE STATE UNIVERSITY/TENNESSEE MILLER COLISEUM | 6 | 1 |
| 167-MLT DISPOSAL/MECCIE THREALKILL | 0 | 1 |
| 170-MR. BULTS, INC (MBI) | 222 | 103 |
| 184-PAT READE DISPOSAL | 0 | 2 |
| 188-PRECISION FIELD SERVICES, LLC | 1 | 3 |
| 194-PRINTNET USA, INC. | 1 | 0 |
| 203-RR WASTE SOLUTIONS, LP | 38 | 64 |
| 225-SWEEPING CORPORATION OF AMERICA, INC. | 0 | 17 |
| 254-WASTE INDUSTRIES, LLC | 2,164 | 47 |
| 255-WASTE MANAGEMENT, INC. | 5,940 | 126 |
| 281-REPUBLIC SERVICES, INC | 34 | 17 |
| 288-J&J SERVICES, INC. | 1,641 | 34 |
| 311-B & B DISPOSAL | 0 | 0 |
| 314-NEWLAND DISPOSAL | 0 | 2 |
| 316-ETERNAL RETURNS LLC | 0 | 2 |
| 318-P & M SERVICES | 33 | 3 |
| 319-RED DOG DUMPSTERS | 100 | 3 |
| 320-QUEEN CITY DISPOSAL | 124 | 2 |
| 37-BURNICE WINFREY DISPOSAL | 0 | 2 |
| 41-CLARKSVILLE DISPOSAL (WASTE CONNECTIONS OF TENNESSEE, INC.) | 736 | 10 |
| 51-CORDELL JOHNSON DISPOSAL SERVICE | 0 | 1 |
| 52-COUNTY DISPOSAL | 0 | 4 |
| 62-HUGGINS DISPOSAL | 0 | 1 |
| 69-EAGLE DISPOSAL | 15 | 6 |
| 9-ADVANCED DISPOSAL SERVICES MIDDLE TENNESSEE, LLC | 0 | 0 |
| 96-GRAY'S DISPOSAL COMPANY | 0 | 12 |

Source: Metro Nashville Public Works Department

Table B-29 List of Permitted C&D Haulers, Associated Containers and Trucks

| Hauler | Containers | Truck |
|--|------------|-------|
| 22-GUERRERO, LUGO | 5 | 2 |
| 108-INNOVATIVE BUILDING SPECIALTIES, INC. | 0 | 1 |
| 109-INSTALLATION GROUP, LLC | 0 | 2 |
| 110-J&A CONSTRUCTION, LLC | 11 | 3 |
| 113-J&S CONSTRUCTION COMPANY | 0 | 7 |
| 114-J&V CONSTRUCTION, INC. | 1 | 1 |
| 13-ALL SEASON LANDSCAPING | 3 | 1 |
| 146-LORENA AREAS | 0 | 0 |
| 152-MARCOR CONSTRUCTION | 0 | 1 |
| 153-MARKS REMODELING | 1 | 1 |
| 157-MCINTOSH-MURPHY CO., INC. | 0 | 2 |
| 162-MIDDLE TENNESSEE ROOFING COMPANY, INC. | 0 | 1 |
| 168-MODERN DAY WRECKING | 5 | 3 |
| 171-MS-COT SERVICES, LLC | 0 | 0 |
| 172-MUSIC CITY THRIFT | 0 | 1 |
| 173-MUSIC CITY WASTE, LLC | 216 | 6 |
| 175-NASHVILLE WILBERT BURIAL VAULT COMPANY (BICKS, INC.) | 0 | 1 |
| 180-P&M DISPOSAL | 71 | 2 |
| 187-PHIPPS CONSTRUCTION COMPANY, INC. | 0 | 1 |
| 190-PREMIUM RESTORATION SERVICES, INC. | 1 | 1 |
| 198-R.D. HERBERT & SONS COMPANY | 0 | 1 |
| 200-RAUL SEPULVEDA | 2 | 2 |
| 202-RB CONSTRUCTION/RAN BATSON CONSTRUCTION, INC. | 2 | 0 |
| 204-RELIABLE ROOFING CONSTRUCTION & REPAIR SERVICE, INC. | 0 | 2 |
| 205-RESOURCE MANAGEMENT CO., INC. | 0 | 8 |
| 208-ROBERTO DEL ANGEL | 1 | 1 |
| 209-ROY S. JONES CONSTRUCTION CO., INC. | 0 | 1 |
| 211-RSS ROOFING SERVICES & SOLUTIONS, LLC | 6 | 5 |
| 212-BLESSING OF GOD CONSTRUCTION | 3 | 3 |
| 218-SOUTHEASTERN RECYCLING | 1 | 1 |
| 219-SOUTHERN ROOFING COMPANY, INC. | 1 | 2 |
| 22-GUERRERO, LUGO | 5 | 2 |
| 222-STAR CONSTRUCTION, LLC | 0 | 2 |
| 223-SUMNER ROOFING COMPANY, INC. | 22 | 1 |
| 227-T.H.E. CONSTRUCTION | 1 | 1 |
| 229-TENANT BUILDING GROUP, LLC | 0 | 1 |
| 230-TENN-STAR HOME IMPROVEMENTS, LLC | 1 | 1 |
| 234-THE PORCH COMPANY, INC. | 0 | 0 |
| 236-THE WILLS COMPANY, INC. | 1 | 6 |

Appendix B • Existing Solid Waste System

| Hauler | Containers | Truck |
|---|------------|-------|
| 244-TRUE-LINE CORING & CUTTING, NASHVILLE, LLC | 1 | 2 |
| 250-VARGAS CONSTRUCTION | 1 | 1 |
| 251-VICENTE RAYO PEREZ | 2 | 2 |
| 252-VILLAS CONSTRUCTION, INC. | 1 | 1 |
| 257-WHEELER INC. | 1 | 2 |
| 258-WHOLESALE HOME SERVICES | 1 | 1 |
| 260-WIREHOUSE LLC | 3 | 1 |
| 266-THE ROOF TECH | 1 | 1 |
| 27-BAU CONSTRUCTION | 3 | 3 |
| 272-KING ROOFING CO., LLC | 1 | 1 |
| 29-BEECH CONSTRUCTION SERVICES, INC. | 7 | 0 |
| 295-Griffin Waste Services | 188 | 2 |
| 296-Diamond Disposal USA, Inc. | 18 | 0 |
| 309-BIN THERE DUMP THAT/JNB ENTERPRISES | 179 | 5 |
| 313-ASCENCION CAHUEC CASTRO | 0 | 1 |
| 33-BONE DRY ROOFING | 1 | 1 |
| 34-BRICKMAN GROUP | 0 | 13 |
| 35-BUCHI PLUMBING, HEATING & AIR CONDITIONING, INC. | 0 | 1 |
| 38-C&D CONSTRUCTION, INC. | 2 | 4 |
| 42-CLINARD COMPANY, INC. | 0 | 1 |
| 44-COLLIER ROOFING COMPANY, INC. | 0 | 3 |
| 48-CONRAD CONSTRUCTION CO., INC. | 0 | 1 |
| 50-CONSTRUCTION UNLIMITED, INC. | 0 | 1 |
| 56-DAVET ROOFING, INC. | 4 | 3 |
| 60-DEMONBREUN ROOFING, INC. | 0 | 1 |
| 63-DIXIE EARTH MOVERS, INC. | 0 | 3 |
| 70-EARTH FIRST LLC | 164 | 4 |
| 78-ESTES ROOFING, INC. | 5 | 2 |
| 82-FIRST RESPONSE ENVIRONMENTAL GROUP | 23 | 7 |
| 84-FIVE STAR SERVICE | 1 | 1 |
| 87-FRANSISCO ARRIAGA | 2 | 3 |
| 88-FULL CIRCLE DISPOSAL, LLC | 300 | 11 |

Source: Metro Nashville Public Works Department

Table B-30 Non-Fund Revenue by MPW Business Unit

| Business Unit | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| Metro Collection-42803100 | \$3,839,412 | \$4,203,672 | \$4,182,861 | \$4,649,887 | \$4,738,869 | \$5,424,025 |
| Solid Waste Tires-42701300 | \$0 | \$0 | \$0 | \$580,598 | \$533,119 | \$711,706 |
| Convenience/Recycle Ctrs-42804520 | \$475,278 | \$396,697 | \$375,437 | \$426,106 | \$489,328 | \$555,515 |
| Front Loader Collection-42803500 | \$221,250 | \$250,010 | \$250,000 | \$250,093 | \$249,996 | \$295,159 |
| Drop Off Recycle Centers-42804510 | \$278,539 | \$216,277 | \$217,875 | \$167,232 | \$64,645 | \$185,467 |
| Solid Waste Haz Grant-42301300 | \$85,000 | \$85,000 | \$85,000 | \$85,000 | \$42,500 | \$127,500 |
| Solid Waste Rebate Grant-42301500 | \$52,345 | \$46,875 | \$51,374 | \$97,745 | \$53,417 | \$122,741 |
| Compost Program-42804710 | \$188,843 | \$208,189 | \$231,073 | \$194,942 | \$264,515 | \$102,519 |
| Curbside Recycling-42804300 | \$307,122 | \$232,633 | \$193,396 | \$195,807 | \$7,248 | \$64,129 |
| Downtown Business Recycling-42804200 | \$31,235 | \$35,256 | \$28,488 | \$26,417 | \$0 | \$46,251 |
| Education/Pub Relations-42801200 | \$23,500 | \$33,500 | \$14,718 | \$27,720 | \$62,320 | \$44,280 |
| Household Hazardous Wast-42804800 | \$4,423 | \$2,734 | \$3,372 | \$1,253 | \$81 | \$0 |
| Grand Total | \$5,506,946 | \$5,710,843 | \$5,633,593 | \$6,702,799 | \$6,506,036 | \$7,679,292 |

Table B-31 Operational Expense by MPW Business Unit

| Business Unit | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Metro Collection-42803100 | \$13,058,976 | \$13,343,675 | \$13,440,011 | \$13,698,517 | \$14,121,407 | \$14,442,845 |
| Communications, Advertising and Promotion | \$0 | \$0 | \$0 | \$0 | \$0 | \$20 |
| Internal Service Fees | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Other | \$560 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Personal Services | \$973,409 | \$1,016,473 | \$957,882 | \$983,015 | \$968,148 | \$1,131,219 |
| Professional & Purchased Services | \$11,521,929 | \$11,738,725 | \$11,788,952 | \$12,175,492 | \$12,625,897 | \$13,032,823 |
| Repairs & Maintenance Services | \$426,461 | \$547,110 | \$190,887 | \$247,389 | \$253,849 | \$265,951 |
| Supplies & Materials | \$136,605 | \$41,367 | \$502,290 | \$292,622 | \$273,513 | \$12,832 |
| Travel, Tuition and Dues | \$12 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Utilities | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Administration-42861110 | \$1,587,579 | \$2,129,656 | \$1,862,154 | \$2,140,575 | \$2,996,583 | \$3,023,423 |
| Communications, Advertising and Promotion | \$41,983 | \$36,962 | \$26,446 | \$53,975 | \$52,277 | \$43,723 |
| Internal Service Fees | \$996,883 | \$1,357,335 | \$1,224,971 | \$1,499,644 | \$2,136,243 | \$2,316,998 |
| Other | \$14,350 | \$9,744 | \$13,857 | \$16,099 | \$11,756 | \$12,692 |
| Personal Services | \$429,171 | \$632,526 | \$500,822 | \$480,426 | \$457,234 | \$436,146 |
| Professional & Purchased Services | \$4,705 | \$4,975 | \$4,342 | \$2,995 | \$172,483 | \$102,709 |
| Repairs & Maintenance Services | \$15,813 | \$6,601 | \$3,585 | \$412 | \$17,154 | \$20,091 |
| Supplies & Materials | \$30,420 | \$32,649 | \$35,895 | \$40,513 | \$56,231 | \$40,640 |
| Travel, Tuition and Dues | \$984 | \$3,387 | \$3,270 | \$2,789 | \$4,129 | \$2,464 |
| Utilities | \$53,270 | \$45,478 | \$48,966 | \$43,723 | \$89,076 | \$47,962 |
| Convenience/Recycle Ctrs-42804520 | \$1,128,451 | \$1,167,821 | \$1,239,435 | \$1,420,849 | \$1,735,777 | \$1,823,157 |
| Communications, Advertising and Promotion | \$0 | \$1,645 | \$252 | \$84 | -\$46 | \$271 |
| Internal Service Fees | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Other | \$513 | \$1,807 | \$1,980 | \$1,484 | \$1,100 | \$1,485 |
| Personal Services | \$612,349 | \$611,369 | \$644,057 | \$682,066 | \$921,451 | \$874,493 |
| Professional & Purchased Services | \$506,817 | \$545,674 | \$590,058 | \$732,550 | \$797,395 | \$936,899 |
| Repairs & Maintenance Services | \$0 | \$0 | \$0 | \$0 | \$0 | \$1,593 |
| Supplies & Materials | \$7,570 | \$6,229 | \$2,943 | \$4,360 | \$15,878 | \$8,416 |
| Travel, Tuition and Dues | \$1,202 | \$1,097 | \$145 | \$305 | \$0 | \$0 |
| Utilities | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Brush Collection-42803700 | \$806,330 | \$902,588 | \$1,009,477 | \$1,336,438 | \$1,384,696 | \$1,394,881 |
| Communications, Advertising and Promotion | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Internal Service Fees | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Other | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Personal Services | \$806,202 | \$900,389 | \$1,007,150 | \$1,333,102 | \$1,384,520 | \$1,392,531 |
| Professional & Purchased Services | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Repairs & Maintenance Services | \$0 | \$1,150 | \$0 | \$0 | \$0 | \$0 |
| Supplies & Materials | \$128 | \$1,049 | \$2,328 | \$3,336 | \$176 | \$2,350 |

Appendix C

Waste and Recycling Materials Characterization Study

C.1 Study Approach and Work Plan

Metro Nashville commissioned CDM Smith to perform a characterization study of landfilled MSW to provide supporting data for the Solid Waste Master Plan. Thanks to a grant provided by the Tennessee Department of Environment & Conservation (TDEC) that funded the waste characterization study. The TDEC funding also allowed the study to be expanded to include materials collected through the single stream, curbside recycling program in the Urban Services District and various private hauler curbside collection services in the USD and GSD. The full waste and recycling characterization report is available as a separate document.

The primary objectives of the study were to determine:

- Compositional differences in landfilled MSW and recycled materials between:
 - The Residential and Commercial sectors
 - The Urban Services District (USD) and the General Services District (GSD)
 - The summer and fall seasons
- The types and percentages of non-recyclable materials being placed in curbside recycle bins (i.e.; contamination).
- The types and percentages of recyclables remaining in landfilled MSW.
- The most abundant material categories being landfilled.

CDM Smith conducted the study over two seasons. The first sampling event was performed in July 2017 over a two-week period. The first week was dedicated to sampling MSW-to-be-landfilled at the Republic and Waste Management transfer stations and the second week focused on single stream recyclables received at the Waste Management River Hills Material Recovery Facility (see **Figure C-1** for facility locations). The second sampling event occurred over a two-week period in October 2017 and followed the same sampling plan.

A work plan, included in the full report, was developed to ensure representative results. The sampling protocol complied with the American Society for Testing Materials (ASTM) D5231 – Standard Test Method for Determination of the Composition of Unprocessed Municipal Solid Waste. Trucks were selected for sampling by experienced staff located at the scale house of each facility. The drivers of incoming trucks were interviewed to identify their collection route and waste sector(s) and were selected for sampling based on the sampling distribution plan. Sample

sorting and weighing was performed under the supervision of experienced staff and data was recorded on the field logs provided in the full report.



Figure C-1
Transfer Stations and Material Recovery Facility Locations

Over the two seasons, 285 samples, with a combined weight of 30 tons, were sorted and weighed. For landfilled MSW, the sampling distribution was 50/50 between the Residential and Commercial sectors and 78/22 between the USD and GSD. For recycled materials the distribution was 57/43 and 80/20, respectively.

Collected samples were sorted into nine material classes:

1. Paper
2. Plastics

3. Glass
4. Metals
5. Organics
6. C&D Debris
7. Miscellaneous Inorganics (televisions and other household/office items consisting of multiple types of materials)
8. Household Hazardous Waste (HHW)
9. Textiles

The nine classes were further separated into 50 material categories (definitions are provided in appendix A of the report):

1. **Paper** – Newsprint, High Grade Office Paper, Magazines/Catalogs, Uncoated OCC, Kraft, Boxboard, Mixed Paper - Recyclable, Milk and Juice cartons/boxes, and Other Paper
2. **Plastics** - #1 PET Bottles/Jars, #1 Other PET Containers & Packaging, #2 HDPE Bottles/Jars - Clear, #2 HDPE Bottles/ Jars - Color, #2 Other HDPE Containers & Packaging, #6 Expanded Polystyrene Packaging (EPS), #3-#7 Other – All, Other Rigid Plastic Products, Grocery & Merchandise Film Bags, Trash Film Bags, Commercial and Industrial Film, Other Film, and Remainder/ Composite Plastic
3. **Glass** - Recyclable clear, brown, green, and blue Glass Bottles and Jars, Flat Glass, and Other Glass
4. **Metals** - Aluminum Beverage Containers, Other Aluminum, Ferrous containers (tin cans), Aerosol cans, Other Ferrous, Other Non-Ferrous, and Other Metal
5. **Organics** - Yard Waste - Compostable, Yard Waste - Woody, Food Scraps, Bottom Fines and Dirt, Diapers, Other Organics
6. **C&D Waste** - Clean Dimensional Lumber, Clean Engineered Wood, Wood Pallets, Painted Wood, Treated Wood, Concrete, Reinforced Concrete, Asphalt Paving, Rock and Other Aggregates, Bricks, Gypsum Board, Composition Shingles, Other Roofing, Plastic C&D materials, Ceramics/Porcelain, and other C&D.
7. **Inorganics** – Televisions, Computer Monitors, Computer Equipment/ Peripherals, Electronic Equipment, White Goods - refrigerated, White Goods - not refrigerated, Lead-acid Batteries, Other Household Batteries, Tires, Household Bulky Items, and Fluorescent Lights/Ballasts.

8. **HHW** - Latex Paint, Oil Paint, Plant/Organism/Pest Control/Growth, Used Oil/Filters, Other Automotive Fluids, Mercury-Containing Items, Sharps & Infectious Waste, Ash, Sludge, & Other Industrial Processed Wastes, Sewage Solids, and Other HHW
9. **Textiles** – Carpet, Carpet Padding, Clothing, and Other Textiles.

C.2 Principal Findings

C.2.1 Landfilled MSW

Figure C-2 shows the percentage, by weight, of the nine material classes for the Residential and Commercial sectors. Paper, Organics, and Plastics accounted for approximately two thirds of the landfilled Residential/Commercial MSW. A significant amount of C&D waste was also present.

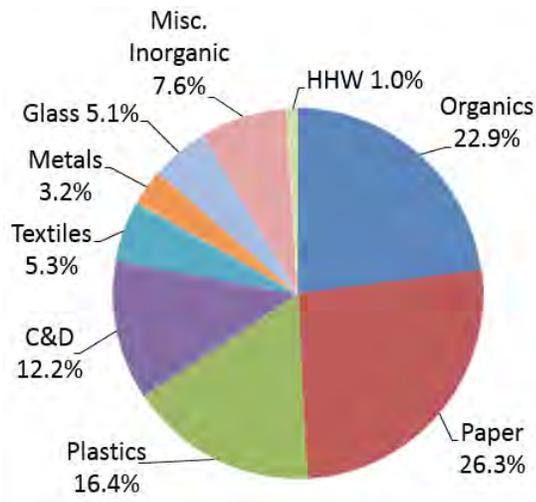


Figure C-2
Composition of Residential/Commercial Landfilled MSW by Weight

Table C-1 lists the top ten material categories in the landfilled MSW Residential/Commercial MSW. Food Scraps, C&D waste, and Other Paper categories account for more than one third of landfilled Residential/Commercial MSW. The two most abundant materials being landfilled are Food Scraps and C&D Waste.

Table C-1 Top Ten Categories in Landfilled Residential/Commercial MSW

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|---|----------------------------------|---------------------------|
| Food Scraps | 15.4% | 15.4% |
| C&D Waste | 12.2% | 27.6% |
| Other Paper | 9.3% | 36.9% |
| Uncoated OCC | 7.9% | 44.8% |
| Household bulky items, batteries, tires, fluorescents, other misc. inorganics | 6.1% | 50.9% |
| Clothing and Other Textiles | 4.7% | 55.7% |
| Boxboard | 3.2% | 58.9% |
| Yard Waste - Compostable; leaves, grass, branches <0.5" | 2.6% | 61.5% |
| Plastic Film | 2.3% | 63.8% |
| Diapers | 2.3% | 66.1% |
| Total | 66.1% | 66.1% |

Comparison of Residential to Commercial, as illustrated in **Figure C-3**, shows similar percentages for Paper and Plastics. However, the Residential sector has much higher Organics content and the Commercial sector has significantly higher C&D Waste content.

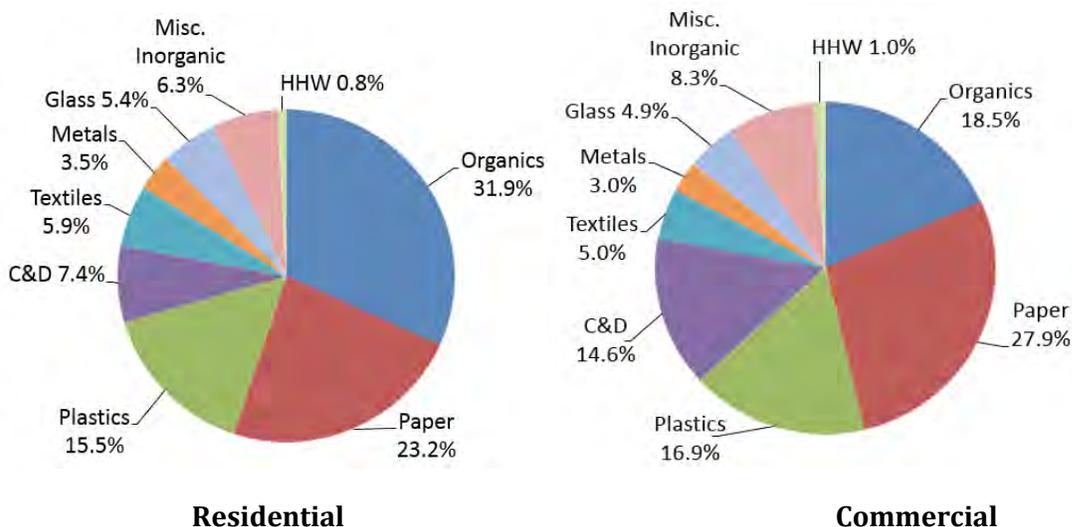


Figure C-3
Comparison of Residential and Commercial Landfilled MSW by Weight

Tables C-2 and **C-3** list the top ten material categories for Residential and Commercial landfilled MSW. Food Scraps is the largest category in Residential waste and is more than twice the percentage of the next largest category which is Other Paper. None of the top ten categories for Residential are materials included in the USD curbside recycling program. The top category for

Commercial waste is C&D Waste. Uncoated OCC is the third highest category indicating that additional efforts should be made to target Uncoated OCC for recycling.

Table C-2 Top Ten Material Categories in Landfilled Residential MSW

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|---|----------------------------------|---------------------------|
| Food Scraps | 20.8% | 20.8% |
| Other Paper | 9.3% | 30.0% |
| Construction and Demolition materials | 7.4% | 37.4% |
| Household bulky items, batteries, tires, fluorescents, other misc. inorganics | 5.1% | 42.5% |
| Clothing and other textiles | 5.1% | 47.6% |
| Diapers | 3.7% | 51.4% |
| Uncoated OCC | 3.5% | 54.9% |
| Other Organic | 3.2% | 58.1% |
| Yard Waste - Compostable; leaves, grass, branches <0.5" | 3.1% | 61.3% |
| Glass Bottles and Jars - clear | 3.0% | 64.3% |
| Total | 64.3% | 64.3% |

Table C-3 Top Ten Material Categories in Landfilled Commercial MSW

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|---|----------------------------------|---------------------------|
| Construction and Demolition materials | 14.6% | 14.6% |
| Food Scraps | 12.7% | 27.3% |
| Uncoated OCC | 10.1% | 37.4% |
| Other Paper | 9.4% | 46.7% |
| Household bulky items, batteries, tires, fluorescents, other misc. inorganics | 6.6% | 53.3% |
| Clothing and other textiles | 4.6% | 57.9% |
| Boxboard | 3.6% | 61.5% |
| Trash Bags | 2.4% | 63.9% |
| Other Film | 2.3% | 66.2% |
| Yard Waste - Compostable; leaves, grass, branches <0.5" | 2.3% | 68.5% |
| Total | 68.5% | 68.5% |

Comparison of landfilled MSW from the USD and GSD is provided in **Figure C-4**. The results show slight variations but, overall, the composition of the two districts are quite similar.

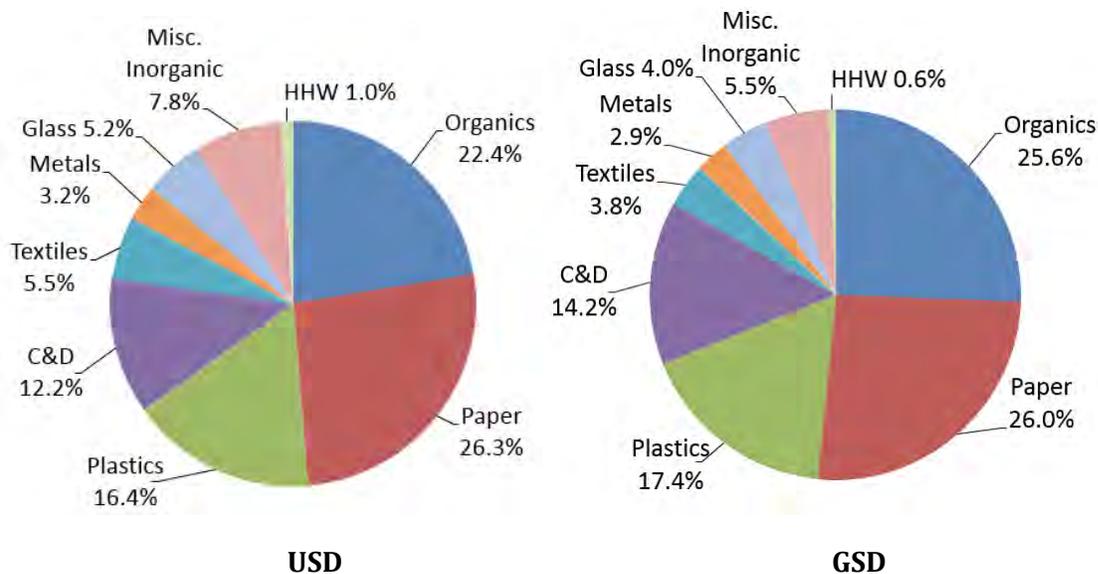


Figure C-4
Comparison of Residential USD and GSD Landfilled MSW by Weight

Seasonal variations in waste composition were evaluated by comparing the Summer and Fall sampling results as shown in **Figure C-5**. The most notable difference is the higher percentage of C&D Waste in the Summer. Minor differences include Organics and Paper (higher in the Fall) and Glass (higher in the Summer).

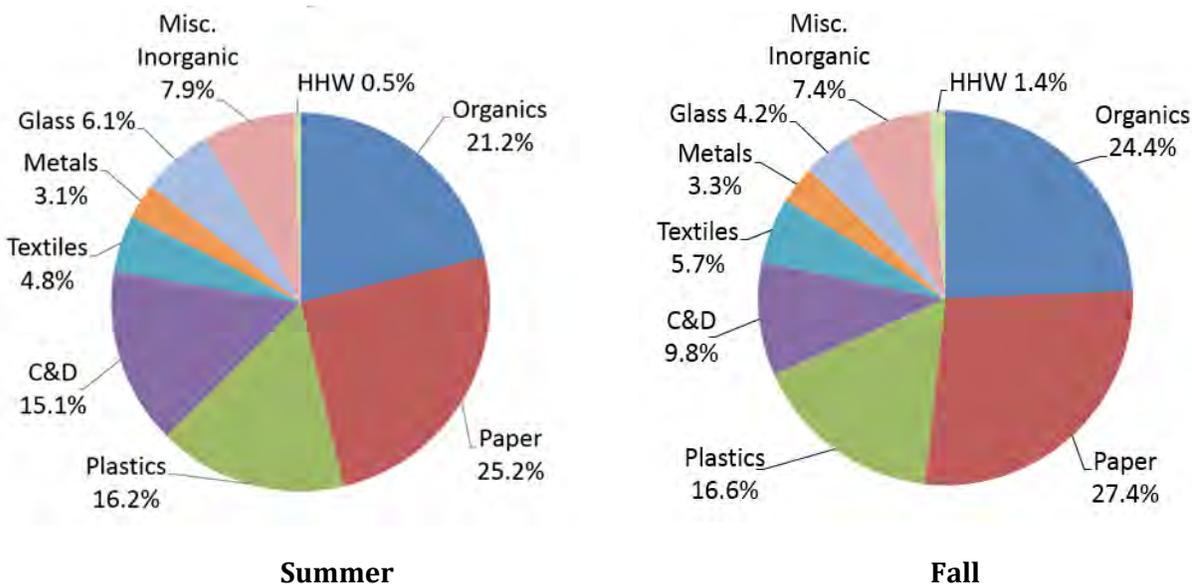


Figure C-5
Comparison of Summer and Fall Landfilled MSW by Weight

C.2.2 Recycled Materials Characterization

Figure C-6 shows the percentage, by weight, of each of the nine material classes for the materials collected from the curbside recycling program for the combined residential and commercial sectors. As expected, Paper and Plastics account for nearly 90 percent of the collected material (the curbside program accepts: Paper, Uncoated OCC, Plastic Bottles and Containers, Ferrous Cans and Aluminum Cans, Foils and Trays). Glass is the largest source of contamination in the recycled material stream at 3.3%. Organics and C&D waste are other major contaminants.

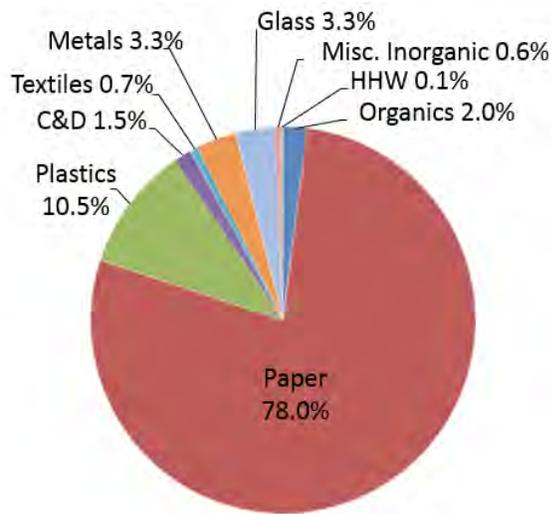


Figure C-6
Composition of Materials Collected from the Single Stream Curbside Recycling Program

Table C-4 lists the top ten categories found in the recycled residential/commercial materials. Uncoated OCC is the most prevalent material recycled.

Table C-4 Top Ten Categories in Residential/Commercial Recycled Materials (combined seasons)

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|---------------------------------------|----------------------------------|---------------------------|
| Uncoated OCC | 37.6% | 37.6% |
| Magazines/Catalogs | 9.7% | 47.3% |
| Newsprint | 8.0% | 55.3% |
| Boxboard | 7.7% | 63.0% |
| High Grade Office Paper | 5.3% | 68.3% |
| Mixed Paper - Recyclable | 5.0% | 73.3% |
| #1 PET Bottles/Jars | 3.0% | 76.2% |
| Other Paper | 2.8% | 79.1% |
| Kraft | 1.6% | 80.6% |
| Construction and Demolition materials | 1.5% | 82.2% |
| Total | 82.2% | |

Comparison of materials collected for Residential and Commercial recycling, as provided in **Figure C-7**, shows that Commercial has a higher percentage of Paper but lower amounts of Plastic and Metals. With the exception of Organics and C&D Waste, the level of contaminants is higher for the Residential recycle stream as it shows higher percentages of Glass, Textiles and Misc. Inorganics.

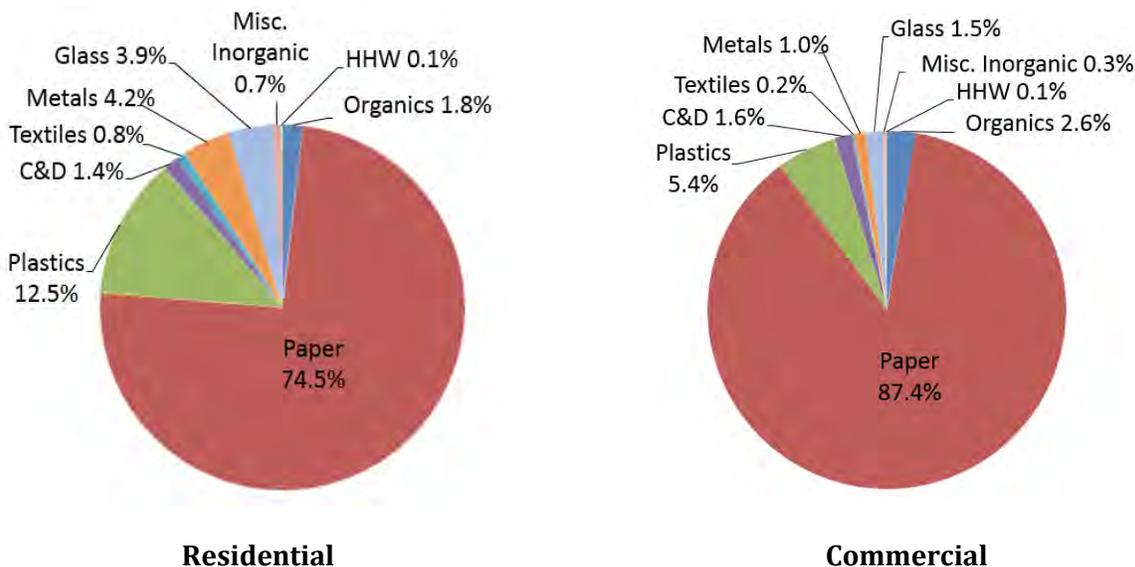


Figure C-7
Comparison of Residential and Commercial Materials Collected for Recycling

Tables C-5 and **C-6** list the top ten categories found in the recycled materials for the Residential and Commercial sectors. Uncoated OCC is the number 1 category for both sectors. For the Commercial sector, Uncoated OCC is more than the next 6 categories combined. Nearly all the top 10 categories for Residential are a form of Paper with the exception of #1 PET and Aluminum Containers. None of the top ten categories for Residential are contaminants whereas six of the top ten categories for Commercial are non-recycled materials.

Table C-5 Top Ten Material Categories in Residential Recycled Materials

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|-------------------------------------|----------------------------------|---------------------------|
| Uncoated OCC | 26.1% | 26.1% |
| Magazines/Catalogs | 11.9% | 38.1% |
| Newsprint | 10.8% | 48.8% |
| Boxboard | 8.3% | 57.1% |
| Mixed Paper - Recyclable | 6.4% | 63.5% |
| High Grade Office Paper | 5.4% | 68.9% |
| #1 PET Bottles/Jars | 3.8% | 72.8% |
| Compostable Paper and 'other' paper | 3.2% | 76.0% |
| Kraft | 1.9% | 77.9% |
| Aluminum Beverage Containers | 1.6% | 79.5% |
| Total | 79.5% | 79.5% |

Table C-6 Top Ten Material Categories in Commercial Recycled Materials

| Category | Waste Composition % By Weight | Cumulative % By Weight |
|---------------------------------------|----------------------------------|---------------------------|
| Uncoated OCC | 68.2% | 68.2% |
| Boxboard | 6.1% | 74.3% |
| High Grade Office Paper | 4.9% | 79.2% |
| Magazines/Catalogs | 3.8% | 83.0% |
| Food Scraps | 2.1% | 85.1% |
| Compostable Paper and 'other' paper | 1.6% | 86.7% |
| Construction and Demolition materials | 1.6% | 88.2% |
| Other Film | 1.4% | 89.6% |
| Mixed Paper - Recyclable | 1.2% | 90.8% |
| Glass Bottles and Jars - clear | 1.1% | 91.9% |
| Total | 91.9% | 91.9% |

Appendix D

Stakeholder Engagement

D.1 Public Education and Outreach

This section provides further details on the overall efforts completed regarding all stakeholder and public engagement. The key to any successful plan is this public engagement and acceptance; and therefore, we understand these are just the Plan's first steps in what will be a consistent public education and outreach process throughout the implementation of the plan moving forward.

D.2 Davidson County Solid Waste Regional Board

The Solid Waste Regional Board (Board) was formed in November 1992 in response to the Solid Waste Management Act of 1991. The purpose of the Solid Waste Region Board is to prepare comprehensive and integrated solid waste management plans for the Nashville region. Board members are responsible to provide the region's legislative bodies with information to make informed decisions about solid waste management. CDM Smith held three meetings with the Solid Waste Regional Board to provide updates of the Solid Waste Master Plan. Meetings were held on September 6, 2017, December 6, 2017 and March 29, 2018.

D.2.1 Solid Waste Region Board Meetings

During the September 6, 2017 meeting, CDM Smith discussed the drivers for and main priorities of the Plan. These include implementing clear goals, metrics and timelines for reaching zero waste within 30 years (as well as plans for quicker implementation), addressing organics diversion, evaluating community equity components, and determining the best approaches to public education and community and regional promotion. Waste disposal and recycling statistics of Davison County were presented along with an update in scheduled public engagement forums, an online survey, and the waste and recycling characterization study. CDM Smith also provided a research update with included information on tonnage projections for Metro Nashville, examples of organic waste beneficial uses, successful zero waste diversion programs, updates on the changing recycling market, and potential policy options being considered.

The second progress meeting held on December 6th provided Metro Public Works updates on current organics diversion and collection efforts, glass recycling, education and other regional efforts. The Board was provided updates on public engagement activities including interviews with key environmental groups and updates on the online survey and the waste and recycling characterization study. CDM Smith also identified leading policies and programs associated with zero waste communities.

The Board asked questions and provided feedback throughout the meeting including:

- How does Nashville compare to other cities that implemented similar recommended zero waste diversion approaches?

- Interest in exploring reuse and reduction programs at the source via education and other programming.
- How to drive end markets for recyclable materials to the Nashville region?
- Best way to encourage people to recycle and care about recycling?
- Use of recyclable materials in upcoming construction projects.

During the March 29th meeting, CDM Smith presented the results from the public online survey and the waste and recycling characterization study. The meeting included discussion about program strategies including high performance featured strategies and zero waste featured strategies. Communities utilizing zero waste strategies were also presented for comparative purposes. CDM Smith also discussed diversion modeling, project costs, and program foundation policies and funding.

D.3 Task Force

The Task Force was developed by the Metro Nashville Public Works department in order that various agencies, organizations, educational institutions and individuals can provide input into the Plan. This input will help ensure a community-driven and implementable plan is developed. The members of the Task Force represent a broad range of interests and issues and have offered a variety of options for input and discussion. The Task Force has met quarterly throughout the development of the Solid Waste Master Plan. CDM Smith has held three meetings with the Task Force. These meetings were held on September 7, 2017, December 7, 2017, and March 30, 2018.

D.3.1 Task Force Meetings

The goal of the first meeting was to provide the members an overview of why the Solid Waste Master Plan was being developed, introduction of the Task Force and Solid Waste Master Plan team and explain the priorities and tasks for the plan. CDM Smith also presented plans for public engagement and the overall project schedule and the next steps moving forward.

The second meeting provided updates about Metro Public Works, the waste and recycling characterization study, and the public online survey results. CDM Smith also presented ongoing public engagement activities, summary of research recommendations, and Metro's current solid waste fund structure and the associated challenges. A discussion followed the presentation where Task Force members were able to ask questions and provide feedback. Questions pertained to the online survey, the waste and recycling characterization study results, benefits to the community, and how to expand and improve educational efforts.

The March 30th meeting was structured differently than the first two meetings in order to fully engage the members while also facilitating a broader and deeper discussion of the goal to achieve 90+% diversion from landfill disposal. The meeting focused on the planned strategies for moving waste diversion efforts to the high-performance level (diverting 75% of the waste stream). Several of the strategies discussed were save-as-you-throw services, enforcing existing bans, small business policies, C&D deposit systems, and improved residential contracts/franchises. Strategies to move from 75% diversion to 90%+ diversion (achieving zero waste) were also discussed such as public education and outreach, Metro construction recycled content

ordinances, deconstruction and reuse ordinances, food donation, and recycling economic development. These strategies are discussed in detail within Sections 6 and 7 of the Plan. The engaging portions of the meeting were the breakout sessions which included five different topics: organics recycling and recovery, commercial waste, construction and demolition waste, residential waste, and facilities required to support diversion. In each of these breakout sessions, members of the task force discussed their thoughts and opinions on one of the topics more specifically and gave direct feedback to the core project team. These feedbacks were summarized in session notes and taken into account in the final development and recommendations for this plan.

The detailed notes and summarized feedback from each of the breakout sessions are provided as Attachment 1 to this Section. Some of the key feedback received from the Task Force breakout session included:

- How can we ensure the inclusion of small businesses in the provision of services?
- Organics contamination is a big concern for residential curbside pickup, as well as for businesses
- Provide food waste reduction strategies that can be implemented right away
- Incentivize C & D Reuse/Recycle, require C&D recycling, and verify recycling facilities
- Want to see simplicity/convenience for residential programs
- Public awareness/education has to increase. Very important to overall program success.
- Locating facilities in Nashville will run into challenges with zoning issues and the high cost of property.

D.4 Public Meetings

Six public meetings were held throughout Nashville to share the potential aspects of the master plan and receive feedback and comments from the residential and business communities. The meetings were spread strategically throughout the County to give as much of the public an opportunity to attend and participate. The session locations included Madison, Hermitage, Bordeaux, West Nashville, Downtown Corridor/Business District and South Nashville. The details (location, date and time) for each meeting is included in the table below.

Table D-1 Public Input Sessions

| Metro Area | Date | Location |
|-------------------|--------------------------------------|---|
| Madison | June 12, 2018 6:30 – 8 PM | Madison Police Precinct Community Room A 400 Myatt Drive Madison, TN |
| Hermitage | June 14, 2018 6:30 – 8 PM | Hermitage Police Precinct Community Room 3701 James Kay Lane Hermitage, TN 37076 |
| Bordeaux | June 16, 2018 10:00 AM – 11:30 PM | Hartman Park Regional Center 2801 Tucker Road Nashville, TN 37218 |
| West Nashville | June 19, 2018 6:30 – 8 PM | West Police Precinct Community Room 5500 Charlotte Pike Nashville, TN 37209 |
| Downtown | June 20, 2018 4:30 – 6 PM | Lipscomb/Spark Community Room 147 Fourth Avenue North Nashville, TN 37219 |
| South Nashville | June 21, 2018 6:30 – 8 PM | Metro Parks Southeast Community Center (Global Mall) Enter at Library Entrance 5260 Hickory Hollow Parkway Antioch, TN 37013 |

These community and downtown meetings were structured as “open houses” with separate stations representing various aspects of the Plan’s objectives and different elements of waste diversion. The discussion topics included:

- Priorities of the Plan; How to get to Zero Waste; and Policies Critical to the Plan’s Success
- Landfill Disposal Challenges
- Organics Recycling and Diversion
- General waste and residential collection services
- Recycling Performance
- Construction and Demolition Recycling Opportunities

Attendees were able to make public comments at each station as well as at a central public comment table. Feedback received during the public meetings included:

- Need easy to do actions/steps to implement in various neighborhoods, especially apartments.

- Curbside recycling across the entire County
- Enhanced convenience/cost of services
- Provide incentives for businesses to reduce, recycle, and compost
- High priorities for every other week curbside recycling; save-as-you throw; commercial food reuse
- Offer kitchen compost containers with a 3-bin collection system
- What measures will be taken to reduce waste from the start, such as banning straws and plastic bags?

D.5 Metro Council Public Works Committee

The Metro Public Works Department’s mission is to increase the quality of life for all citizens of Nashville and Davison County through a wide range of services including safe transportation infrastructure, protecting the environment, and creating clean and beautiful neighborhoods. Regarding the Metro Council, the Public Works Committee is responsible for reviewing and acting on solid waste measures prior to being placed on the Metro Council agenda for final vote. To garner feedback from this committee throughout the planning process, CDM Smith held meetings with the following members of the Public Works Committee which currently consists of 10 members: Chairperson Jeremy Elrod, Council Member Fabian Bedne, Council Member Mina Johnson, Council Member Bill Pridemore, Council Member John Cooper and Council Member Jim Shulman. In addition to these meetings, various other council members attended Solid Waste Region Board, Task Force or Public Meetings. The meetings took place in the spring and early summer of 2018 via face-to-face discussions or conference calls.

D.5.1 Meetings

Each meeting was held to discuss each Committee member’s thoughts and opinions on the development of a Solid Waste Master Plan and the specific facets of the planned program. Several of the primary takeaways included:

- Idea of approaching the solid waste system as more of a utility, similar to water, wastewater and stormwater services.
- Remaining capacity of Middlepoint Landfill should be a driving factor for the plan and should be a prominent part of any public notification and outreach on the program.
- Save-as-you-throw might increase illegal dumping/disposal of litter. This issue is a concern in multiple council districts.
- More public outreach and engagement with the community is needed.
- If a solid waste authority is implemented, what are the potential impacts between the USD and GSD and the current funding of the programs and differences in services?

- Recommendation that Nashville should take the leadership role in developing solutions that could lead to regional solutions.
- Recommendation for looking at a rewards-based system to incentivize recycling.
- Make diversion of waste as convenient as possible for residents.
- Increased enforcement is key to controlling the issue of illegal dumping.
- Drive practices for solid waste control for beatification programs.
- When the thermal plant was closed, and the decision was made to go to the landfill (Middlepoint) as a primary disposal practice, it was understood that it would be a temporary solution. Now, almost 20 years later, we need to look at a more permanent solution for the long-term for our citizens. All options need to be “on the table” and evaluated to ensure the best long-term cost-value benefit.

D.6 Summary of Key Input Received from Stakeholders and Incorporated into Plan

As discussed, an essential portion of any comprehensive solid waste master plan is stakeholder and citizen input. As discussed in the paragraphs above, CDM Smith has gathered input from various stakeholders regarding thoughts and opinions on the programs and services needed to increase landfill diversion through recycling, composting, recovery, and reuse programs. Community leaders, environmental groups, concerned citizens and business owners were generous with their time and energy to discuss and collaborate on a variety of approaches to achieving zero waste within the Metro area.

The table below provides a summary of some of the key concepts and approaches received during the public and stakeholder engagement meetings. The table also indicates where the concepts and approaches are specifically discussed in the Plan for easy reference.

Table D-2 Citizen/Stakeholder Group Input

| Stakeholder Input | How Addressed in Plan | Where discussed in the Plan |
|--|--|-----------------------------|
| Solicit input from citizen and stakeholder groups | Increased education and outreach requirements | Sections 6 and 7 |
| Achieve 100% diversion by 2022 | Stepped approach to reaching 90+% over 10+ years. Although all parties want to achieve zero waste as soon as practical, many of the programs must be staggered; and the community properly educated, to be successful. | Sections 6, 7, and 11 |
| Adopt minimum 2-stream wet/dry source separation with inclusion of GSD | Both the current system, 2-stream systems and 3-stream source separation systems were evaluated. The 3-stream program was recommended within USD and GSD with MRF, AD, and composting facilities. | Sections 5 and 6 |
| Develop franchise collection and processing. Divide Metro into zones. | Franchising is identified as a key policy to support implementation | Sections 5, 6, and 12 |
| Provide mandatory recycling | Residential and commercial price incentive programs with material bans | Section 6 |
| Ban plastic shopping bags. | Single-use bag fee or ban | Section 6 |

| Stakeholder Input | How Addressed in Plan | Where discussed in the Plan |
|--|---|-----------------------------|
| Increase per ton disposal fees to deter landfilling | Strategy for incentive surcharges | Section 6 |
| Develop local diversion markets | Use of economic development tools to develop re-manufacturing hub | Section 7 |
| Account for benefits of jobs from recycling and composting | Triple bottom line analysis incorporates benefits of job creation | Section 10 |
| Design and adopt reuse programs | Reuse programs and policies included as zero waste strategies | Section 7 |
| Install observation areas within processing facilities for education | New facilities will be evaluated for education areas | Section 8 |
| Maintain momentum during implementation – early progress | Provide phases of implementation timeline | Section 11 |
| Enforcement of banned materials | Recommended increases in Public Works staff for enforcement | Section 6 |
| Role of publicly-owned facilities in diversion goals | Combined public/private approach to facility infrastructure | Section 8 |
| Require builders to show C&D recycling plans to receive building permits | The plan recommends the development and implementation of a C&D Deposit Program | Section 6 |
| Require zero waste in event permits | A public space recycling strategy is included in the plan | Section 6 |
| Integrate digesters and composting facilities | Anaerobic digesters and composting are identified as key infrastructure | Section 8 |
| Reduce organics contamination in residential and commercial waste | Increased education, inspections, and enforcement | Sections 6 and 7 |
| Improve promotion of backyard composting | Increased education and outreach is a key theme of plan. | Sections 6 and 7 |
| Implement food waste rescue and source reduction strategies | Early adoption of food scrap capture and redistribution ordinance | Section 7 |
| Embed equity in plan to protect small businesses | A multi-pronged program to aid small businesses in increasing recycling. | Section 6 |
| Improve reporting of diversion | Mandatory reporting, measurement, and tracking requirements | Section 6 |

D.7 Statistical and Open Residential and Commercial Survey Responses

An online survey was developed and overseen by our project team (developed and statistically analyzed by Lisa Skumatz, SERA) and was made available to households and businesses in Davidson County in order to gather input on current solid waste and recycling services and what preferences for modified or additional programs the citizens would like to see moving forward. Survey topics included:

- Household and business characteristics
- Use and satisfaction of available programs, perception of costs, service gaps
- Support/interest in key program options such as pay-as-you-throw, recycling improvements, and organics options

The survey also identified programs with low satisfaction, opportunities for improvement, funding feasibility, and insight into variations in geographical areas and participants.

A statistical survey on solid waste and recycling practices, programs, and opinions on potential programs was conducted for both residential and commercial entities in Nashville and Davidson County. The residential segment was broken down into participants residing in single family (SF) homes and multifamily (MF) homes in buildings of four or more units. Participants residing in mobile homes and attached homes with under four units were included in the SF segment. Residential participants were also asked if they lived in a home owner’s association (HOA) and within either the Urban Services District (USD) or General Services District (GSD).

Both residential and commercial respondents were disqualified if they did not live or work within the Davidson County limits. Additionally, they were filtered by familiarity or responsibility with household or business finances or decision making based on data collected by Metro.

The statistical survey gathered data from a sample of participants reflecting the residential and commercial demographics for Davidson County. After completion of the statistical section, the survey was opened up to the general public for additional input. There were over 2,900 SF and 227 MF respondents for the open survey¹. Approximately 1773 of the SF open survey respondents report receiving service from Metro and 70 from the MF sector. The graphs of all the survey questions by group and sector comparisons can be found in **Figures D-6 through D-9** at the end of this section.

Approximately half of all cart using respondents report their carts are full to overflowing when they set them out.

D.7.1 Residential Single Family (SF)

Trash Service and Containers

Approximately 40% of SF respondents said Metro Public Works or Metro’s contracted hauler provides trash collection service and the cost of the service is included in their taxes. Ten other haulers were reported as providing service for the area respondents. Nearly two-thirds of those living in the GSD contract and pay their hauler directly even though about half of SF GSD respondents live in areas with HOA’s.

All of the low-trash generating respondents indicated they recycle in some form and over half of them compost or divert their food waste.

The majority of resident respondents are using 96-gallon carts provided by Metro (87% USD) or by their hauler (82% GSD), and are receiving weekly trash service as shown in **Table D-3**. Both USD & GDS respondents set them out weekly (86%) and use only one cart (75%). All respondents said they used some type of cart (excluding 6% self-haul), however, when asked to identify the size of carts they used 19% reported using bags only. This might suggest they were referring to the number of bags they put into their cart each week; a quarter of those responding who used bags said they used five bags per week and nearly half replying only one bag set out per week.

About a quarter of respondents said they use 20 – 35-gallon containers, but neither Metro nor most of the other haulers use those size cans. Pictures of wheeled cart sizes and corresponding

¹ Number of open survey respondents as of June 30th, 2018

gallon labels, along with an image of a Metro brown can, were provided for reference in the survey. This may be an example of how little attention people pay to their trash service and should be taken into consideration for outreach if changing to a multiple size can option or when estimating trash volumes based on resident responses.

Table D-3 Trash Collection Frequency

| How often is your service collection? | Trash | | | |
|---------------------------------------|--------|--------|--------|--------|
| | All SF | All MF | SF-USD | SF-GSD |
| Every Week | 86% | 88% | 90% | 85% |
| Every Other Week | 3% | 2% | 9% | 6% |
| About once a month | 2% | 0% | 2% | 3% |
| N/A Self-haul or other | 9% | 4% | 0% | 4% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Regardless of can size, approximately half of the respondents reported their cans are completely full to overflowing when they set them out (82% set out weekly). About 20% of those with full carts report they are not recycling and over 60% report not diverting any food scraps.

Between a quarter and a third of the respondents indicated their carts are 50% full or less when they put them out and 60% of this group are using collection services. These self-reported amounts may suggest they could use a smaller cart or less frequent collection. All of these low-trash-volume respondents indicated they recycle in some form and over half of them compost or divert their food waste.

Curbside Services Offered

When asked about services such as allowed set out amounts, availability of smaller carts, or compost service availability, over a third to half of all SF respondents marked they were unsure if their trash hauler provided them. However, 43% did report their trash hauler provided curbside recycling at no additional cost. Nearly three quarters of those within the USD recognized their recycling service was not an additional charge, but that type of service drops to about 10% for those outside the USD. Excluding the “not sure” responses, more resident respondents said their hauler did not offer curbside compost, set trash limits, save-as-you-throw type programs, bulky items collections or recycling for an additional fee. About an equal number said they could set out unlimited amounts of trash vs those that were volume restricted (29% yes vs. 34% no). **Table D-4** asks residents if they know what services are available, but not whether they use the service in order to understand if they are aware a service is available regardless of whether they use it. Whether they participate in recycling and the method they use is asked in **Table D-5**. For example, in Table D-4 28% of the SF respondents in the GSD say their hauler offers recycling service for an extra fee, but in Table-D-5, only 9% of that group report using that service.

Table D-4 Curbside Service Available Options

| Does your TRASH hauler provide any of the following options? | Yes | | | | Not Sure | | | |
|--|--------|--------|--------|--------|----------|--------|---------|--------|
| | All SF | All MF | SF-USD | SF-GSD | SF all | MF all | SF -USD | SF-GSD |
| Unlimited trash set out (no charge for extra) | 31% | 24% | 28% | 35% | 36% | 53% | 47% | 29% |
| Set Limit on amount Trash- Pay for extra trash | 18% | 9% | 11% | 22% | 47% | 49% | 59% | 41% |
| Save As You Throw | 9% | 3% | 4% | 13% | 46% | 51% | 59% | 37% |
| Curbside Recycling -Free (NO extra charge) | 43% | 10% | 72% | 25% | 23% | 35% | 17% | 28% |
| Curbside Recycling- Pay extra | 19% | 1% | 6% | 28% | 34% | 39% | 39% | 32% |
| Bulky item collection (i.e. couches, washing machines) | 19% | 16% | 19% | 19% | 42% | 45% | 43% | 43% |
| Compost - Free (Yard Waste or Food Waste-separate cart, bag) | 15% | 3% | 18% | 12% | 44% | 40% | 51% | 40% |
| Compost- Pay extra (Yard Waste or Food Waste- cart or bag) | 6% | 1% | 4% | 8% | 50% | 40% | 58% | 45% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Recycling

Approximately three quarters of all SF respondents are recycling in some form, with almost half using curbside service at no additional cost, but over 75% of those live in the USD, less than a quarter of those outside the USD report having recycling included with trash (Table D-5). Three quarters of all SF report using single stream. Of those recycling, over 50% estimate they recycle half to most of all the material they generate.

Table D-5 Recycling Methods

| How does your household RECYCLE? | All SF | All MF | SF-USD | SF-GSD |
|---|--------|--------|--------|--------|
| Curbside recycling -NO extra charge | 44% | 14% | 78% | 23% |
| Curbside recycling - additional fee | 5% | 3% | 0% | 9% |
| ONLY use Recycling drop-off or convenience center | 15% | 16% | 5% | 19% |
| At my/spouse's workplace | 3% | 4% | 2% | 3% |
| Drop-off/convenience center and other methods | 16% | 10% | 12% | 17% |
| With a friend/relative in a town with recycling | 3% | 3% | 2% | 4% |
| Do not recycle | 20% | 54% | 12% | 27% |
| Don't know | 5% | 8% | 2% | 8% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Twice as many of those in the GSD report not recycling in any form compared to those in the USD, but those that are recycling in the GSD report recycling more of their generated materials than those in the USD. This may suggest that it may be more convenient to recycle in the USD, but those that do recycle in the GSD are more dedicated to recycling. Another possibility is that those in the GSD using curbside services report recycling collection weekly (40%) or every other week (40%) (versus once a month in the USD) which allows for more material to be recycled (see **Table D-6**). All SF respondents report using recycling bins provided by the hauler; however, 40% of those in the GSD say they have to pay for the bins.

Table D-6 Recycling Collection Frequency

| How often is your service collection? | Recycling | | | |
|---------------------------------------|---------------|---------------|----------------|---------------|
| | <i>SF all</i> | <i>MF all</i> | <i>SF -USD</i> | <i>SF-GSD</i> |
| Every Week | 21% | 53% | 13% | 35% |
| Every Other Week | 17% | 7% | 11% | 27% |
| About once a month | 59% | 27% | 76% | 35% |
| N/A Self-haul or other | 3% | 13% | 0% | 4% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

However, 20% report not recycling at all. Of those not recycling, two-thirds report setting out $\frac{3}{4}$ to overflowing 96-gallon trash carts each week. Out of this non-recycling group, over half report curbside recycling or compost service is *not available* through their hauler, the largest percentage (28%) of them saying they use Metro service.

The most commonly recycled materials by SF respondents are cardboard, aluminum cans, and plastic bottles with food scraps, food soiled paper, glass and pet waste reported as the most common materials remaining in the trash. **Table D-7** shows the distribution of materials resident respondents most regularly recycle or compost.

Table D-7 Materials Diverted

| Which materials do you recycle or compost regularly? | All SF | All MF | SF-USD | SF-GSD |
|--|--------|--------|--------|--------|
| Glass bottles | 33% | 40% | 31% | 37% |
| Plastic bottles | 72% | 73% | 78% | 74% |
| Aluminum cans | 72% | 40% | 80% | 67% |
| Tin/steel cans | 39% | 20% | 42% | 41% |
| Milk cartons | 37% | 20% | 38% | 41% |
| Newspaper | 62% | 33% | 67% | 59% |
| Cardboard | 86% | 60% | 93% | 81% |

| Which materials do you recycle or compost regularly? | All SF | All MF | SF-USD | SF-GSD |
|--|--------|--------|--------|--------|
| Cereal boxes | 61% | 33% | 62% | 59% |
| Other paper | 55% | 40% | 58% | 56% |
| Yard/green waste | 7% | 7% | 7% | 7% |
| Food Scraps | 7% | 0% | 9% | 4% |
| Household hazardous waste | 4% | 0% | 2% | 4% |
| Electronics | 8% | 7% | 2% | 19% |
| None, don't recycle | 1% | 7% | 0% | 0% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Drop-off Recycling

The drop-off recycling center is used exclusively for recycling by about 15% of the SF respondents (mostly from those in the GSD) and used in addition to other methods by another 15% (also mostly from the GSD), with about 80% of users bringing materials between once per week and once per month.

Organics – Yard and Food Waste

There are a variety of options used by residents for yard waste materials from composting, landfilling or having landscaping contractors be responsible for disposal. About 10% of the SF respondents are composting at home both yard material and food scraps. Grass-cycling (leaving clippings on lawn) is practiced by a little over half of the respondents and about a third are using Metro’s Brush Collection for their branches and shrubs. About a quarter of the SF respondents report they don’t have yard waste materials. Only around 5% say they take yard waste material to the landfill. In **Table D-7**, under 10% of the respondents say they divert yard or food scraps, about the same amount that say they compost at home and again in **Table D-9** the majority say they don’t use curbside organics service. These low organics participation number may be in partly due to lack of awareness of a program or available private-sector services. Table D-4 shows that between 40% and 60% of SF respondents are not aware if their hauler offers curbside composting service.

Throwing it “in the trash” is by far (67%) the most common way of disposing of food waste (**Table D-8**), followed by putting it down the garbage disposal. Less than 5% report using a curbside service or taking food waste to a drop-off center.

Table D-8 Food Waste Habits

| What do you do with most of your FOOD WASTE? | All SF | All MF | SF-USD | SF-GSD |
|--|--------|--------|--------|--------|
| Put in garbage disposal | 33% | 29% | 31% | 35% |
| Curbside service takes food scraps | 5% | 3% | 2% | 6% |
| Put in trash | 67% | 78% | 76% | 62% |
| Home compost bin | 9% | 3% | 10% | 9% |
| Drop off at East and Omohundro Convenience Centers | 1% | 1% | 2% | 1% |
| Feed to the dog/pet | 10% | 5% | 7% | 12% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Service Satisfaction

Generally, the SF respondents using curbside services are very or somewhat satisfied, especially with the collection services for trash inside the USD (86%). The remainder of the USD-SF respondents, who were not satisfied, are a little less satisfied with recycling service, rates, and options (63%), for those that use the service, and only about half the respondents using curbside organics services are satisfied with the service, the rates, and the options available. Over half of all the SF responding residents in Davidson County are not using recycling or organics curbside services. About two thirds of the respondents using the programs felt their hauler was responsive to service issues or problems.

Not knowing what can be recycled or if materials actually get recycled are among the top barriers; convenience and program availability were also high.

Table D-9 Curb Satisfaction

| How satisfied are you with the following curbside... | Very & Somewhat Satisfied | | | | Don't Use | | | |
|--|---------------------------|--------|--------|--------|-----------|--------|---------|--------|
| | All SF | All MF | SF-USD | SF-GSD | SF all | MF all | SF -USD | SF-GSD |
| Garbage collection SERVICE | 78% | 47% | 86% | 79% | 7% | 38% | 0% | 5% |
| Recycling collection SERVICE | 44% | 21% | 56% | 38% | 33% | 64% | 16% | 41% |
| Yard waste /org collection SERVICE | 27% | 15% | 30% | 28% | 50% | 71% | 46% | 53% |
| Garbage RATES / value of service | 48% | 27% | 41% | 58% | 31% | 43% | 43% | 18% |
| Recycling RATES / value of service | 30% | 19% | 37% | 28% | 51% | 65% | 46% | 53% |
| Organics RATES / value of service | 14% | 10% | 19% | 13% | 68% | 77% | 68% | 66% |
| Responsiveness of hauler to issues | 42% | 25% | 37% | 53% | 34% | 49% | 40% | 24% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Barriers

Barriers for recycling were spread across many options, only 21% reported they did not have any barriers. Not knowing what can be recycled or if materials get recycled are among the top barriers; convenience and program availability were also high on the barrier list. When separating responses by USD / GSD, over a quarter in the USD said recycling collection is not frequent enough and nearly a quarter in the GSD reported no curbside program as a barrier. Over a third of the respondents in the GSD said it was too expensive to sign up for recycling service.

Table D-10 describes the types of barriers responding residents experience with recycling.

Table D-10 Reported Barriers to Recycling

| What do you see as primary barriers to recycling? | All SF | All MF | SF-USD | SF-GSD |
|---|--------|--------|--------|--------|
| No curbside program | 17% | 29% | 12% | 19% |
| Don't know of any drop-off sites | 12% | 28% | 14% | 8% |
| Too hard to take materials to drop-off | 17% | 22% | 17% | 17% |
| Garbage service is inexpensive | 5% | 4% | 5% | 5% |
| Collection is not often enough | 17% | 4% | 28% | 12% |
| Not enough materials accepted | 15% | 4% | 17% | 13% |
| Don't know what can / can't be recycled | 18% | 18% | 17% | 18% |
| I already recycle a lot - no barriers | 21% | 14% | 21% | 22% |
| Busy / not interested / too much effort | 14% | 19% | 7% | 21% |
| Expensive to sign up for service | 13% | 4% | 5% | 19% |
| What I do doesn't make a difference | 3% | 3% | 5% | 1% |
| Not sure it really gets recycled anyway | 18% | 18% | 21% | 15% |
| HOA doesn't offer recycling | 10% | 13% | 5% | 14% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Proposed Program and Operational Changes

There was no significant opposition to any of the proposed program changes, with support for all programs ranging from 61%-84% and neutral feelings averaging 18%. Outside the USD, the neutral response was closer to 25%. **Table D-11** shows the potential programs that received the most support and relatively little opposition. Although there is good support for programs that include residential services, the highest support is for those programs that encourage businesses and building contractors to recycle more.

Table D-11 Support for Program or Operational Changes

| Support for Program Changes | Somewhat & Strongly Support | | | | Strongly Oppose | | | |
|---|-----------------------------|--------|--------|--------|-----------------|--------|----------|----------|
| | All SF | All MF | SF-USD | SF-GSD | SF all | MF all | SF - USD | SF - GSD |
| Add curbside glass collection | 69% | 57% | 76% | 63% | 1% | 1% | 0% | 1% |
| Add food-waste & yard waste programs | 61% | 51% | 70% | 52% | 2% | 1% | 0% | 4% |
| Backyard composting training & discounted backyard compost bins | 63% | 52% | 71% | 56% | 2% | 0% | 2% | 3% |
| Encourage more recycling by builders and remodelers | 76% | 68% | 81% | 70% | 1% | 1% | 0% | 1% |
| Increase curbside recycling from monthly to every-other-week | 65% | 58% | 74% | 56% | 2% | 1% | 0% | 3% |
| Metro's goal for Zero Waste to Landfills | 71% | 64% | 79% | 62% | 1% | 0% | 2% | 1% |
| Programs and incentives to encourage more recycling by businesses | 76% | 61% | 84% | 68% | 1% | 3% | 0% | 1% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Support was a little lower, ranging from 43%-71% for programs when asked which programs or operational changes they would support *if* trash service *was not* included in taxes, or was a separate cost. On average, a quarter of the SF respondents were neutral on these questions. The most supported programs, by two thirds of the respondents, were to require haulers to include recycling services in trash service rates and to have Metro bid for a contracted hauler (**Table D-12**). Figure D-10 shows public support for operational changes, assuming that trash service fees are not included in taxes, i.e. residents have to pay separately for the respective service.

Table D-12 Program Support if Services Cost

| Support IF trash service not in taxes (or if pay for service) | Somewhat & Strongly Support | | | | Strongly Oppose | | | |
|---|-----------------------------|--------|--------|--------|-----------------|--------|----------|--------|
| | All SF | All MF | SF-USD | SF-GSD | SF all | MF all | SF - USD | SF-GSD |
| Require haulers include curbside recycling in trash rates | 64% | 48% | 71% | 55% | 3% | 3% | 0% | 6% |
| One Hauler- Metro uses bid process to select 1 hauler to provide all curbside collection services | 61% | 43% | 67% | 55% | 2% | 1% | 0% | 4% |
| Require haulers to include curbside yard-waste fees in trash rates | 59% | 42% | 62% | 53% | 3% | 1% | 2% | 4% |
| Save-As-You-Throw (pay less for smaller cans, incl. recycling) | 55% | 47% | 55% | 51% | 3% | 1% | 5% | 3% |
| Require trash haulers to offer yard waste collection service (extra fee) | 47% | 34% | 55% | 43% | 6% | 3% | 2% | 8% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Isolating the single or contracted hauler question shows the potential of lower bills reported as the highest advantage. A third of respondents reported they think there would be no effect on them from the other potential impacts from Metro using a single hauler. About a third of the respondents thought there would be some disadvantage to no longer choosing their own hauler or some haulers might have to leave residential collections.

For each of the three, dollar-savings SAYT scenarios the majority of SF respondents indicated there would be some increase in recycling.

When asked at what dollar savings a month in a Save-As-You-Throw (SAYT) program would cause them to change their recycling behavior, nearly 50% said there would be no change at \$3-\$5 per month and 50% said they would recycle much more with a savings of \$9-\$10 per month (see survey data in the figures at the end of this section). For each of the three dollar-savings scenarios, the majority of SF respondents indicated there would be some increase in recycling (see **Table D-13**).

Table D-13 SAYT Program Recycling Behavior Change

| If Metro had SAYT, Recycling included, what \$ amount would cause you to recycle much more? | All SF | All MF | SF-USD | SF-GSD |
|---|--------|--------|--------|--------|
| Save \$3-5/m | 17% | 17% | 11% | 23% |
| Save \$6-\$8/m | 26% | 25% | 20% | 31% |
| Save \$9-10/m | 50% | 53% | 45% | 51% |

**Highlighted / colored cells represent the highest responses in each column, from each sector*

Similarly, the reported size of cart needed with a SAYT program decreased; nearly 50% using a 96-gallon cart at \$3-\$5 savings to 37% using a 96 gallon at a monthly savings of \$9-\$10 per month.

Nearly two thirds of SF respondents wouldn't use or wouldn't pay additional for a curbside compost or glass collection program. The largest percentage said they would like the programs but would not pay extra for them.

D.7.2 Statistical vs. Open Response Survey Results

The open survey was much heavier with responses from those living in the USD (95%) with the cost of trash service included in taxes. Due to this, the majority of the responses followed very closely the responses from the statistical survey for those living in the USD. The statistical survey gathered data from a random group that represent the demographics of the county. While the open survey includes data and opinions from county residents, it does not reflect responses in the same proportion for demographics of those living in the county. The following are a few of the notable differences between the responses from all the SF in the statistical (S) survey and all the SF responses from the open (O) survey:

- Question 21: I recycle the majority of the waste material I generate. (S) 19% / (O) 48%.
- Question 23: How often is your recycling collected? Every week. (S) 22% / (O) 5%.
- Question 34: How satisfied are you with drop-off glass options? Dissatisfied. (S) 14% / (O) 32%.
- Question 35: What do you see as primary barriers to recycling? Collection is not frequent enough. (S) 17% / (O) 53%; Not enough materials accepted. (S) 15% / (O) 42%.
- Question 36: Which of the following Metro program and operational changes would you support? Support was stronger in the open survey for all the program and operational changes by 20 – 30 percentage points more than the statistical responses.
- Question 44: Do you own or rent? Own. (S) 63% / (O) 90%.
- Question 47: What is the highest level of education by the head of household? Completed graduate / advanced degree. (S) 21% / (O) 45%.

D.7.3 Residential Multi-Family (MF) Results

MF vs. SF Results

Multi-family statistical survey responses were similar to the single-family results and have been included in the SF figures. There were some notable differences.

- About 60% of MF said trash services were paid for in rent vs. 6% of SF.
- More definite about not having compost or organics services.
- More unsure than SF about trash limits, costs, and collection frequency.
- 52% (MF) vs 19% (SF) say they do not recycle.
- Most of the MF that do recycle use drop-off sites, bring materials more frequently than SF drop-off users, and report recycling more of their total materials.
- For satisfaction questions, more MF responded that they don't use the curbside services.
- The largest barriers were "no curbside service" and "too hard to take to a drop-off".
- More neutral responses for questions on yard waste programs, changes in collection frequency of recycling, and on any effects from changing to a single hauler.
- Slightly more inclined to recycle with dollar saving per month incentives with SAYT program.
- Twice as likely to respond "don't need / won't use" potential curbside glass and organics programs.

MF USD vs. GSD

There were few differences between the MF responses from the USD vs. those from the GSD. Most notable were USD MF residents more often use the recycling drop-off (weekly - USD 50% vs 32% GSD) and more of the GSD MF residents used the drop-off monthly (USD 23% vs 67% GSD). In the USD, 60% of MF respondents report recycling at least half of all their materials vs only 12% of those in the GSD. MF respondents in the GSD indicated they regularly recycle cardboard 20 percentage points more than in the USD, but those in the USD recycle glass bottles 45 percentage points and plastic bottles 50 percentage points more than those in the GSD. This might be due to stronger outreach on those items by haulers in those areas. "No curbside program" was seen by twice as many respondents in the GSD as a barrier to recycling compared to those in the USD. MF respondents in the USD were twice as likely to respond that they weren't sure "what gets recycled anyway" compared to GSD respondents.

D.7.4 Commercial Survey Responses (weighted by business size – number of employees)

Employees, owners, and other decision makers of businesses located in Davidson County were surveyed on solid waste issues that might affect their operations. The results of the data were weighted based on census data for the county for size of business by employees.

Business Location and Type

There were 45 business surveys completed. These respondents conduct business in all parts of the county, with a third operating mostly in Central Nashville and 13% each saying they conduct business in most of Nashville and in most of Davidson County. The largest group of respondents (over two thirds) described their main function as office type activities. Business respondents indicated that at their location, most of them generate trash materials either three months (43%) or twelve months (36%) of the year suggesting over a third of the businesses may be seasonal.

Services and Programs

Nearly two thirds of the businesses report having a recycling program, but only 5% report having an organics program. Over half of the recycling or organics programs are only for employees, and about a third include customers.

Nearly two thirds of the businesses report having a recycling program, but only 5% report having an organics program.

Usage of recycling programs is spread across several options with a third of responding businesses using services provided by the trash hauler. Almost twenty percent bring their material to a drop-off location or recycling company. Of the business respondents that have organics programs, most of them are using their trash hauler for organics collection. **Figure D-1** shows collection options used by businesses.

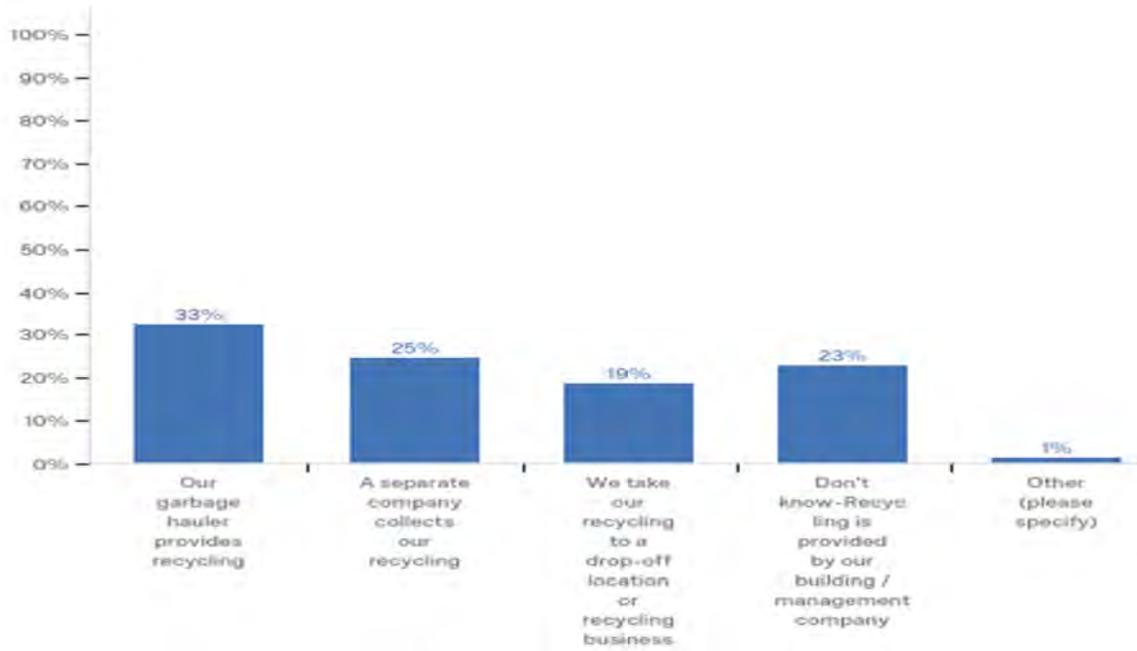


Figure D-1
Recycling Collection

Business respondents were asked about costs for services. Many were unaware of the cost because the service was rolled into space rental or they shared dumpsters with other businesses.

Recycling and Organics Diversion

Office paper and plastic bottles are the most commonly recycled materials followed by aluminum cans and cardboard. Food scraps are reported as the largest remaining material followed by office paper and plastic packaging. Responding companies reported very low recycling rates (**Figure D-2**) with the largest percent saying they recycle only a quarter of their materials. Although nearly two thirds of the companies' report having recycling programs, 75% of them are recycling less than 50% of the material they generate.

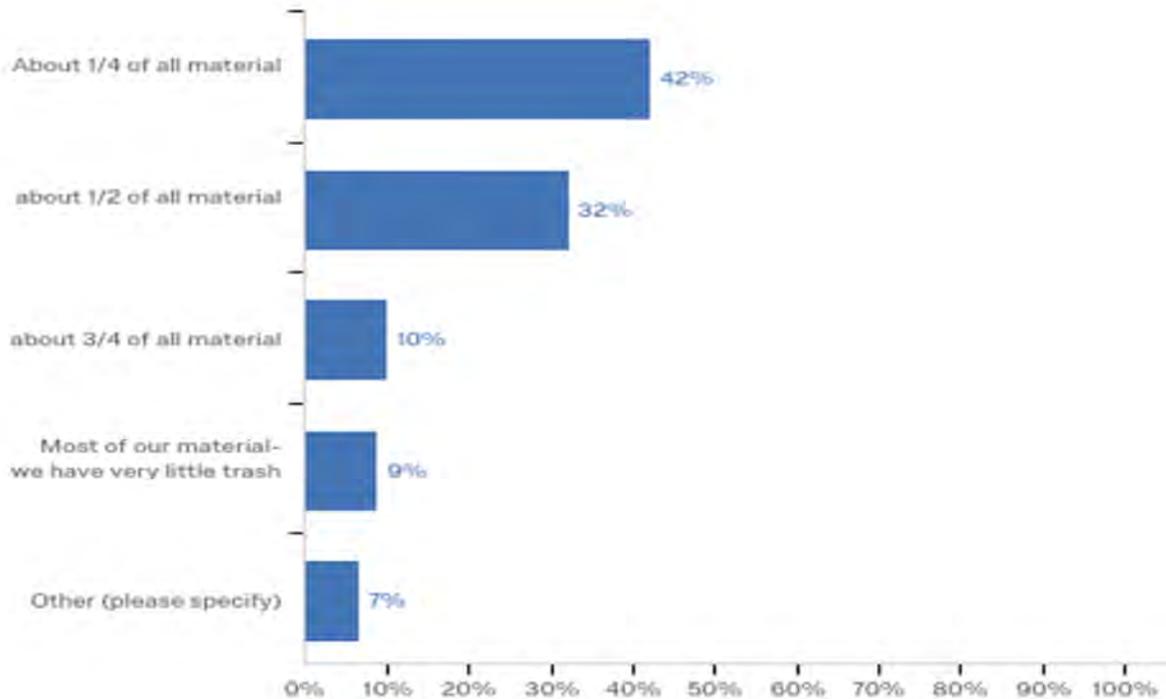


Figure D-2
Amount of Generated Material Recycled

Barriers

One third of the responding businesses described their program as working “great”, with no barriers to recycling. The most common barriers to recycling were no space for containers indoors (15%) or outside (11%) and that employees would not participate (10%). Eight percent said it was too expensive and six percent said it was too much a hassle. Only 5% said they don’t generate enough recyclable materials, but, for organics that was the largest barrier, followed by “it’s too expensive”. Space for containers is seen as a similar barrier for organics as with recycling. The reported barriers to having an organics program are shown in **Figure D-3**.

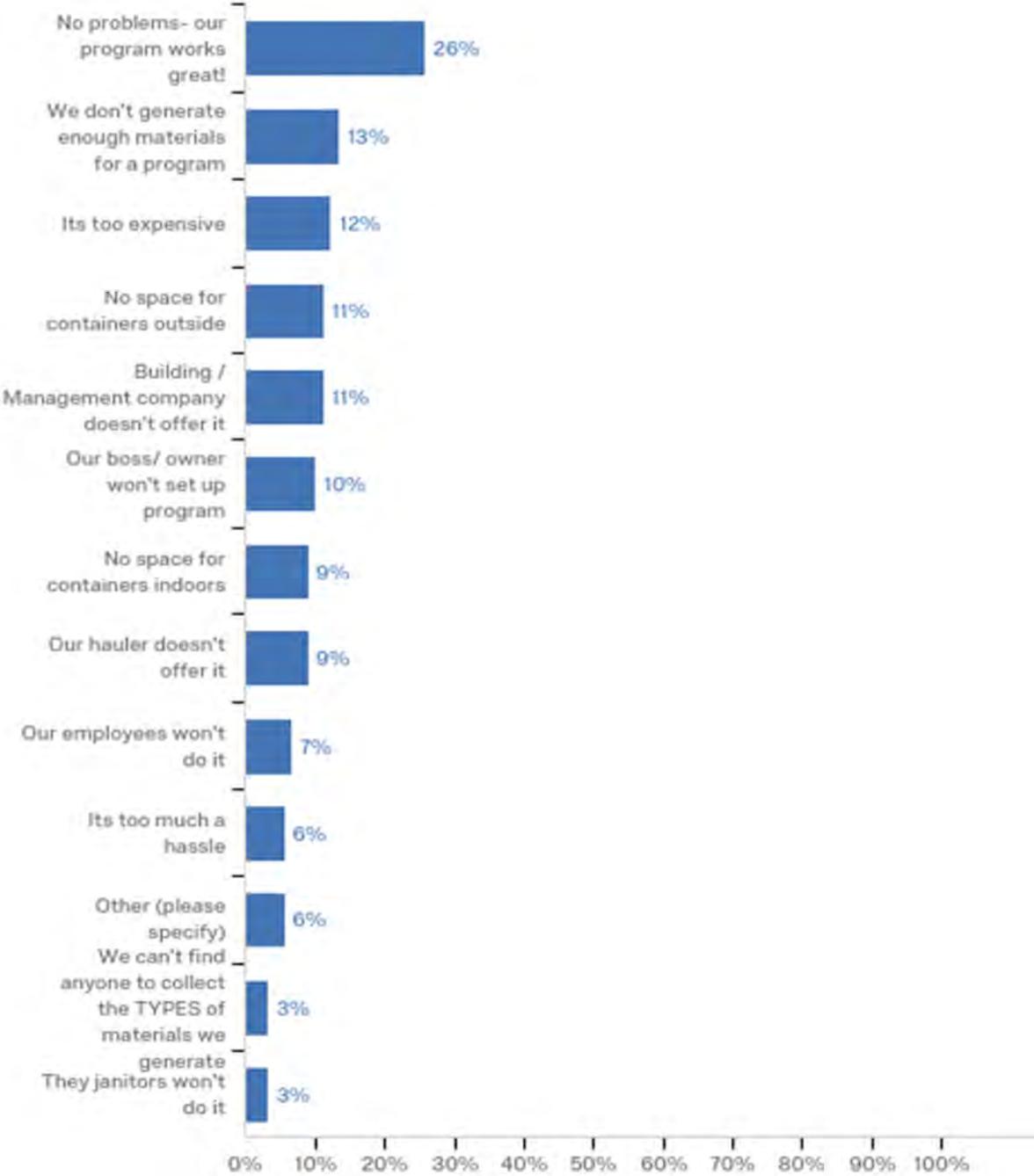


Figure D-3
Barriers to an Organics Program

Construction and Demolition

The majority of the respondents generating construction and demolition (C&D) debris report only working 1-2 jobsites a year and recycle 50% or less of the material. Over a third report sending the material to the landfill and less than 20% hire a company for recycling. The largest barriers reported is that there is no financial incentive to recycle and it's too time consuming (Figure D-4).

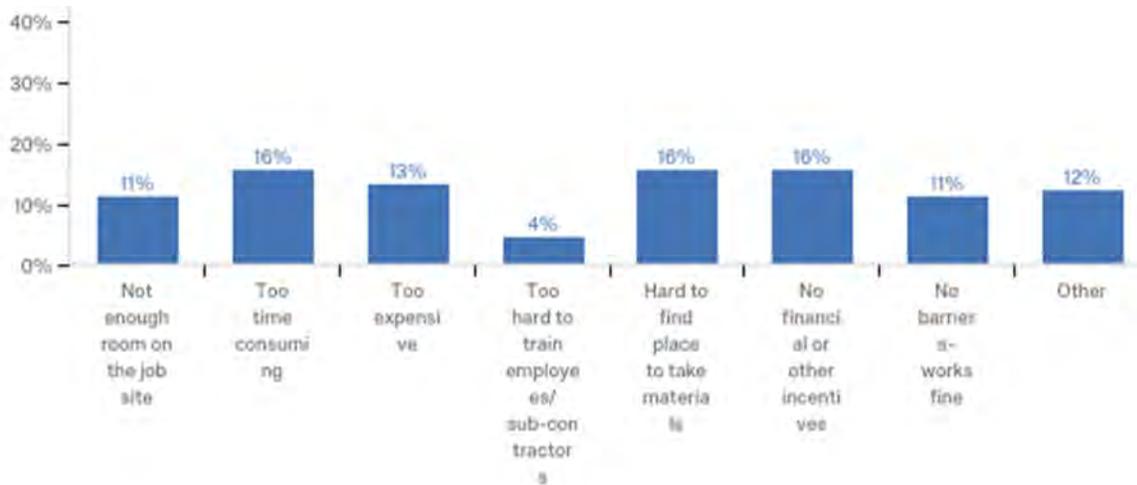


Figure D-4
Barriers to Recycling C&D Materials

Program Satisfaction and Importance

There were more responses on the satisfied side of the scale than the dissatisfied for all solid waste services especially for trash; no respondent reported dissatisfaction with their trash service and the majority were satisfied with the value of the trash service. There were some dissatisfied with the options for recycling and the neutral response was the largest category for cost / value and options for organics services.

Business respondents were asked to rate the importance they placed on a variety of programs. Four programs each rated important by approximately 75% of business respondents. Those were Metro encouraging businesses to recycle, implementing programs to reach zero waste, having the cheapest method for handling trash, and having trash companies including recycling in the cost of services. Ranked the least important was requiring trash companies to include organics but for an additional fee.

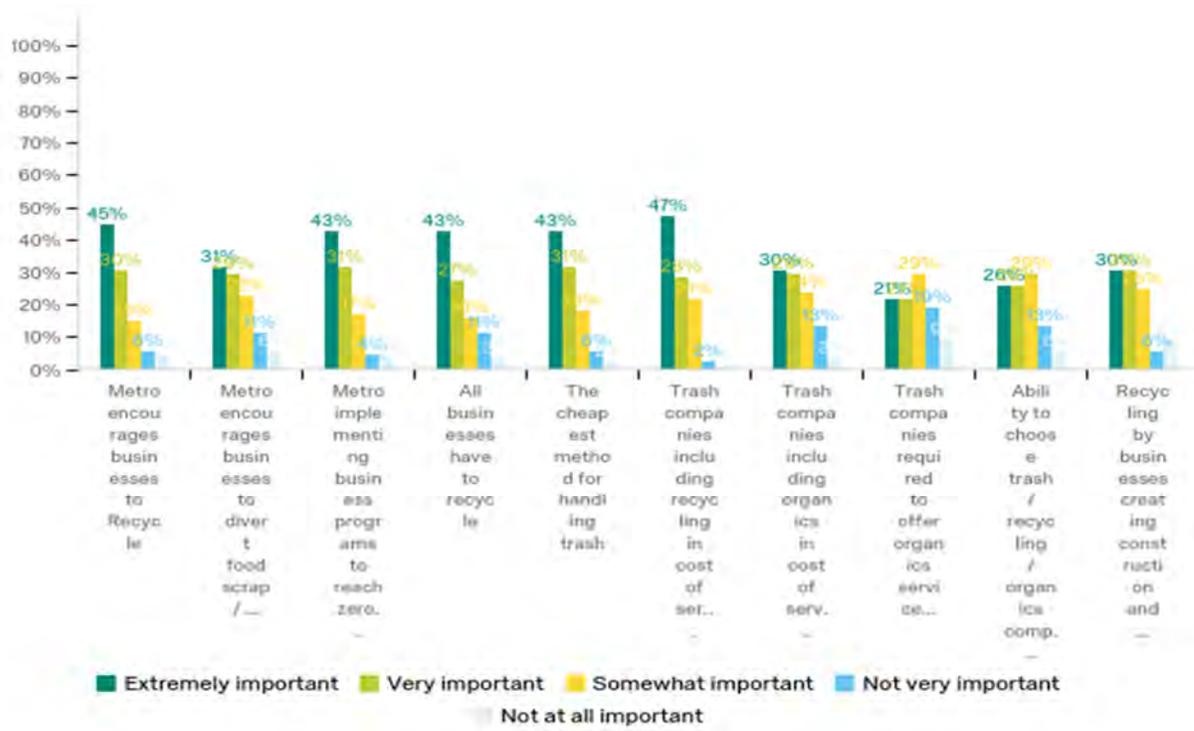


Figure D-5
Importance of Solid Waste and Recycling Options

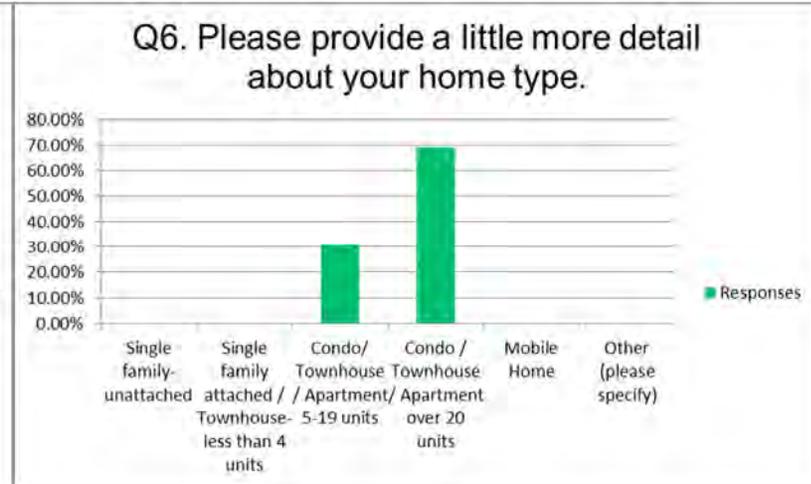
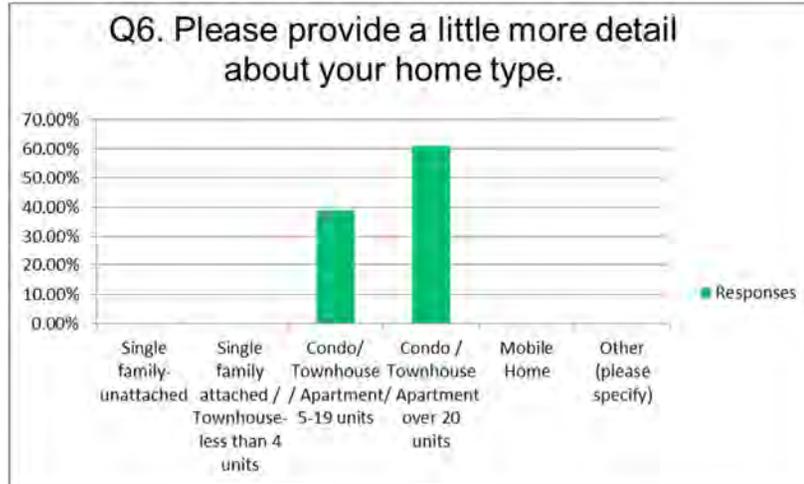
These are the key highlights of the solid waste survey conducted; however, the graphs of all the survey questions by group and sector comparisons for further review and reference can be found at the end of this section in **Figures D-6 through D-9**. These responses were utilized in the review and analysis of the programs proposed as part of this zero-waste plan and give a better picture into the state of the overall solid waste collection, recycling and diversion options that are currently offered and practiced by the community.

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Figure D-6 Survey Results
Nashville Multi Family Comparison (statistical responses only)
In Urban Services District (USD, n:18) vs. In General Services District (GSD, n:26)

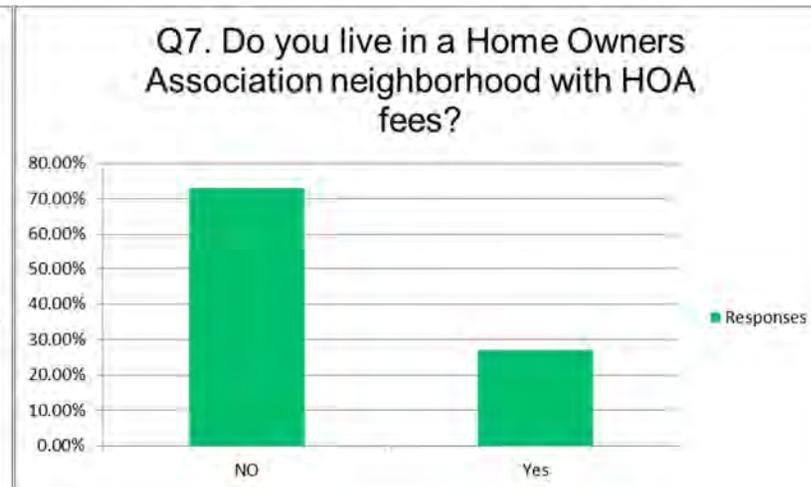
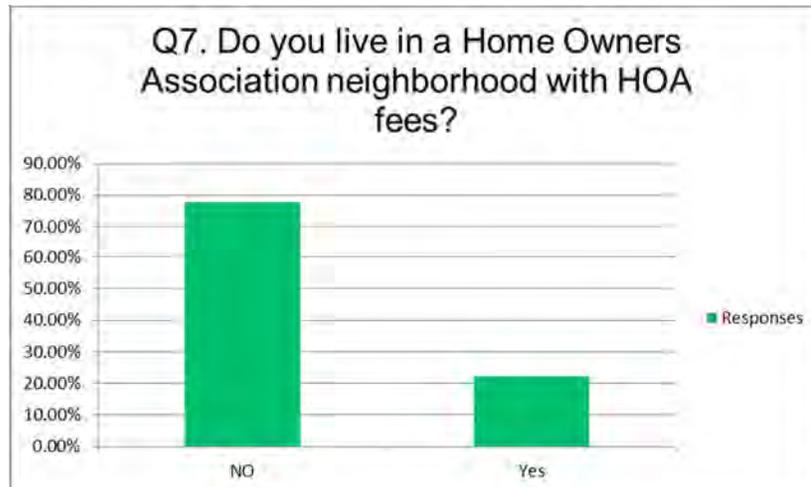
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GSD



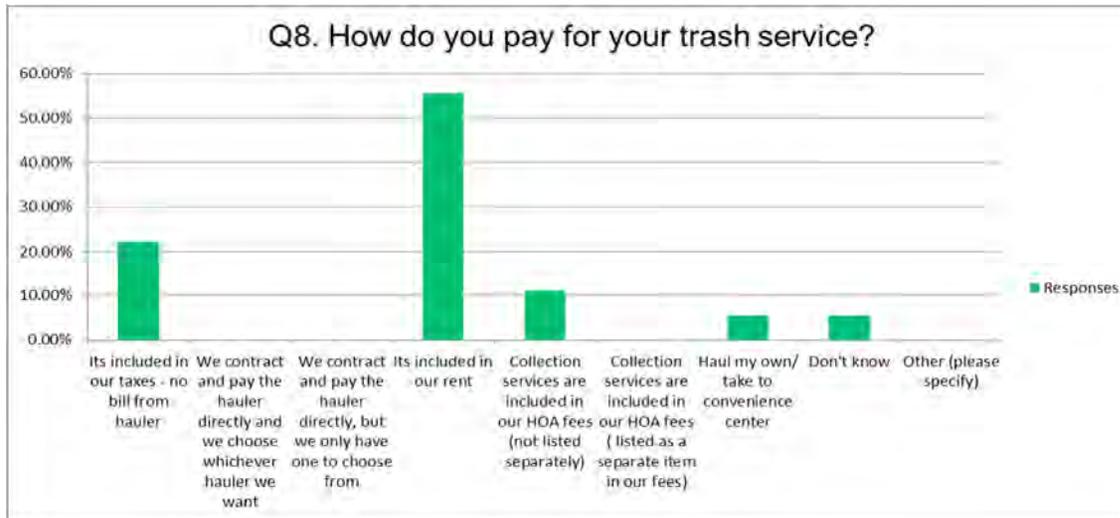
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GSD

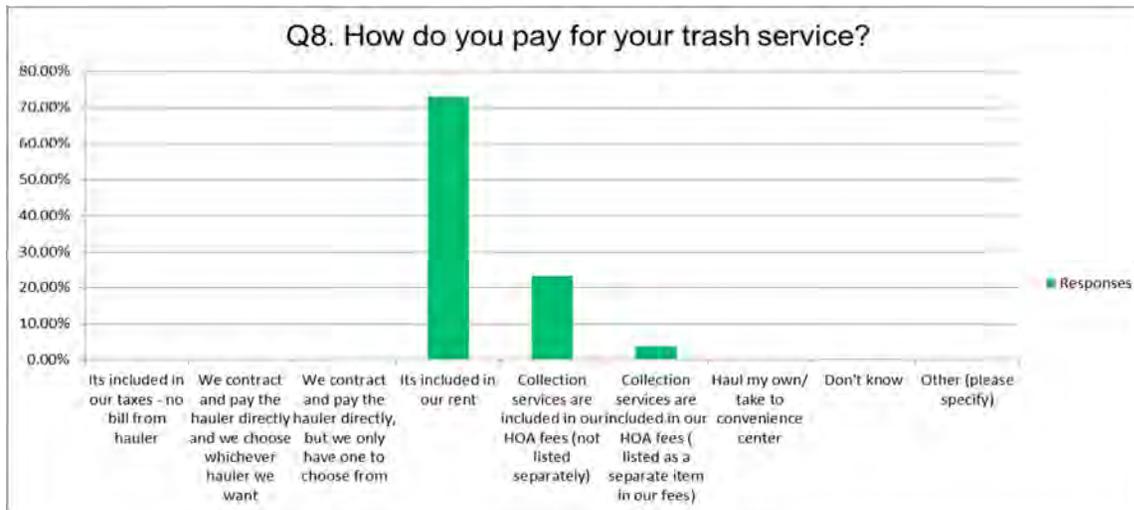


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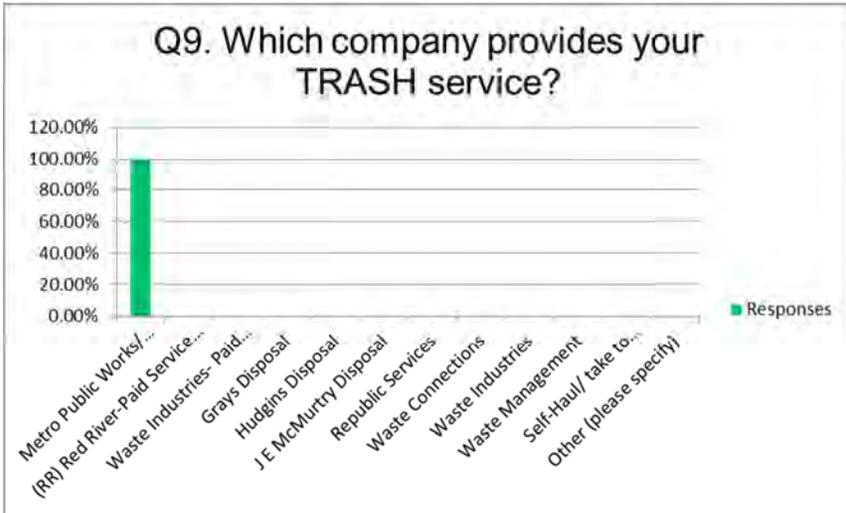
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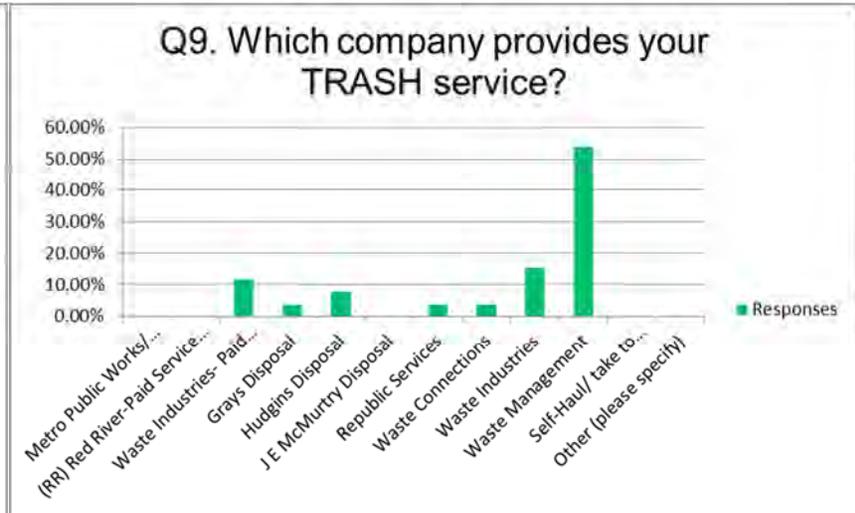
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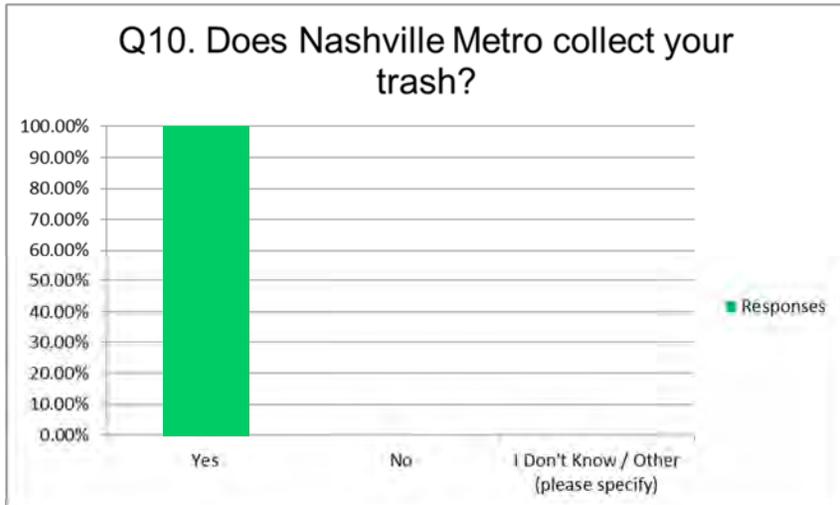
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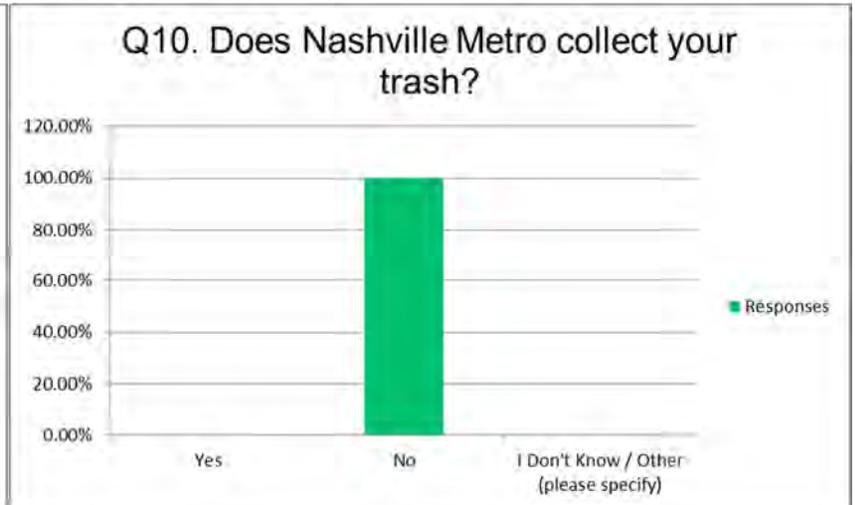
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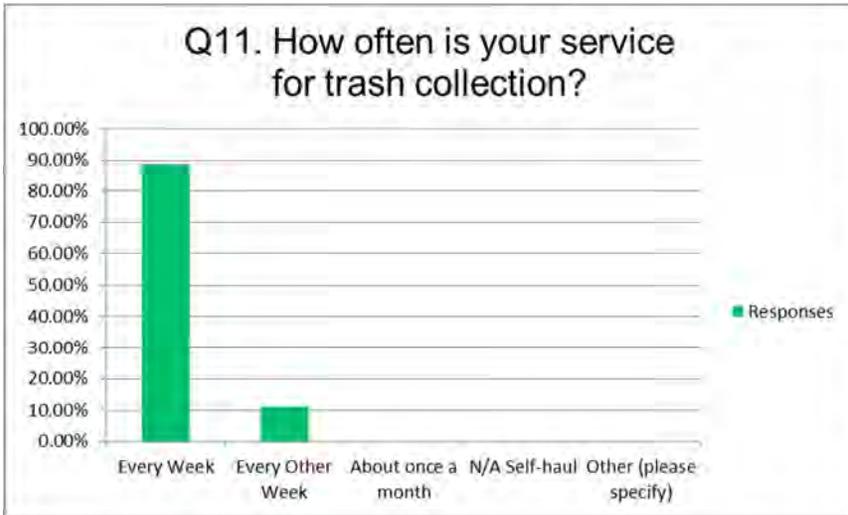
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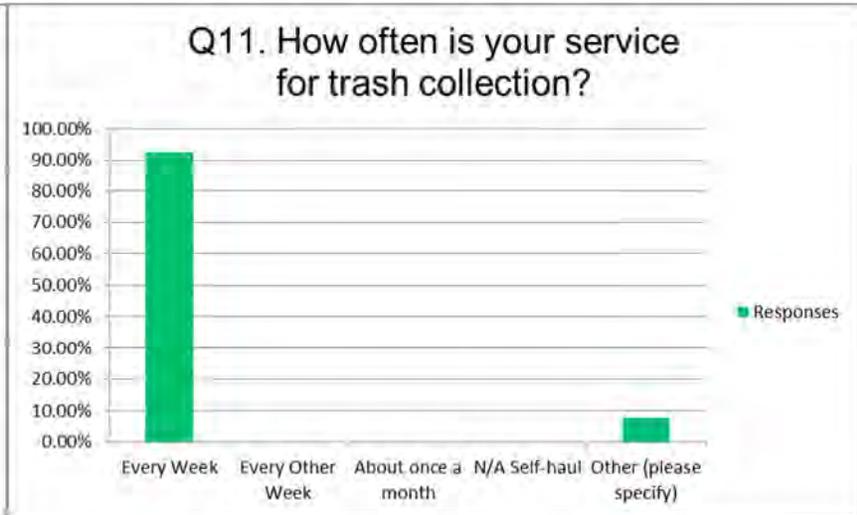
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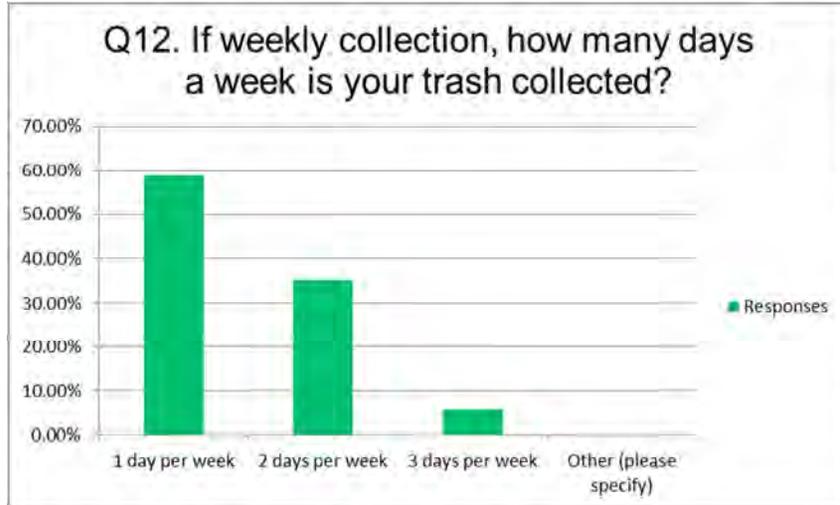
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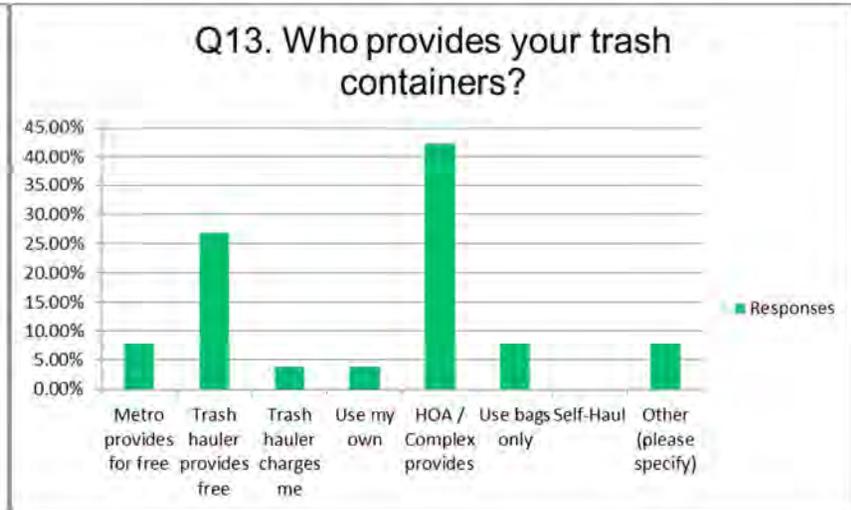
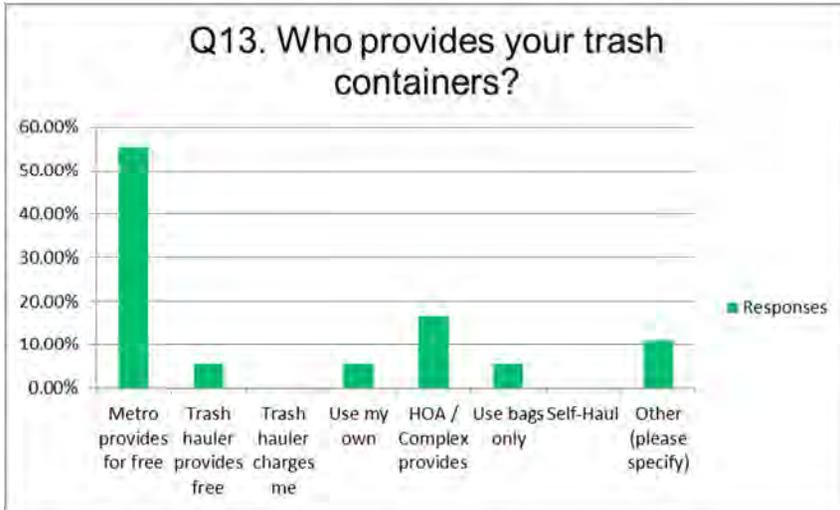
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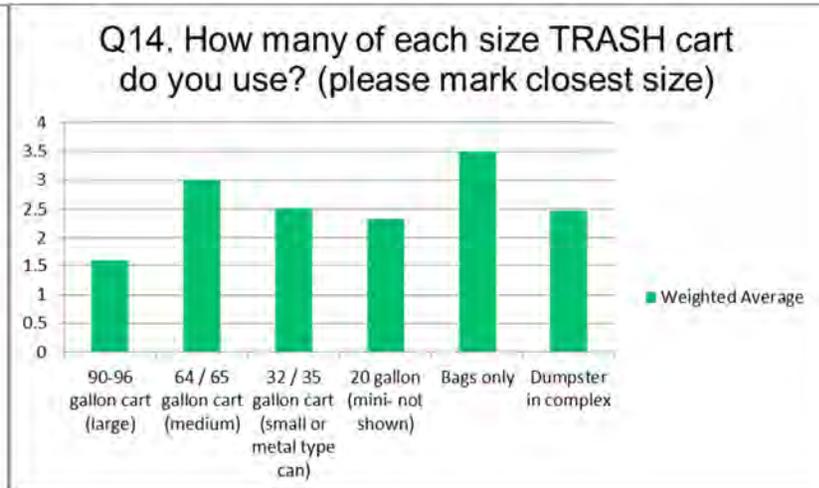
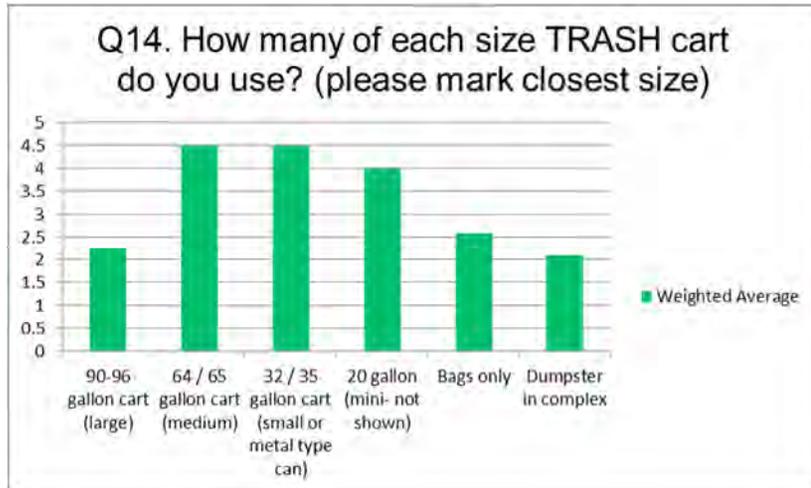


GSD



USD

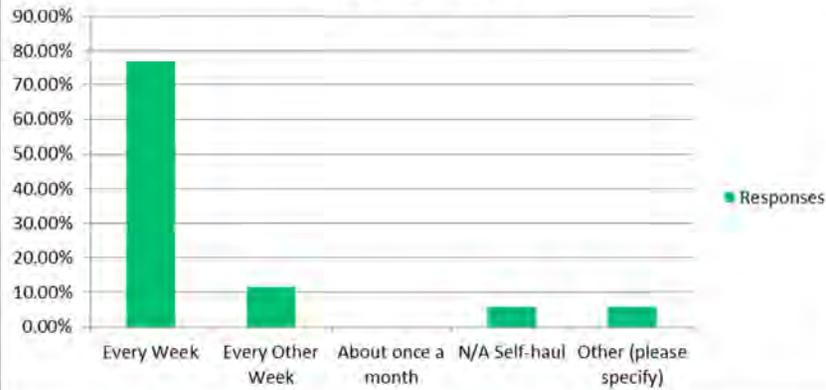
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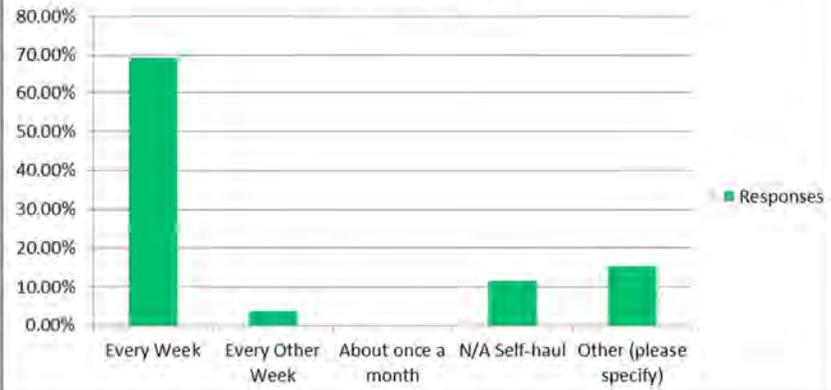
USD

GSD

Q15. How often do you set your trash out for collection?



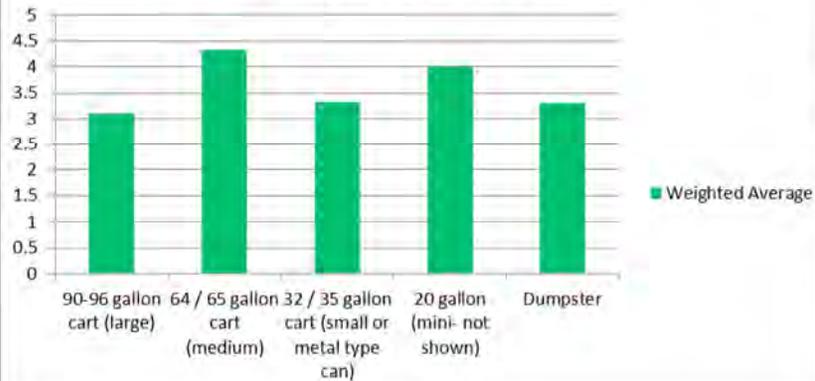
Q15. How often do you set your trash out for collection?



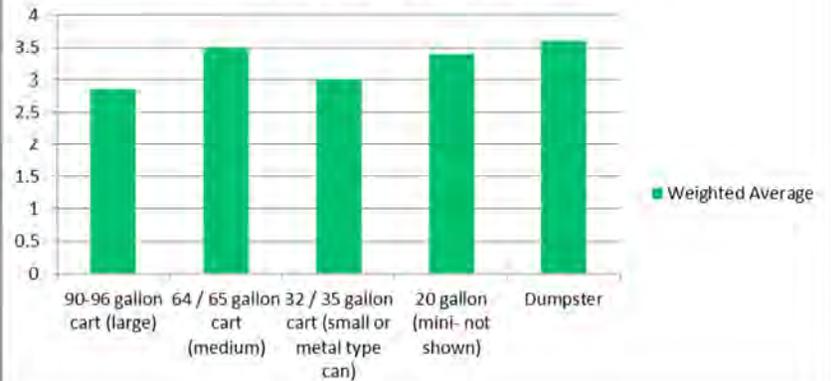
USD

GSD

Q16. How full are your TRASH carts when you set them out?

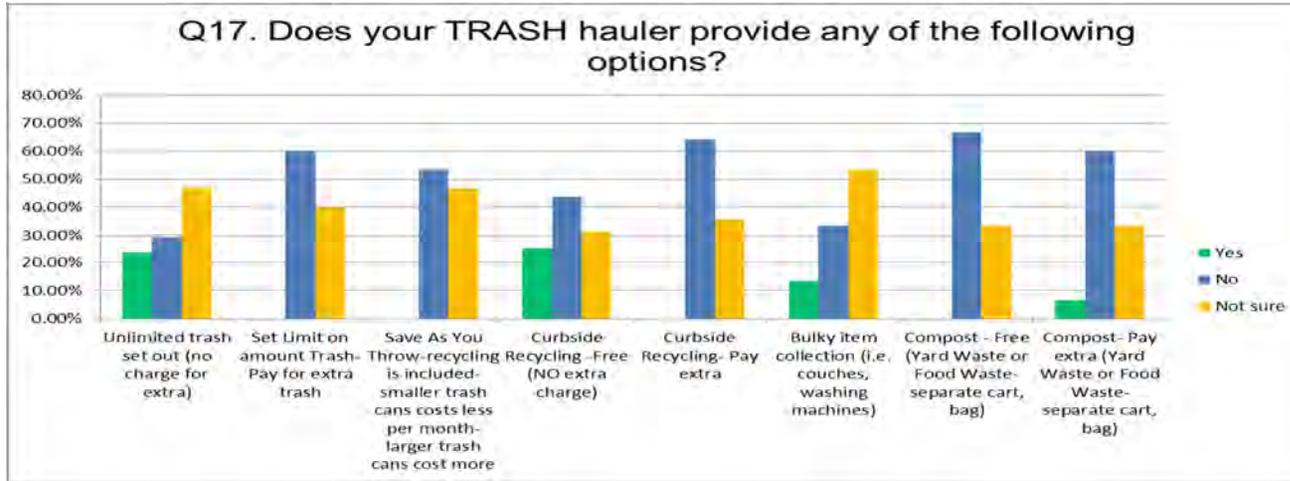


Q16. How full are your TRASH carts when you set them out?

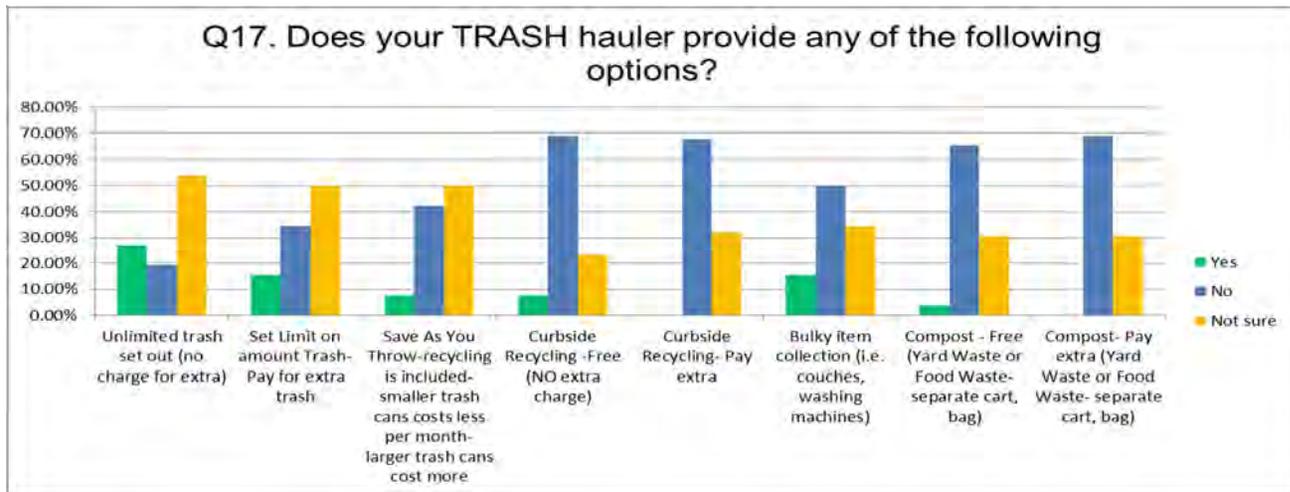


USD

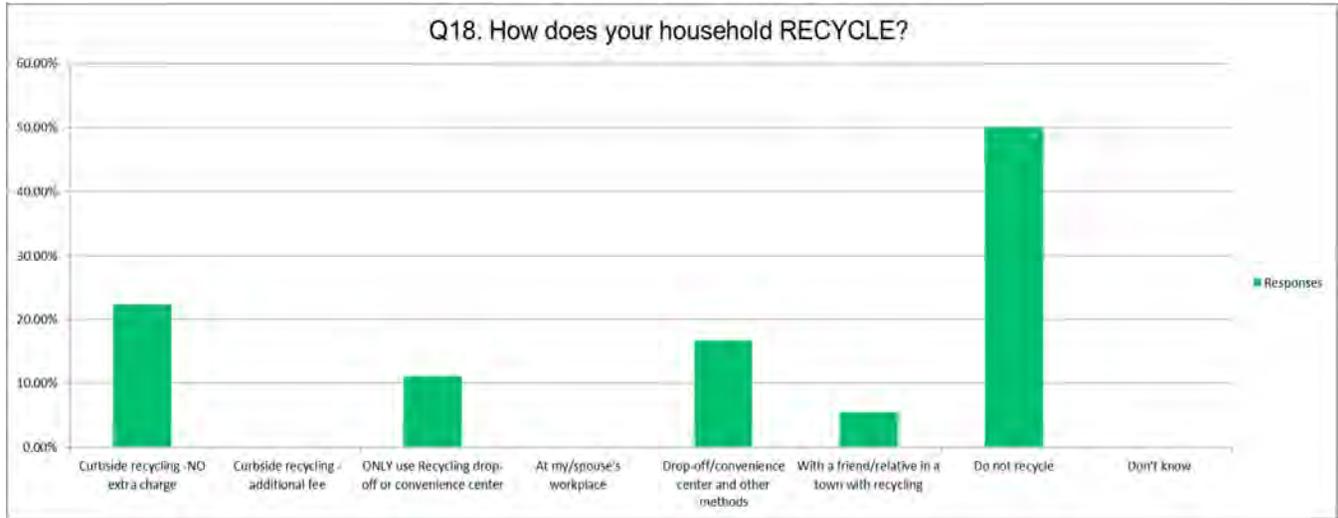
GSD



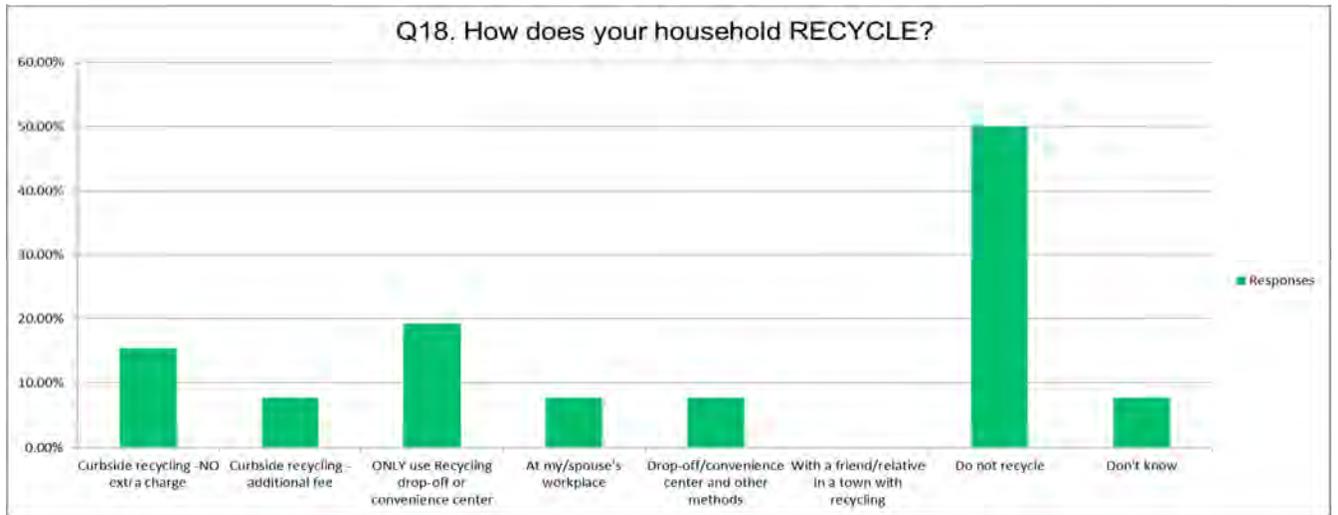
USD



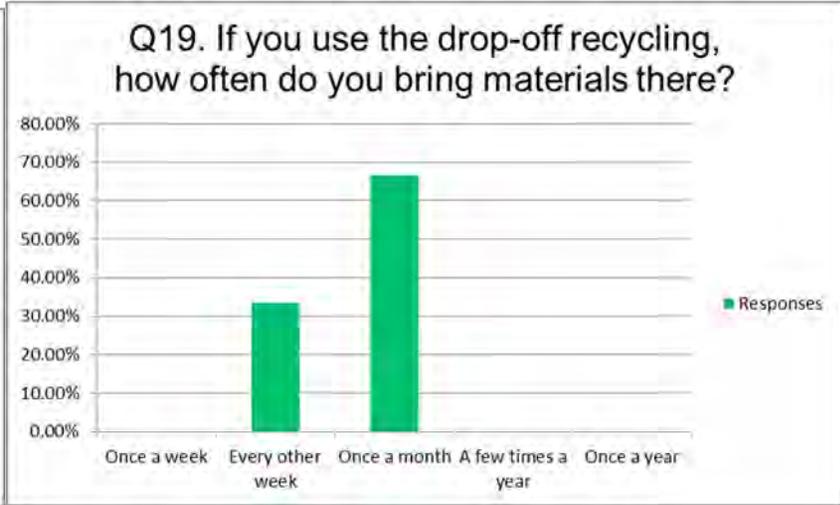
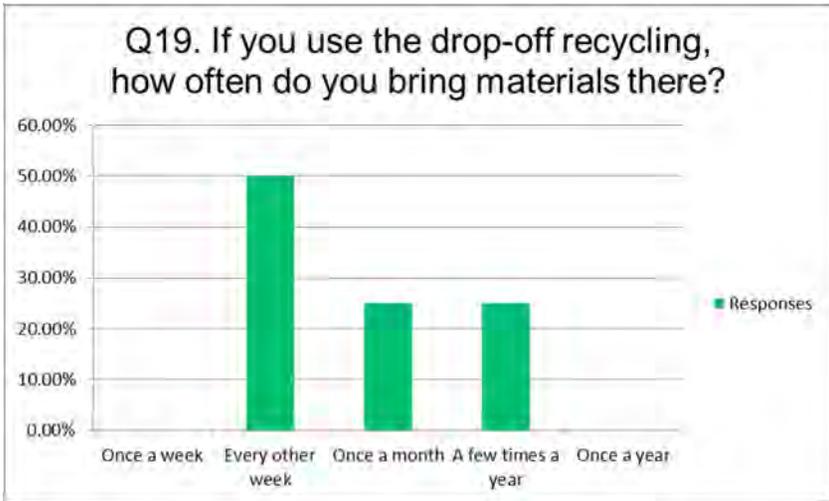
GSD



USD

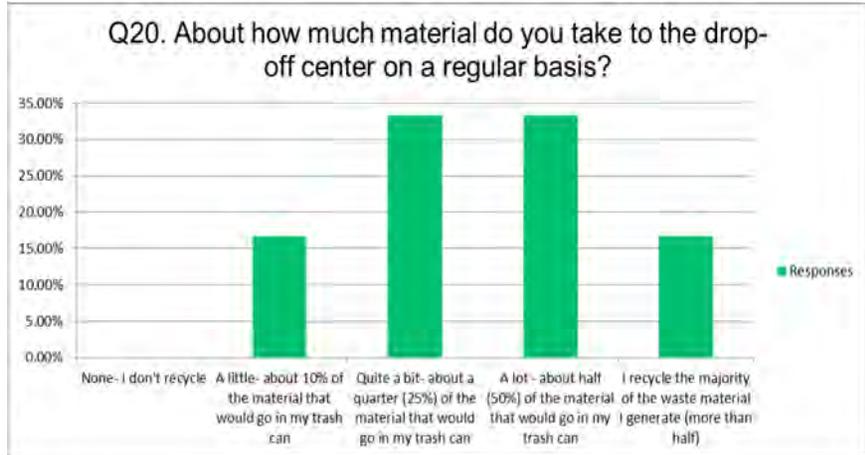
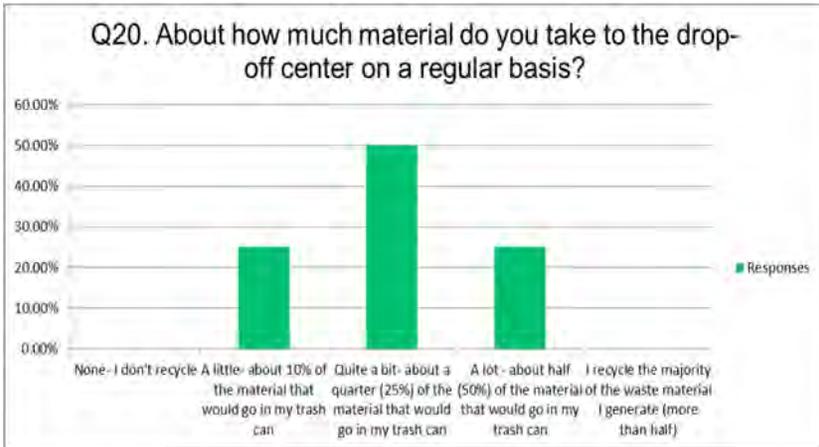


GSD



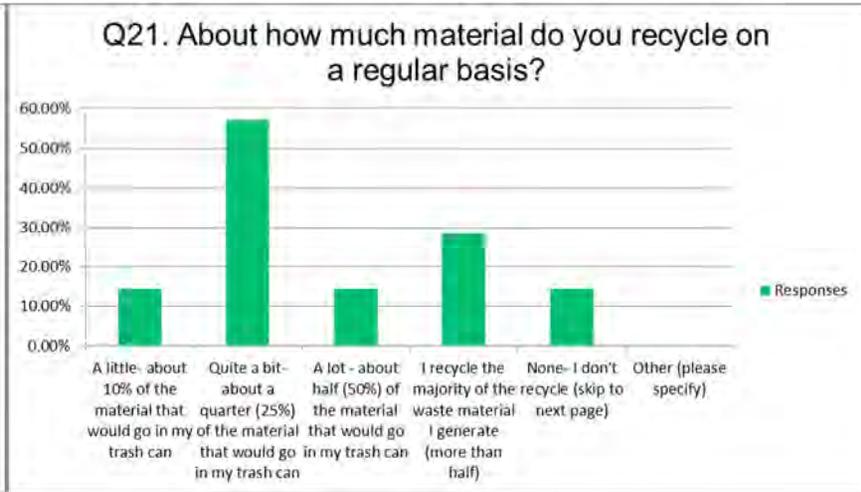
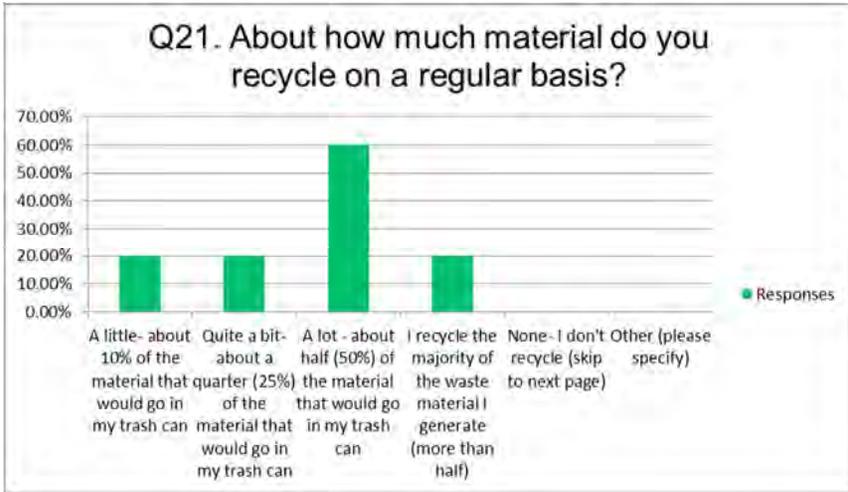
USD

GSD



USD

GSD



USD

GSD

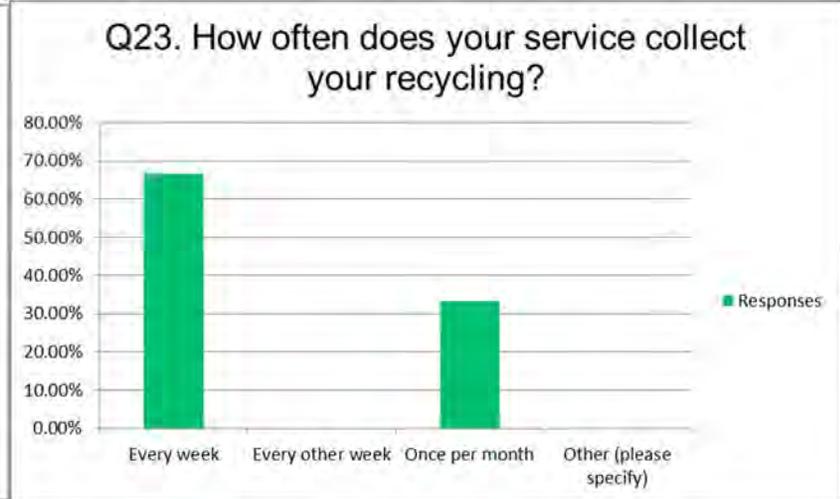


USD

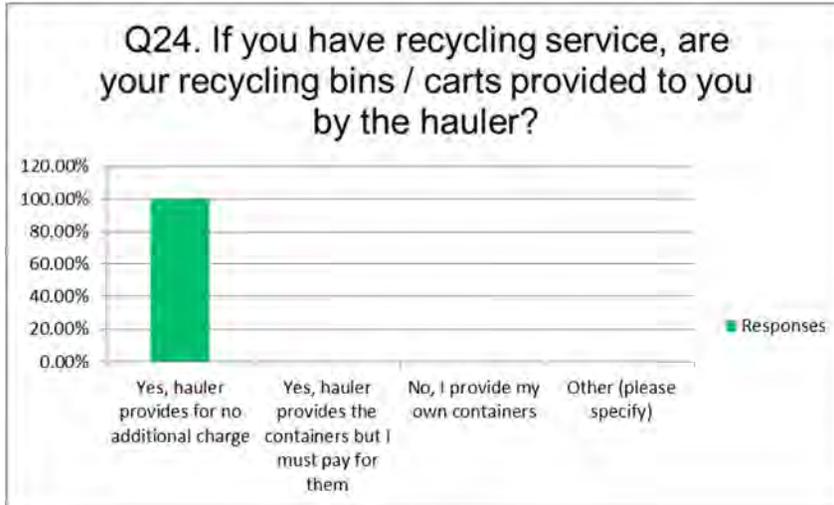
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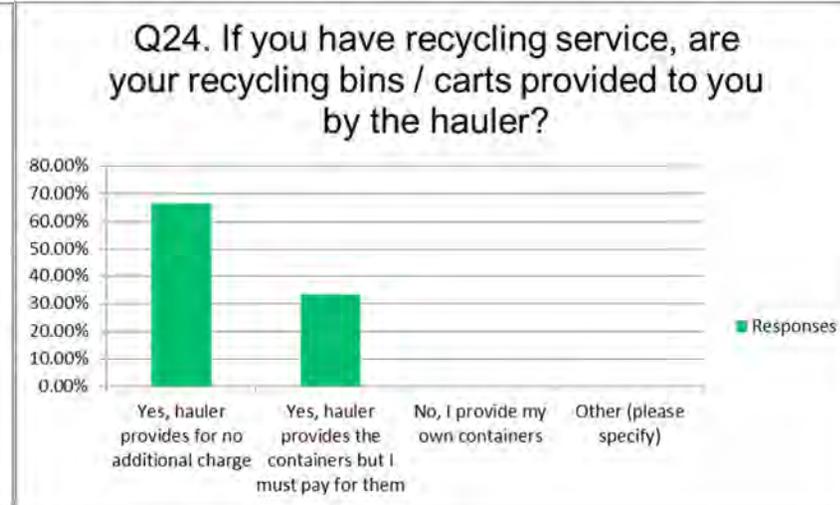
USD



GSD

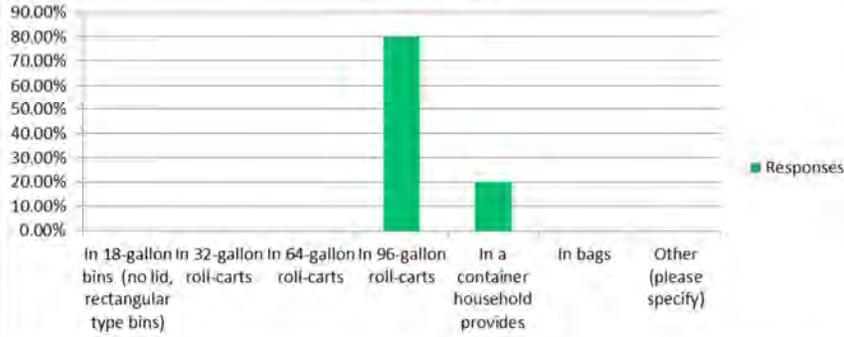


USD

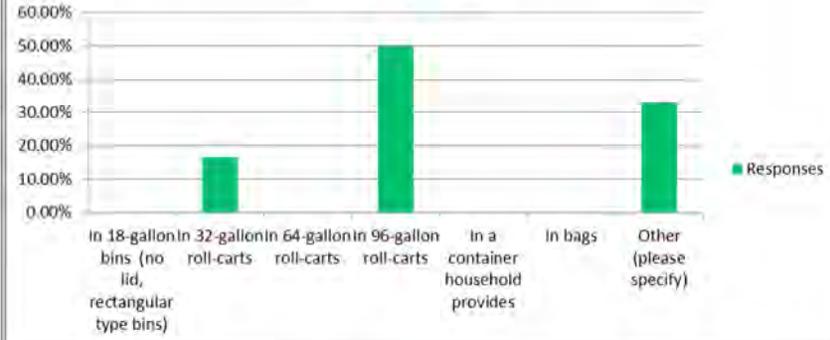


GSD

Q25. If you have curbside recycling service provided by a hauler, how are materials collected?



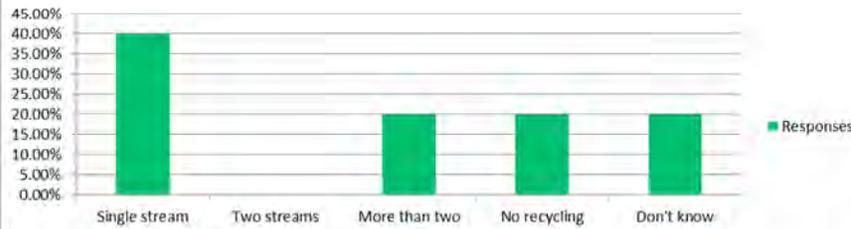
Q25. If you have curbside recycling service provided by a hauler, how are materials collected?



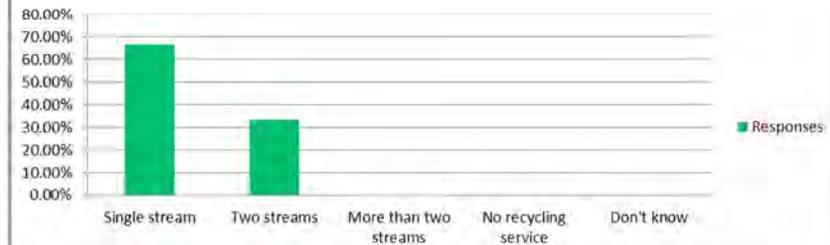
USD

GSD

Q26. If you have curbside recycling service, are your materials collected in separate streams (i.e. paper in one bin, cans, plastics and other containers in a different bin) or are they collected in a single stream (all materials together in one containe



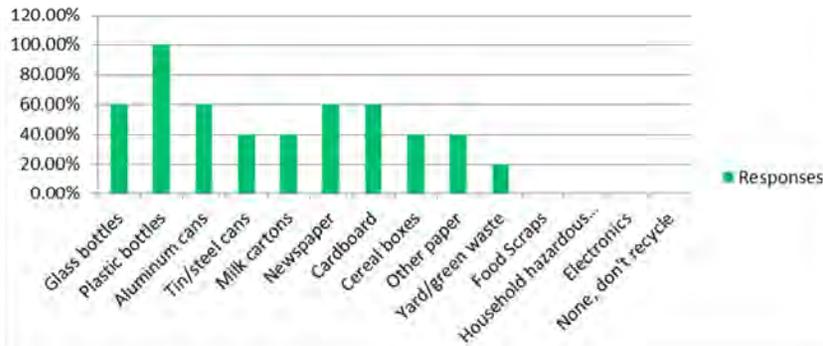
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USD

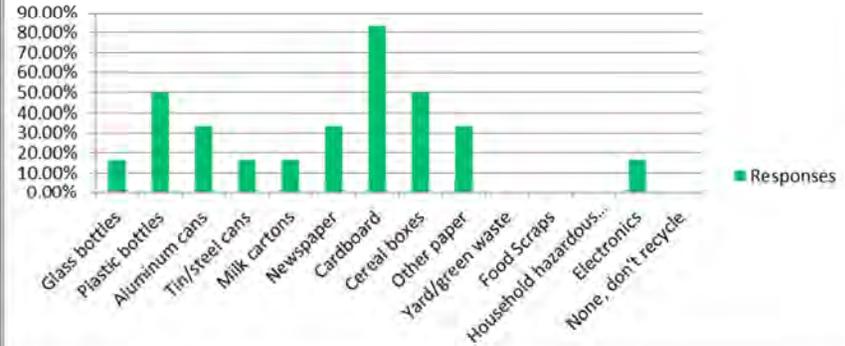
GSD

Q27. Which of the following materials do you recycle (or compost) fairly regularly?
(Select all that apply)



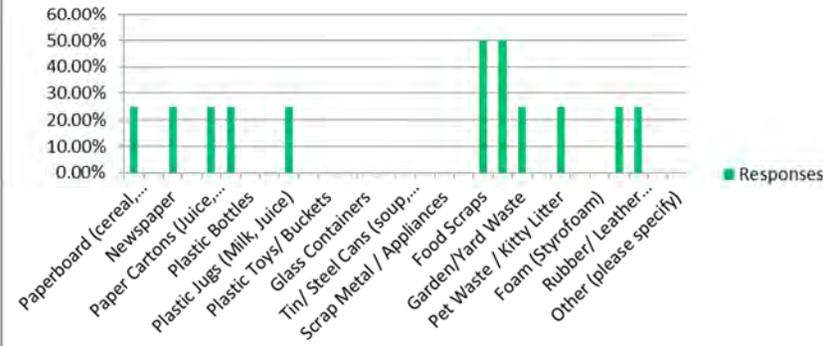
USD

Q27. Which of the following materials do you recycle (or compost) fairly regularly?
(Select all that apply)



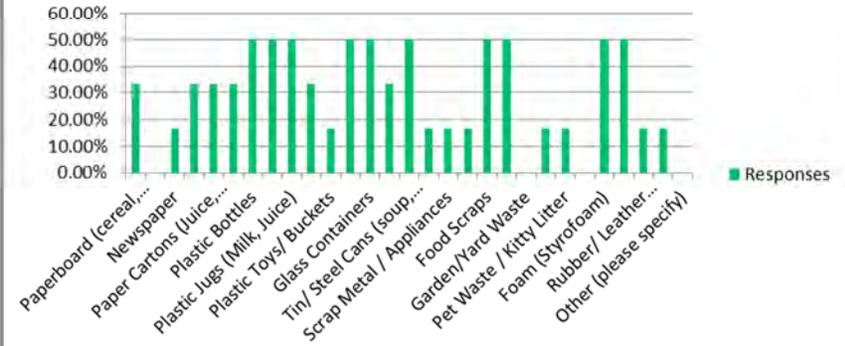
GSD

Q28. Which materials still REMAIN in your trash after any recycling efforts that you do (check all that apply)?

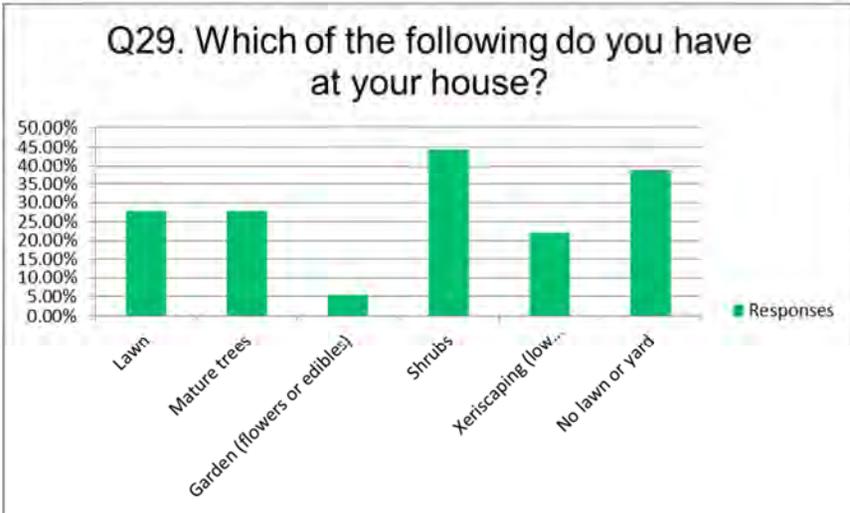


USD

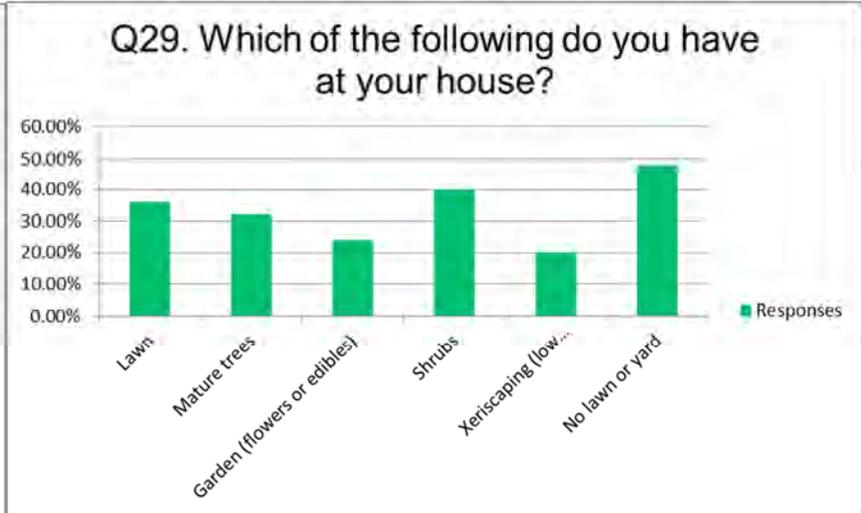
Q28. Which materials still REMAIN in your trash after any recycling efforts that you do (check all that apply)?



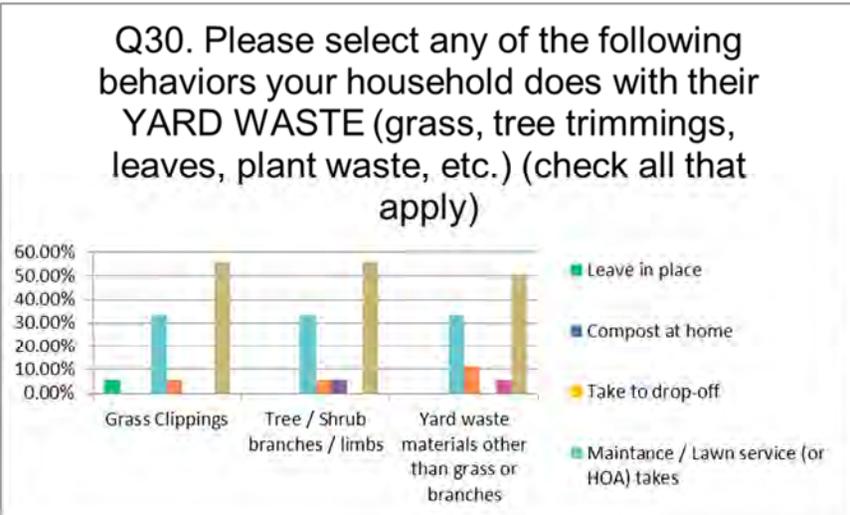
GSD



USD



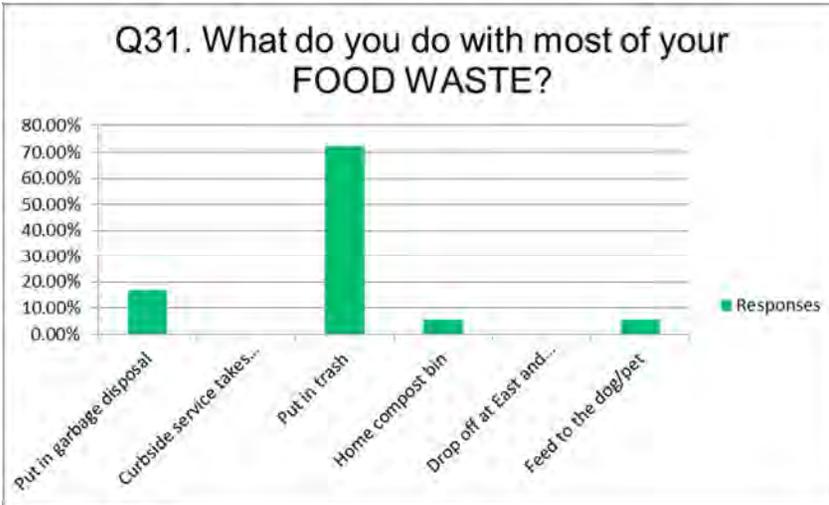
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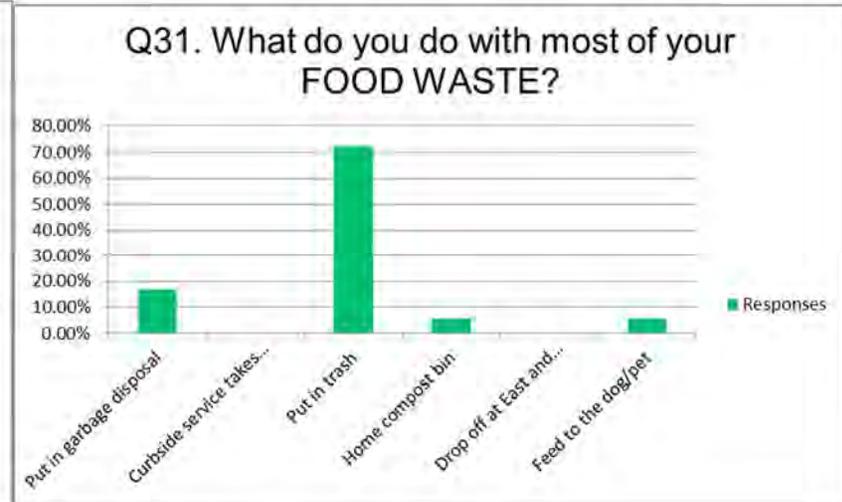
USD



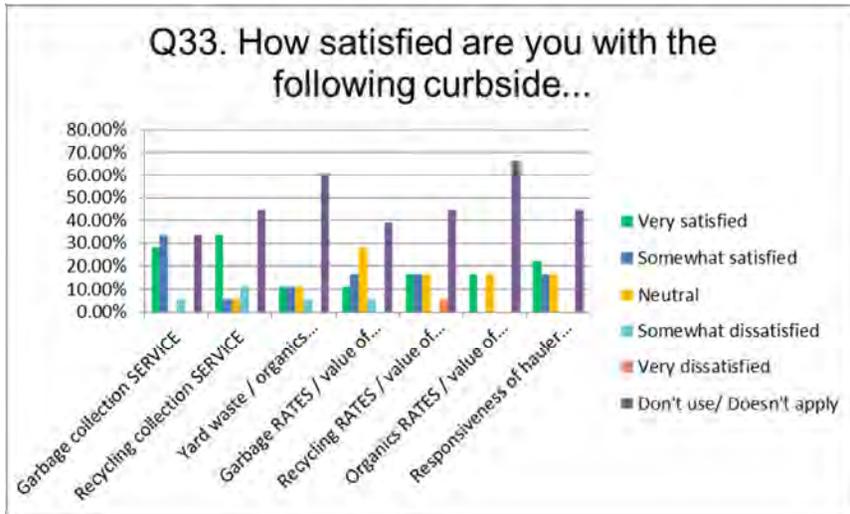
GSD



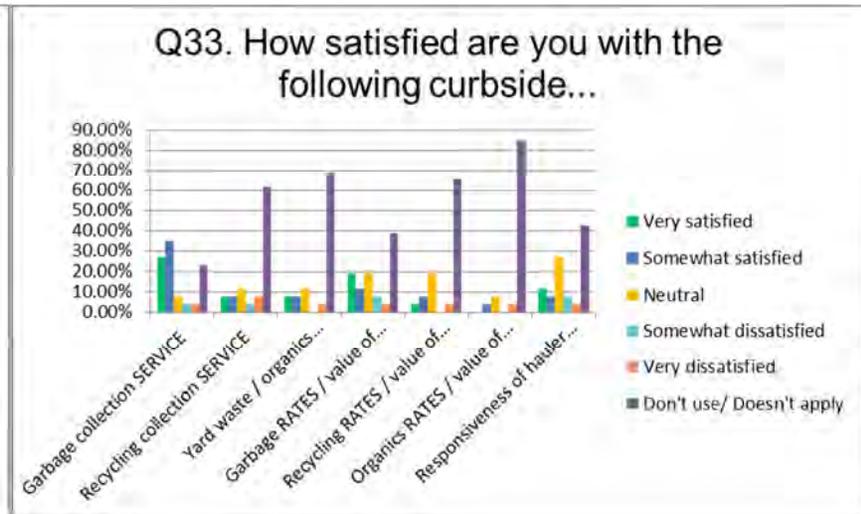
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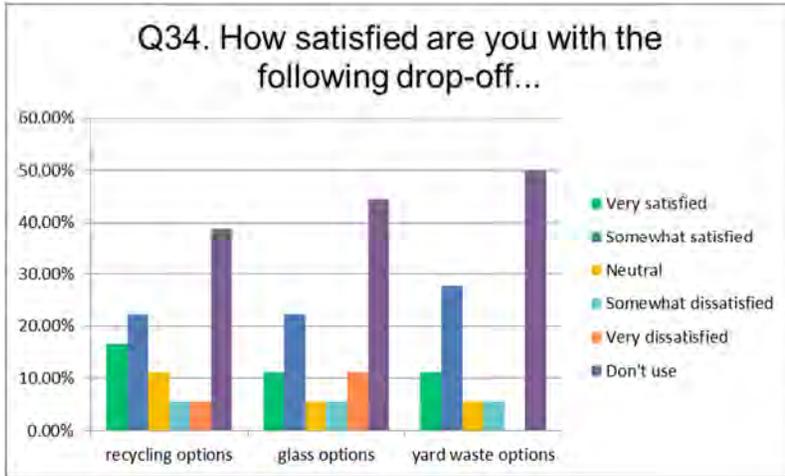
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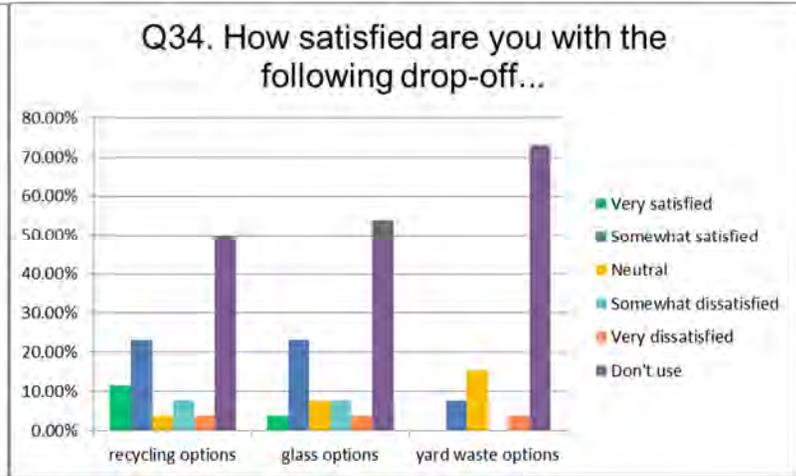
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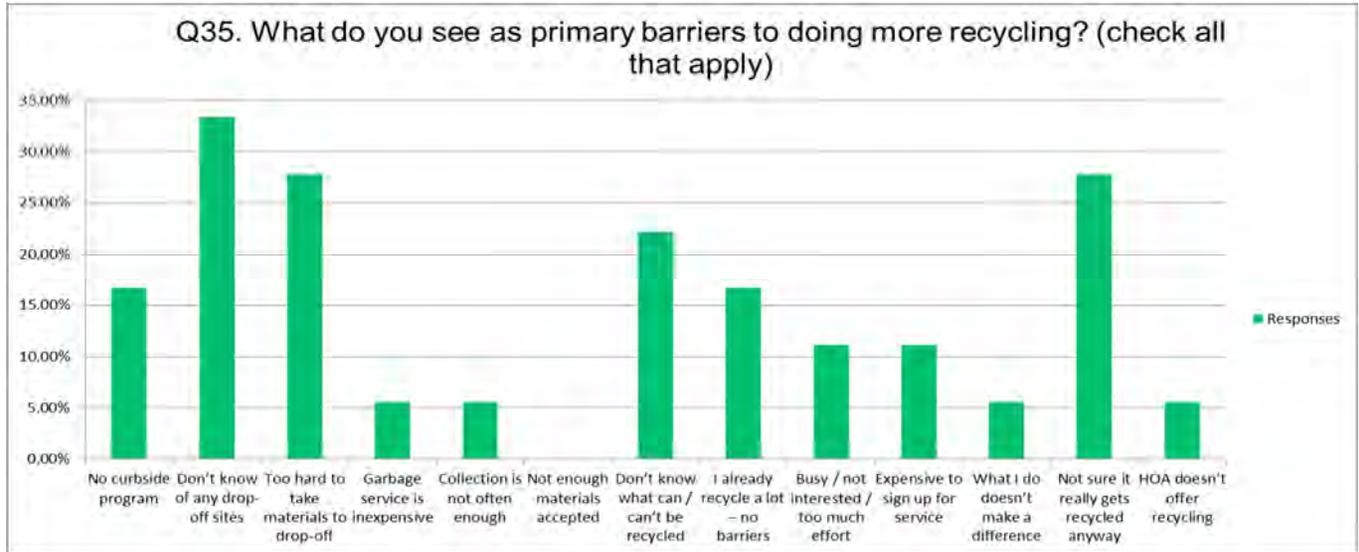
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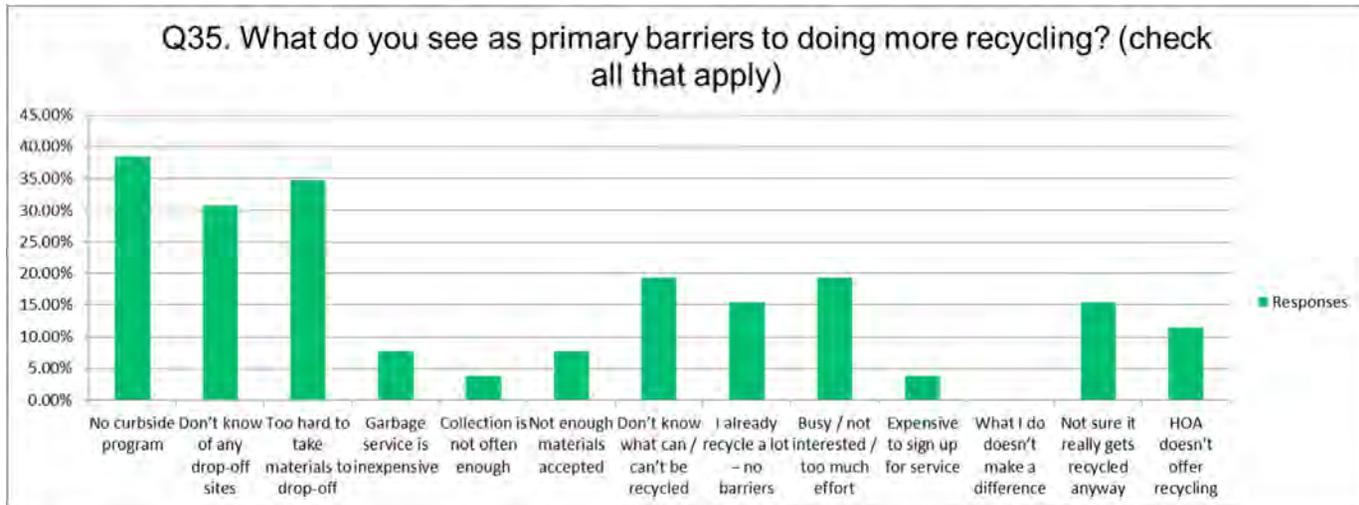
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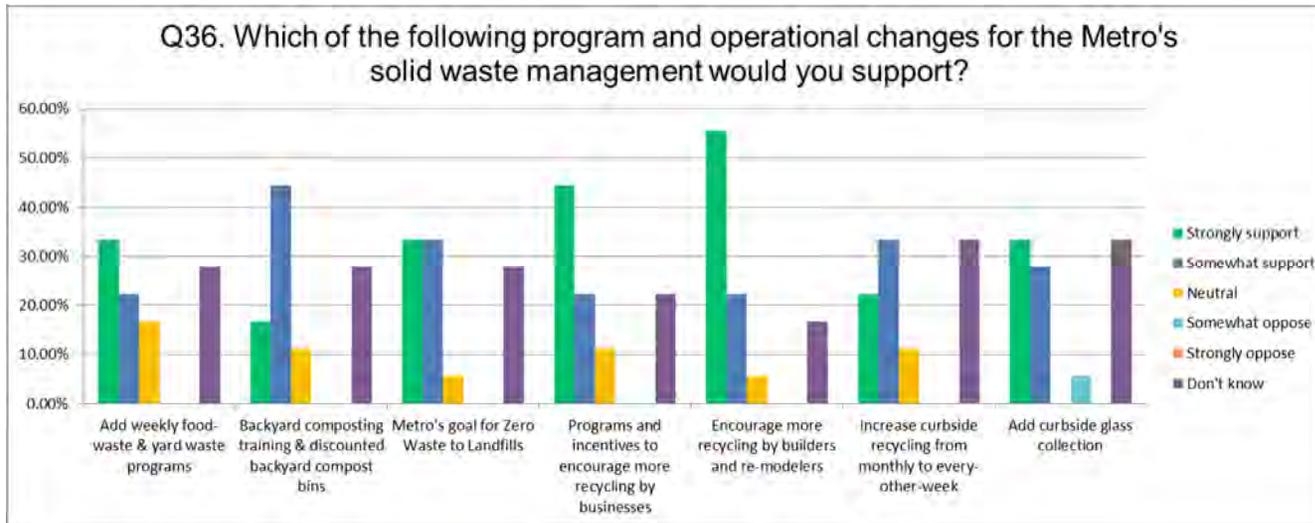
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USD



GSD

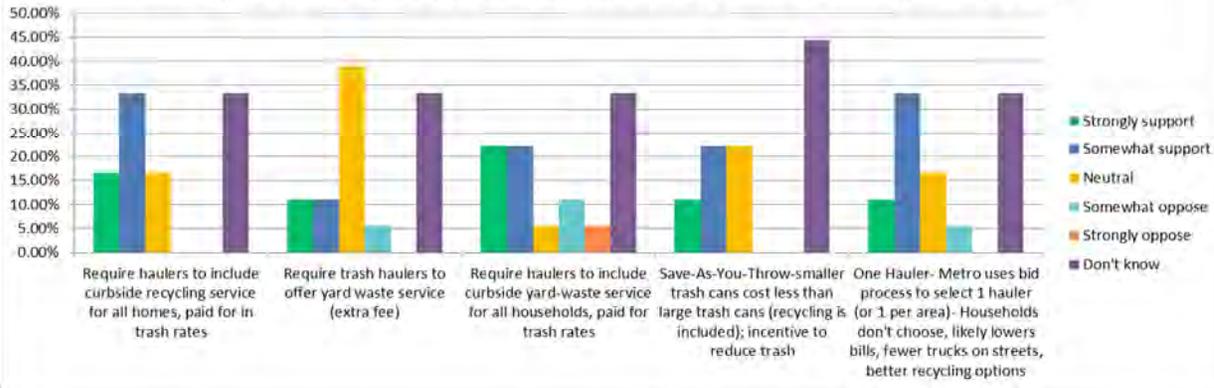


USD



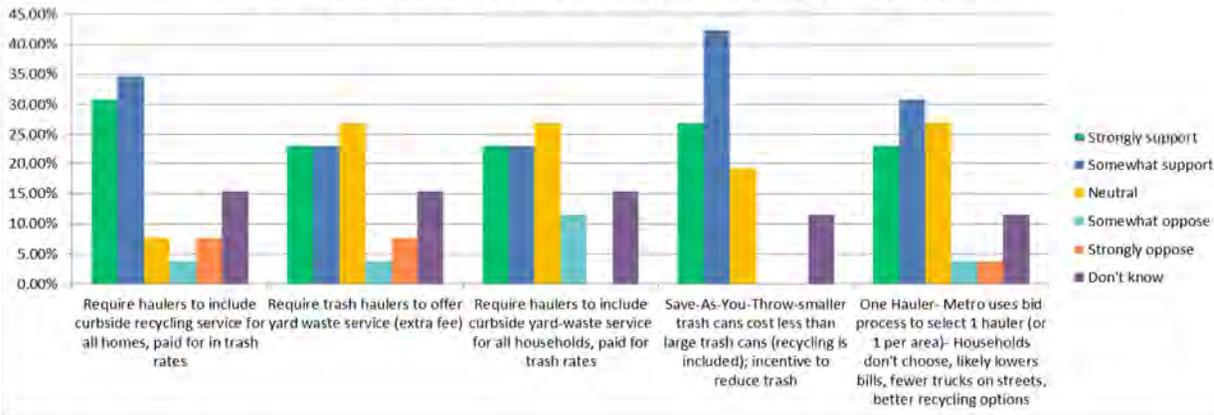
GSD

Q37. IF trash service wasn't included in your taxes (or if you pay separately for service) -Which of the following program and operational changes for the Metro's solid waste management would you support?



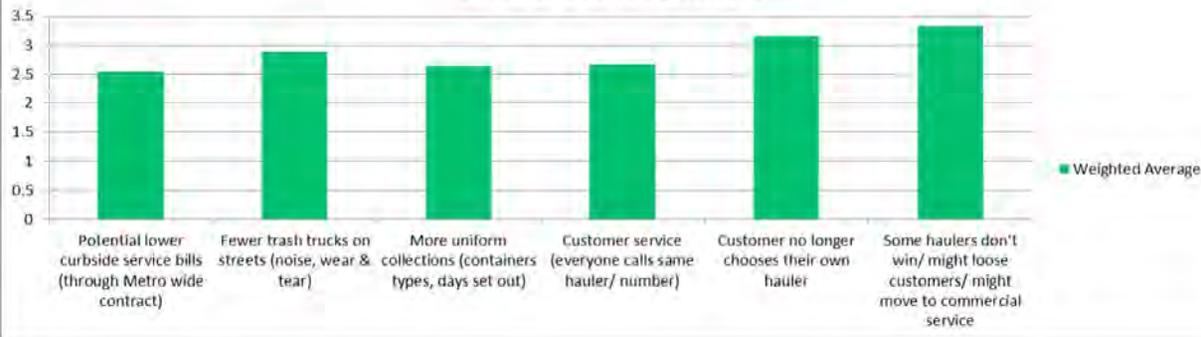
USD

Q37. IF trash service wasn't included in your taxes (or if you pay separately for service) -Which of the following program and operational changes for the Metro's solid waste management would you support?



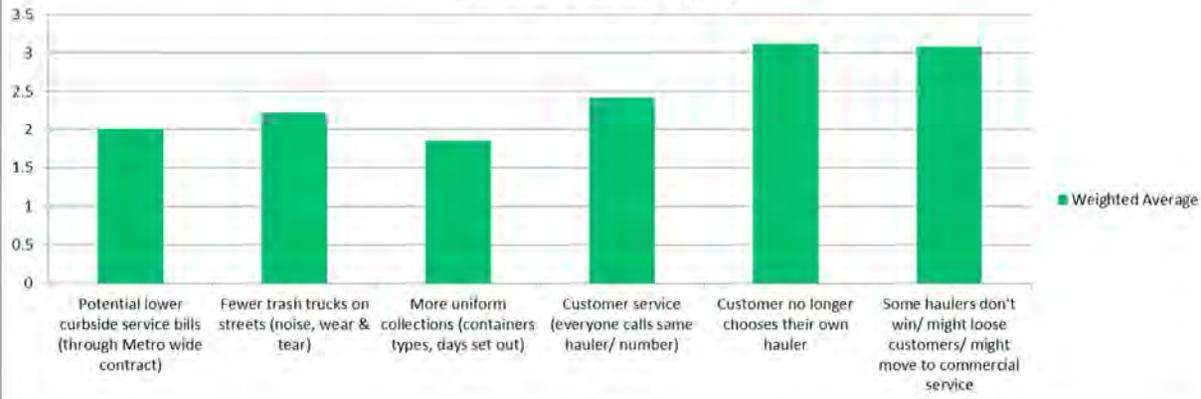
GSD

Q38. If trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section) , please tell us what you would think of the following...



USD

Q38. If trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section) , please tell us what you would think of the following...



GSD

Q39. If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large carts would pay more



USD

Q39. If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large carts would pay more



GSD

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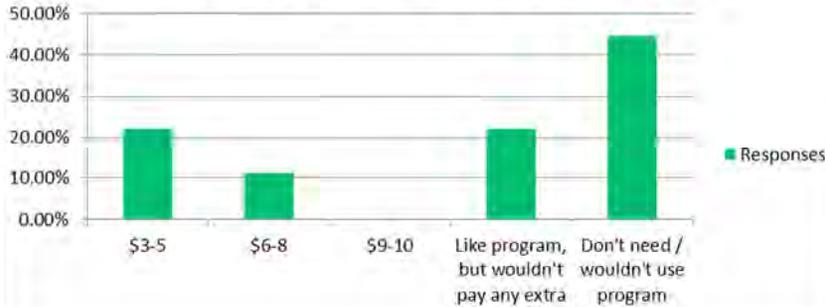
USD

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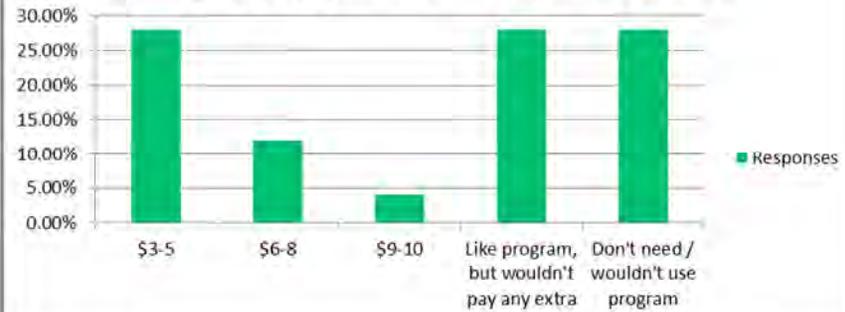


GSD

Q41. If Metro were to institute a curbside ORGANICS (yard waste and/ or food scraps) program, how much would you be willing to pay per month for this service?



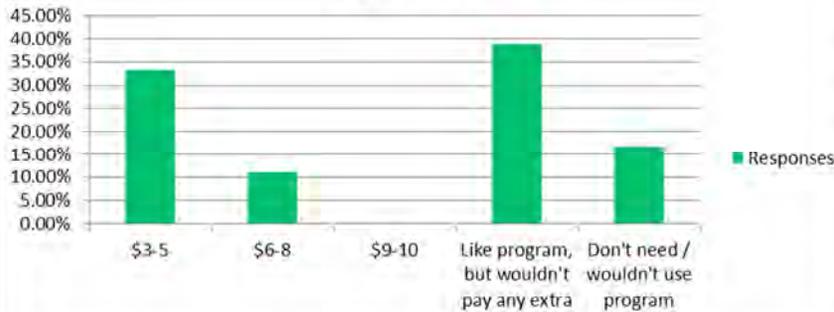
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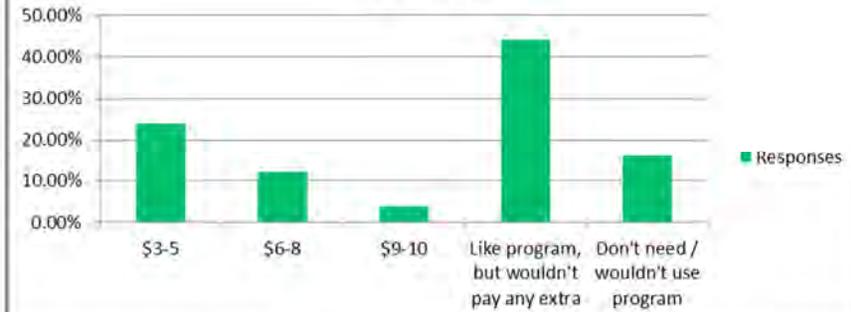
USD

GSD

Q42. If Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?

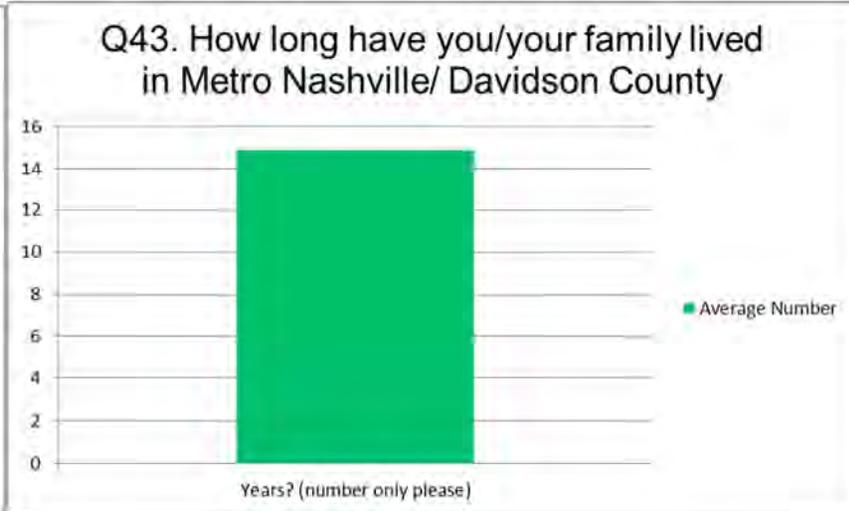
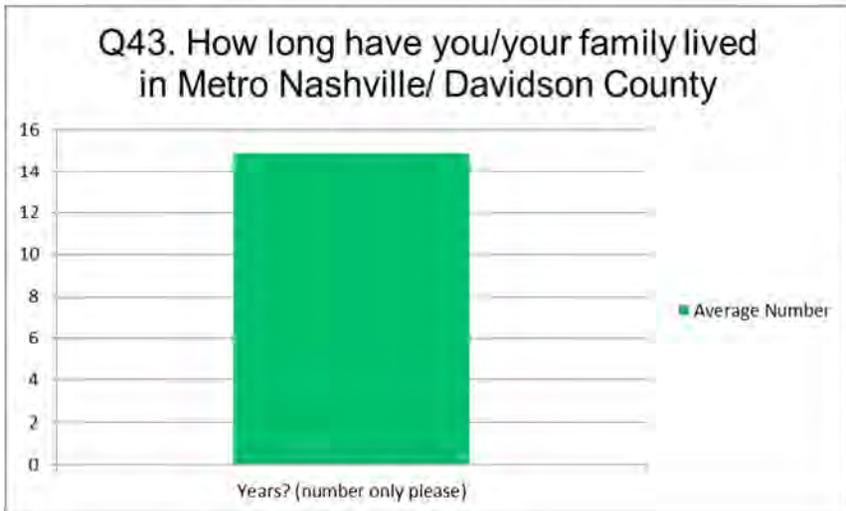


Q42. If Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?



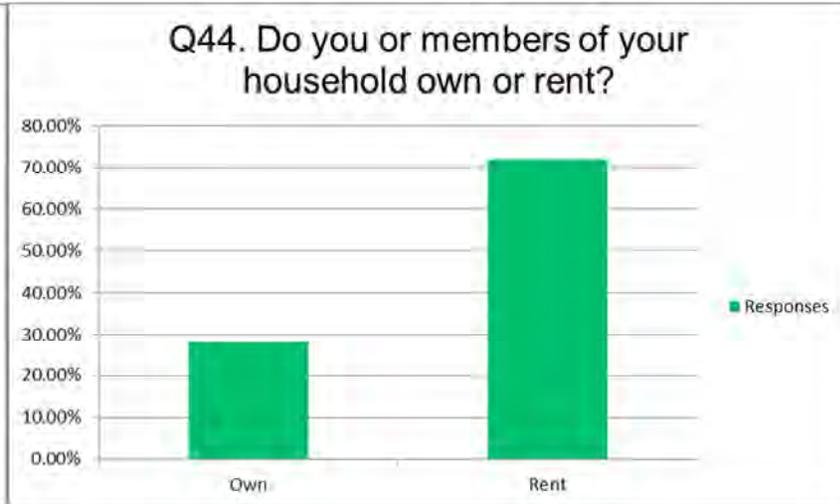
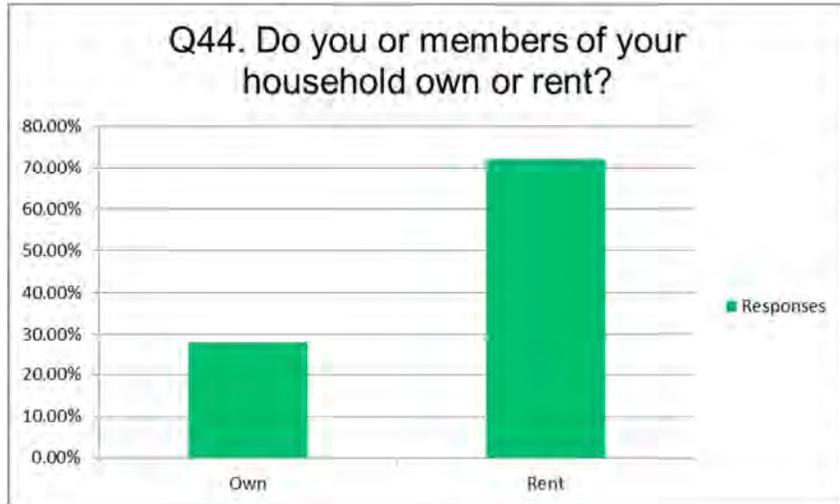
USD

GSD



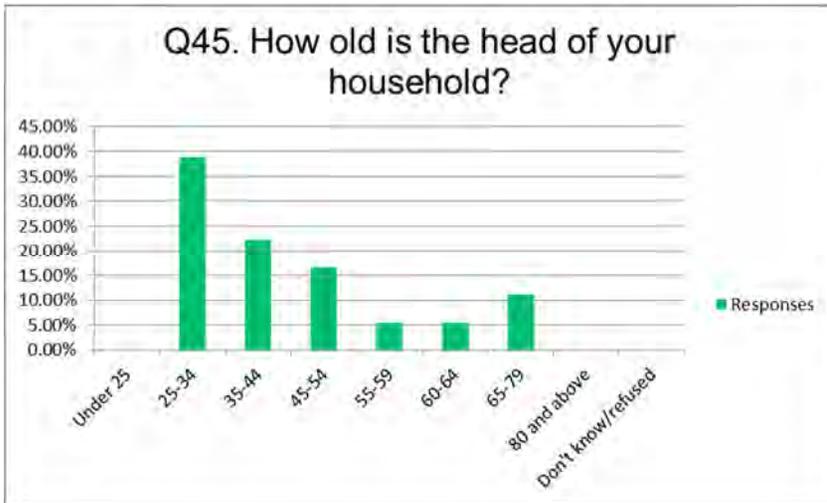
USD

GSD

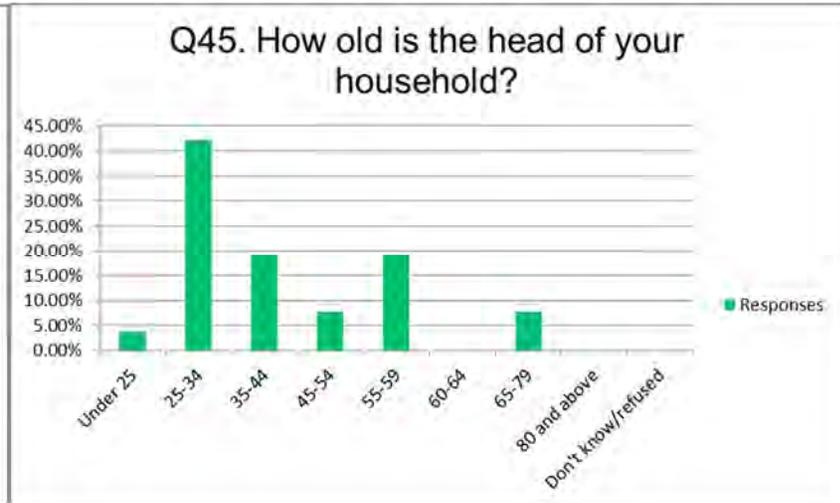


USD

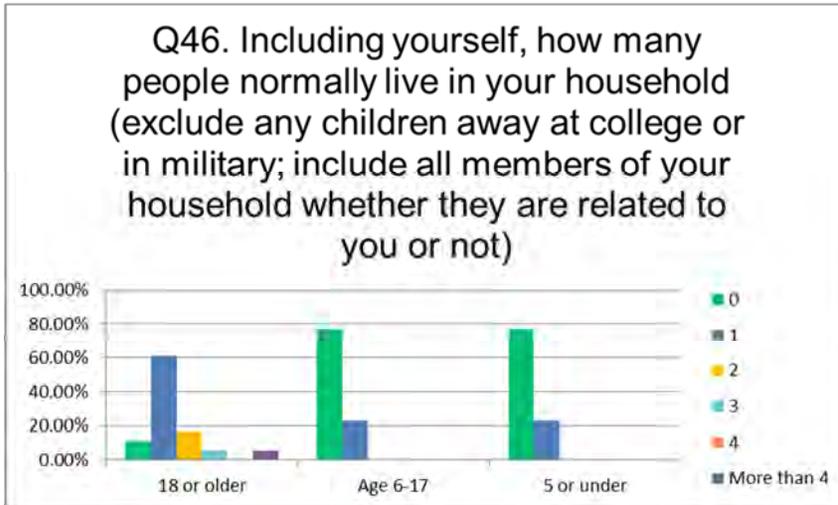
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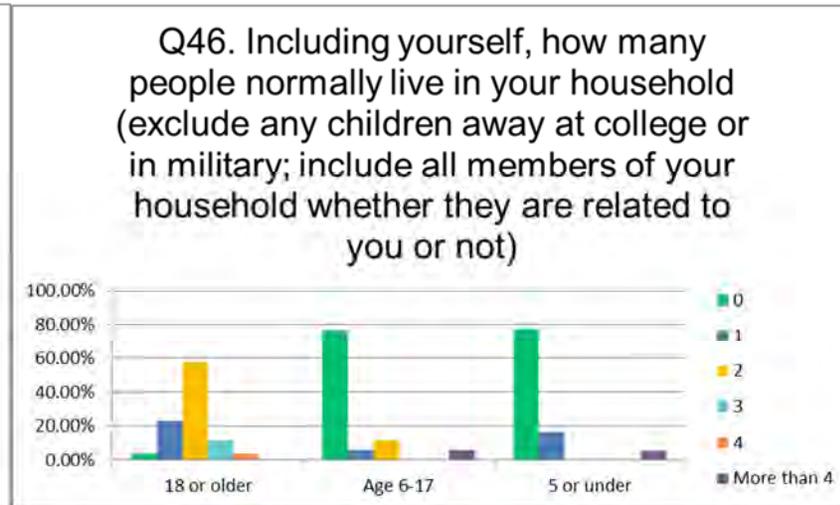
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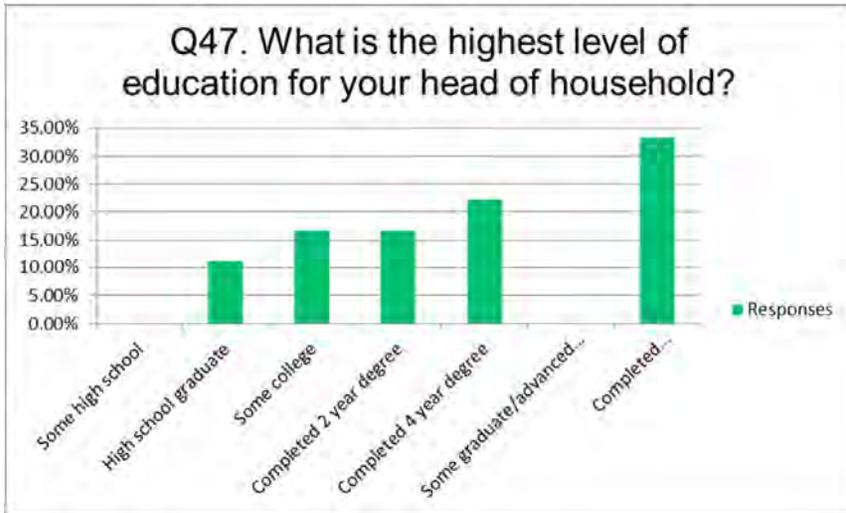
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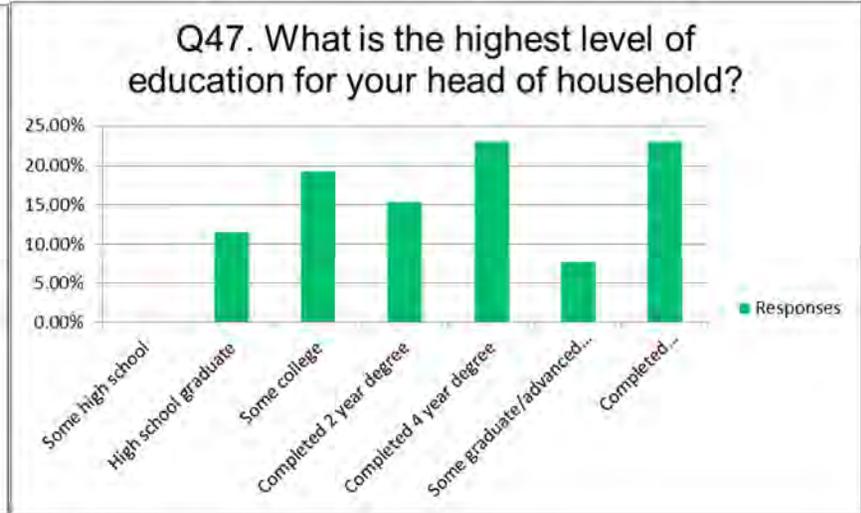
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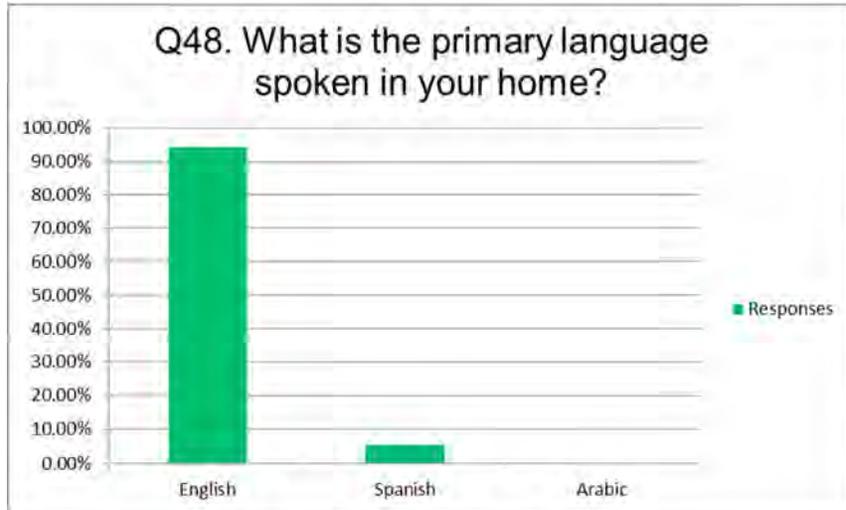
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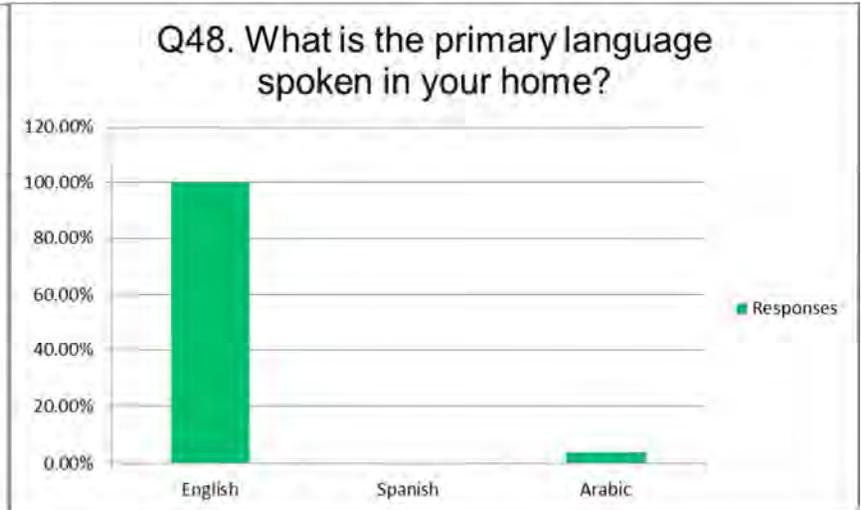
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GSD



USD

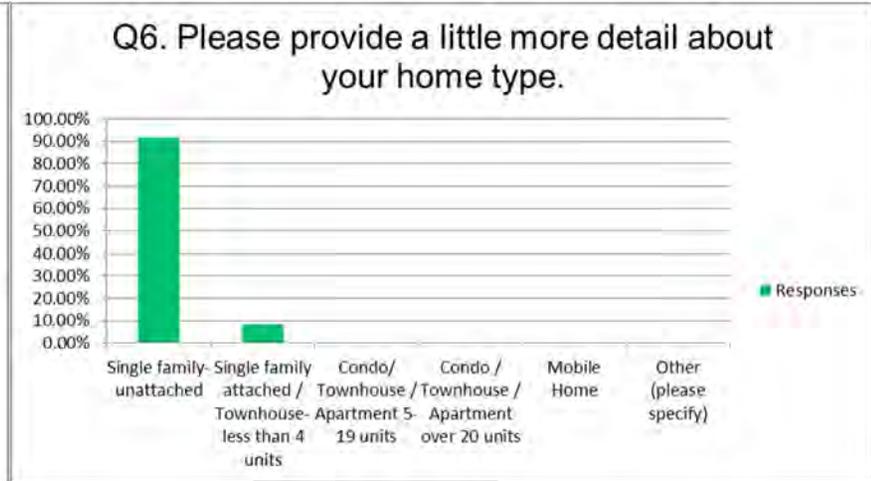
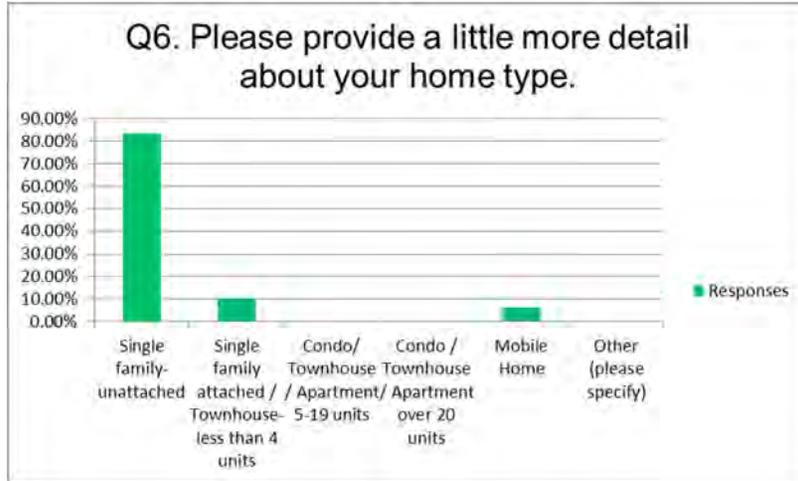


GSD

Figure D-7
Nashville Single Family Comparison
Statistical (n:144) vs. Open Responses (n:2,641)

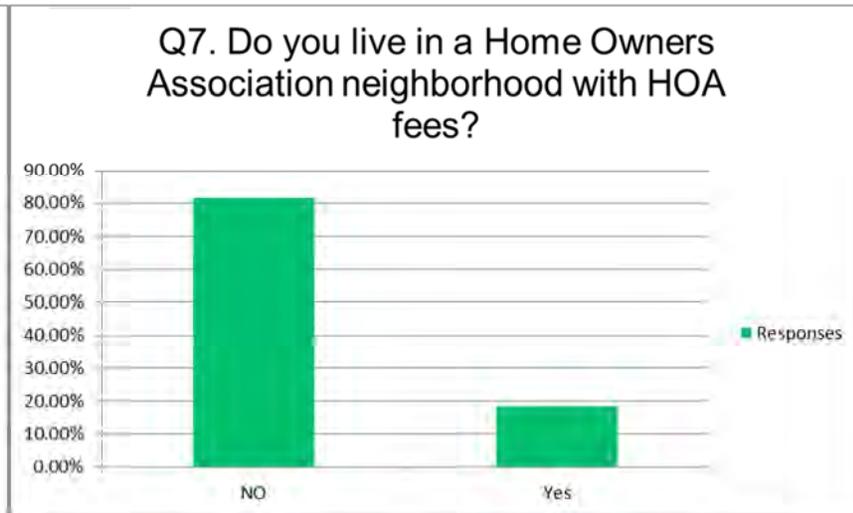
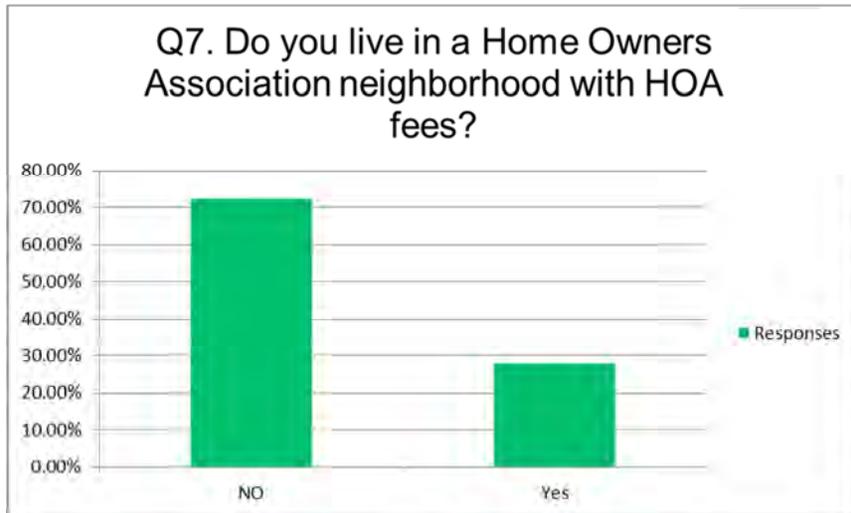
STATISTICAL

OPEN



STATISTICAL

OPEN



STATISTICAL

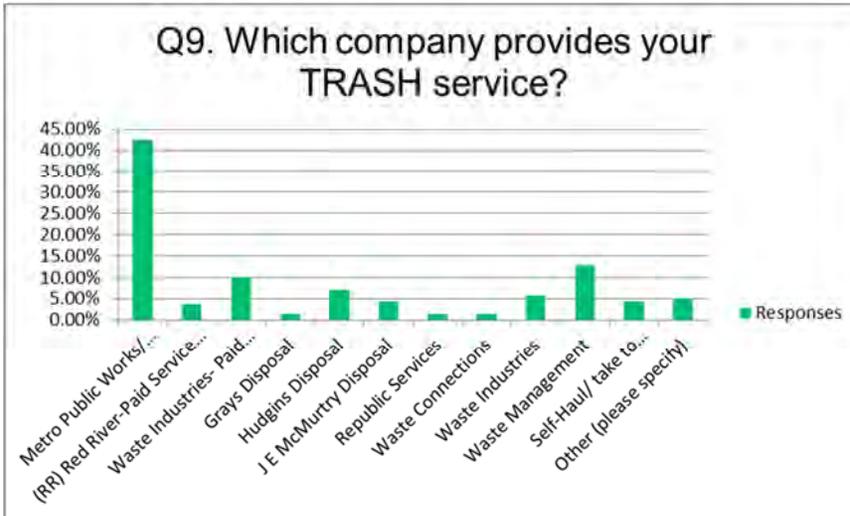
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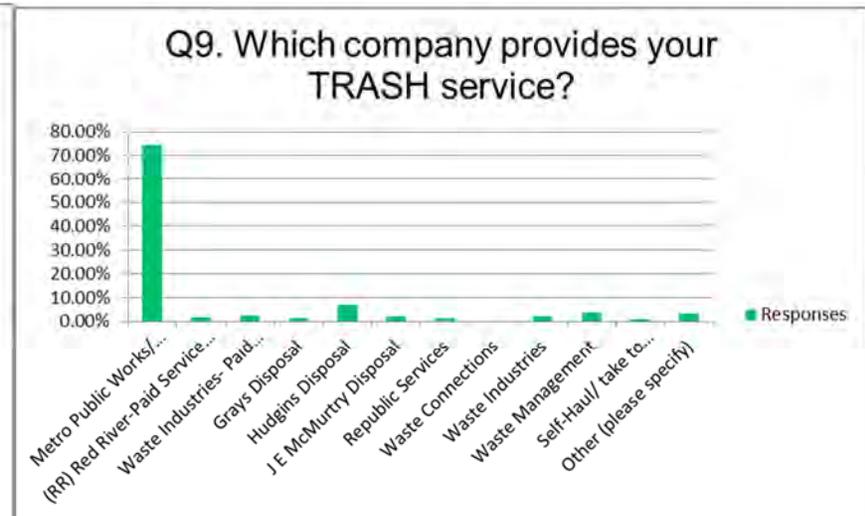
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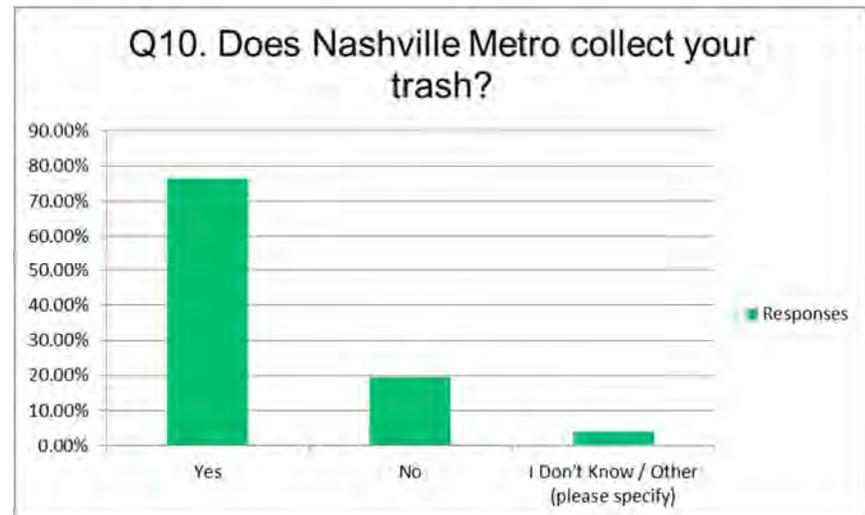
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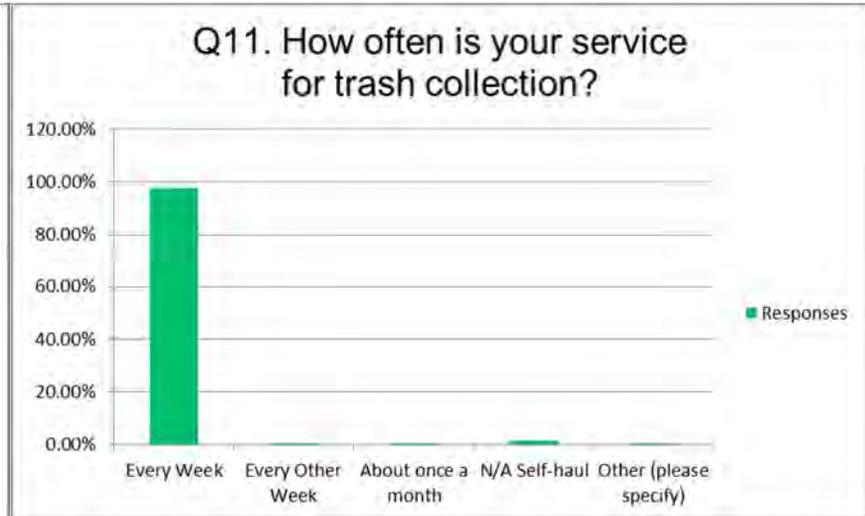
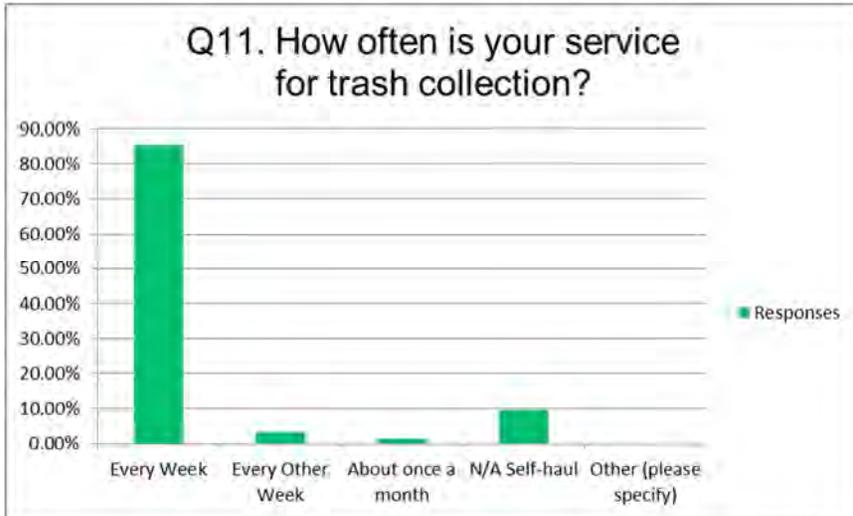
STATISTICAL (Q.10 Not Asked for Statistical)



OPEN

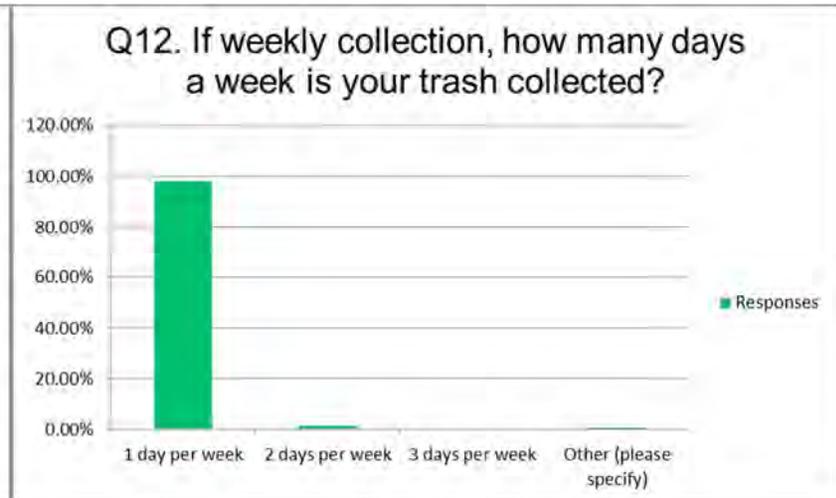
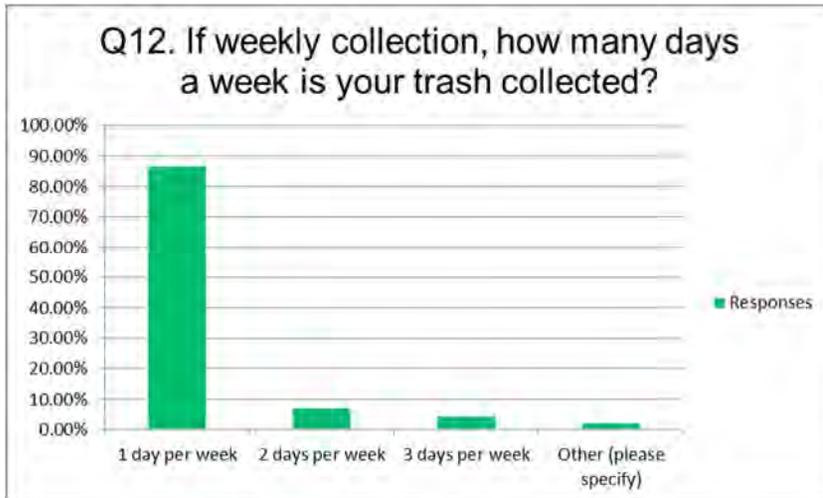


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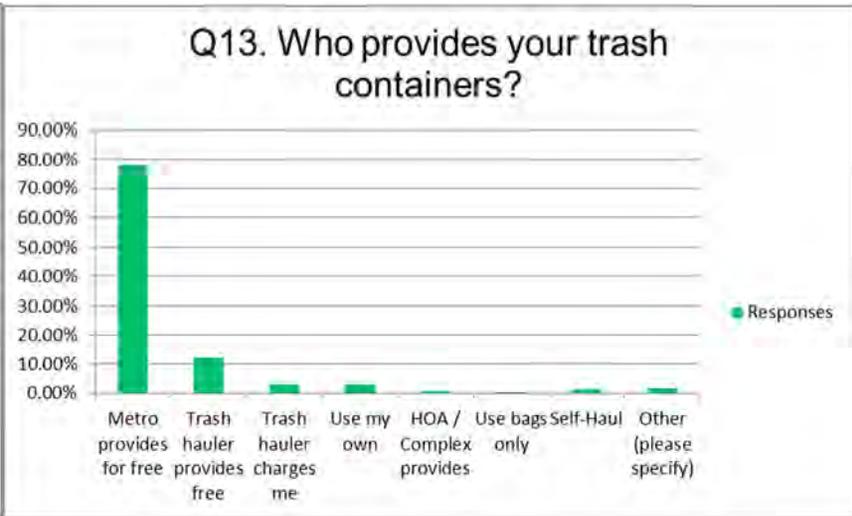
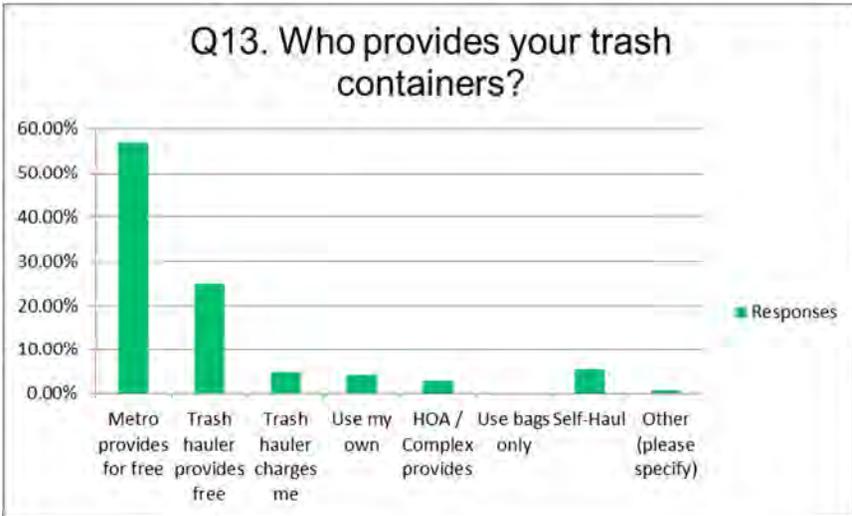
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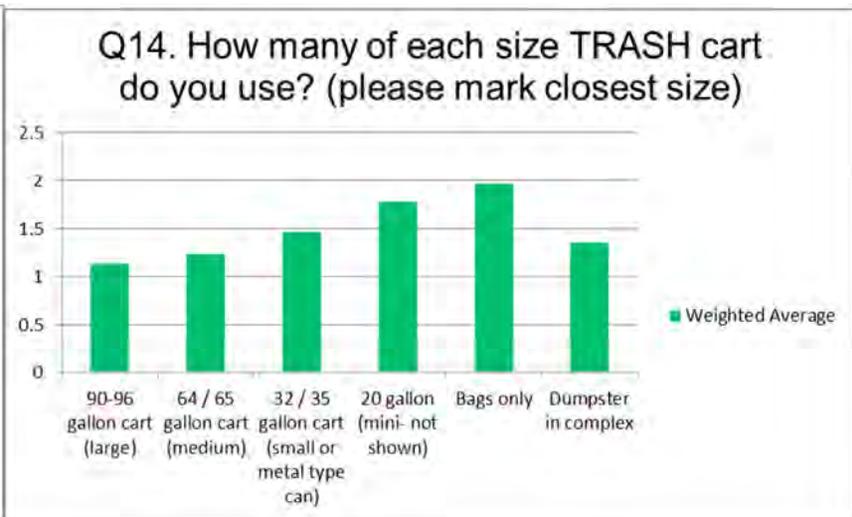
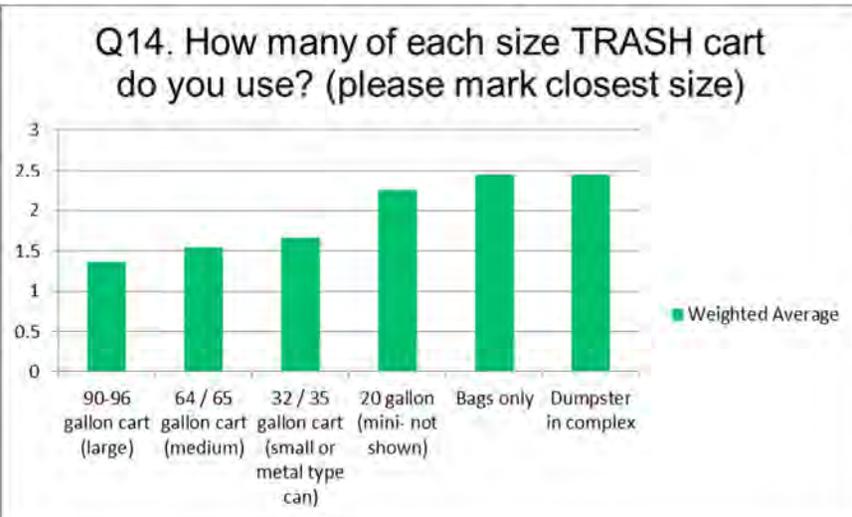
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OPEN



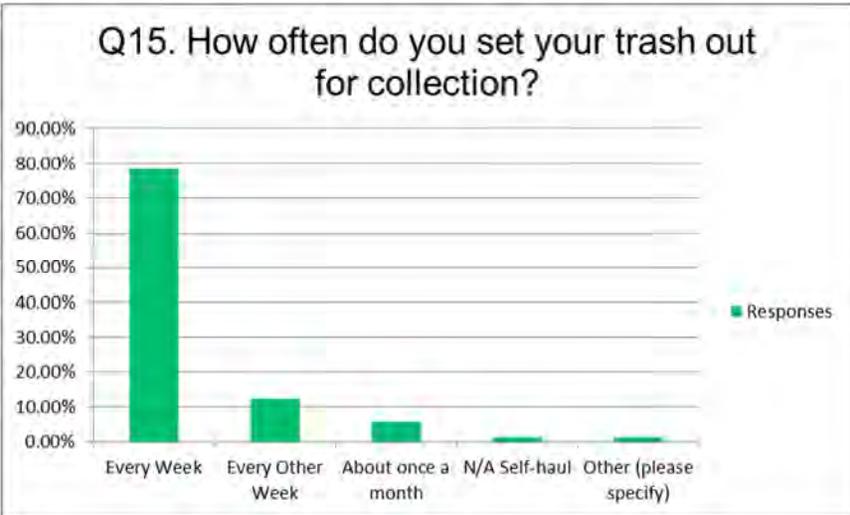
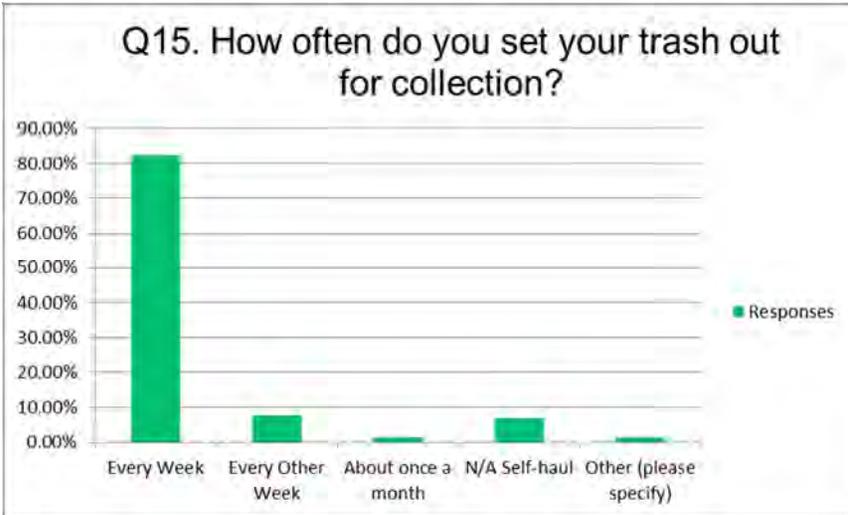
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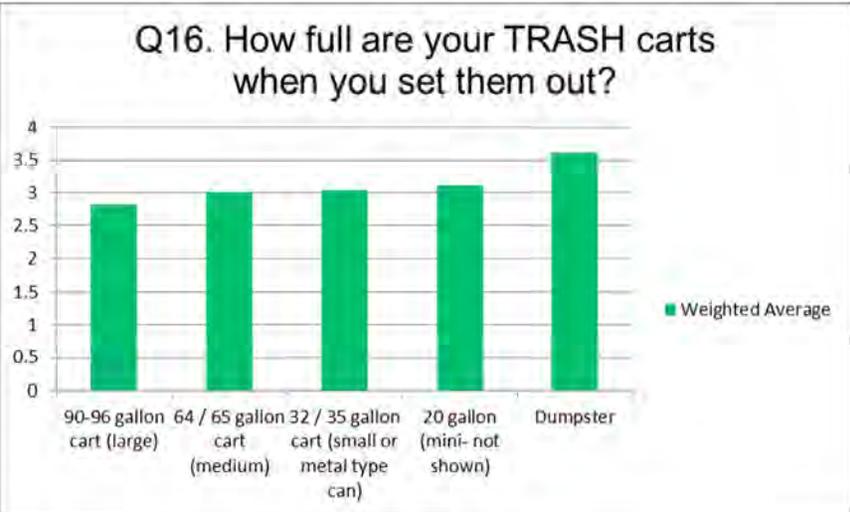
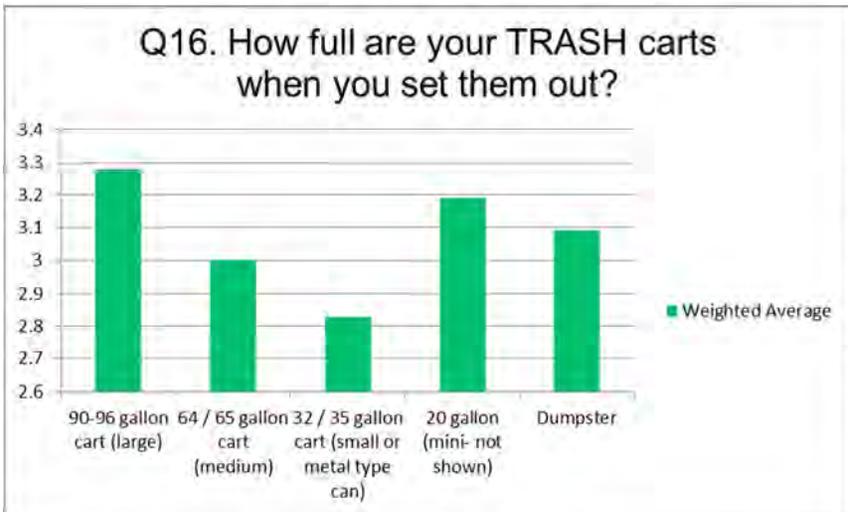
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OPEN



STATISTICAL

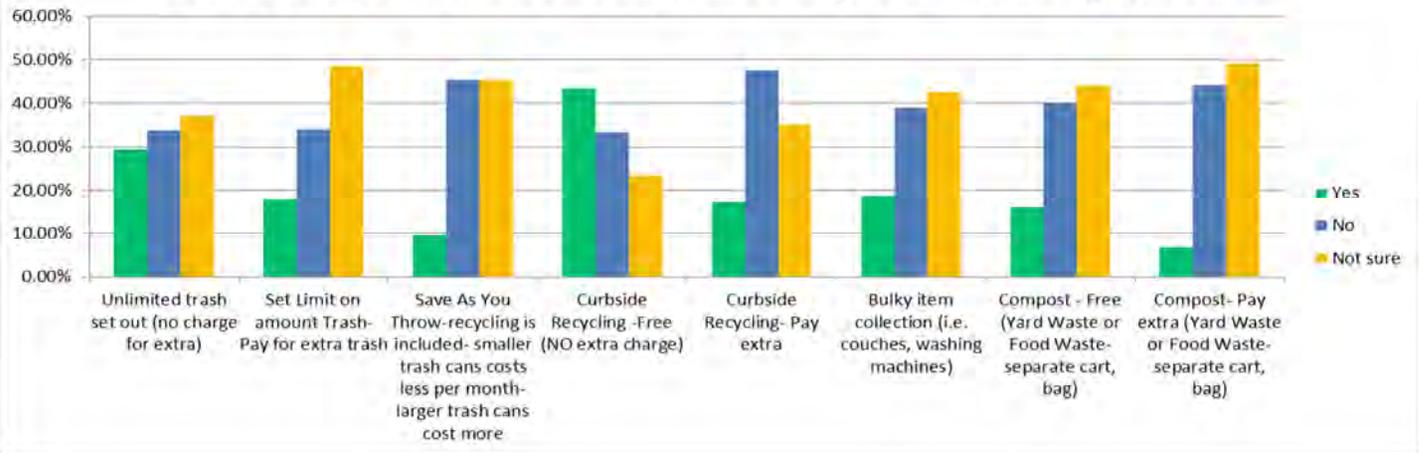
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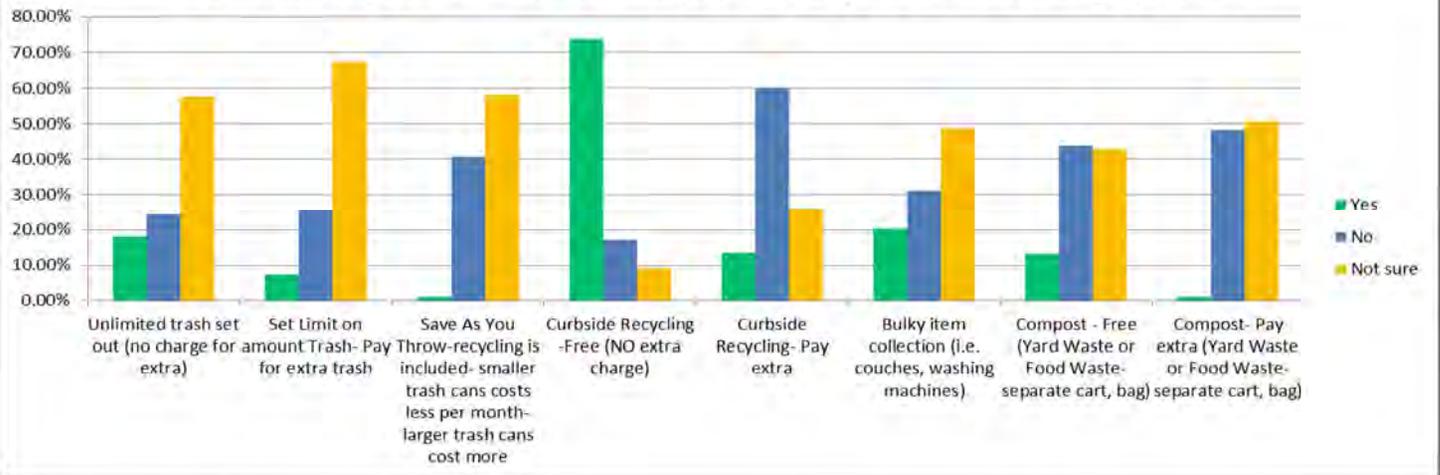
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Q17. Does your TRASH hauler provide any of the following options?

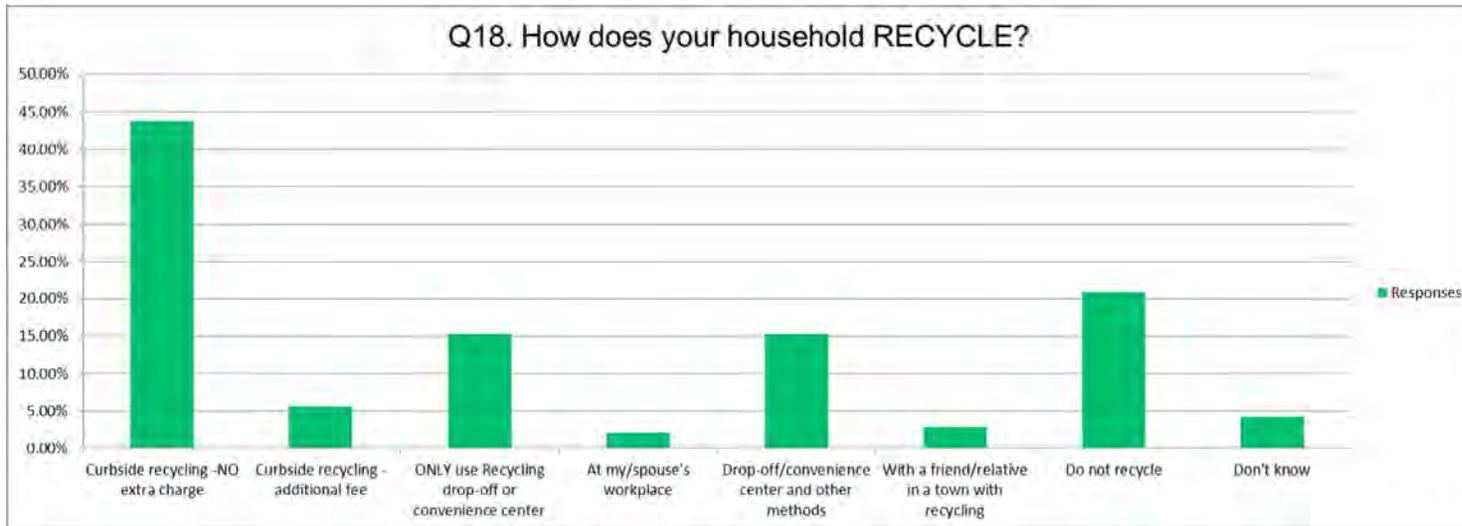


STATISTICAL

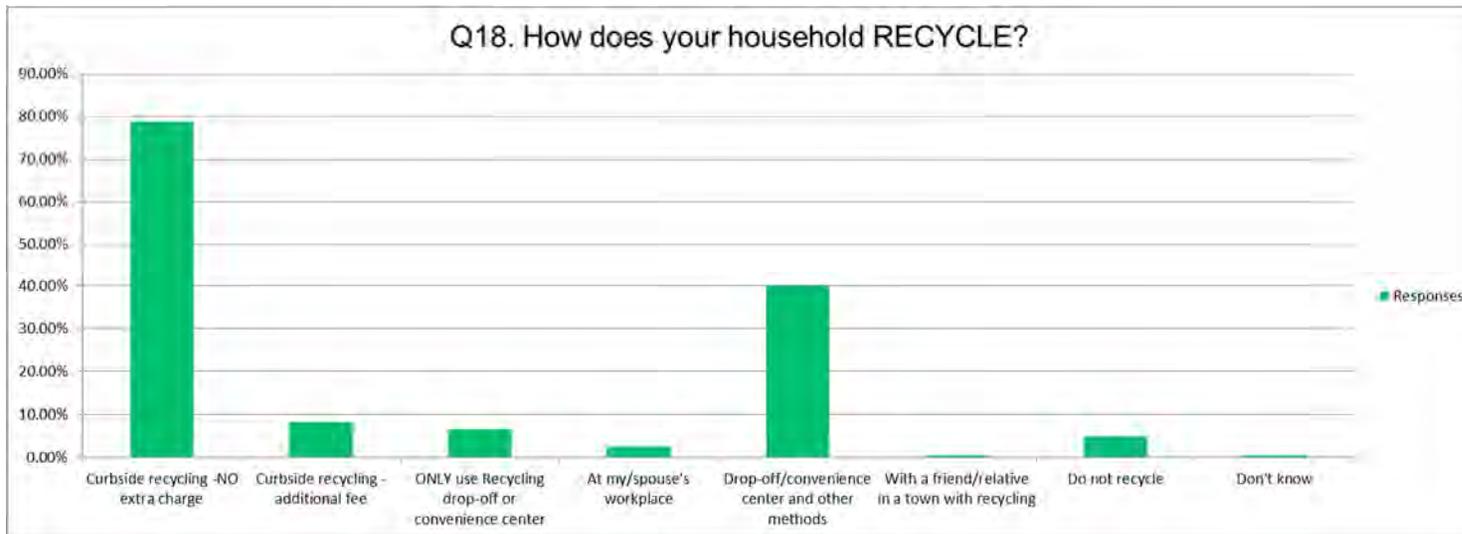
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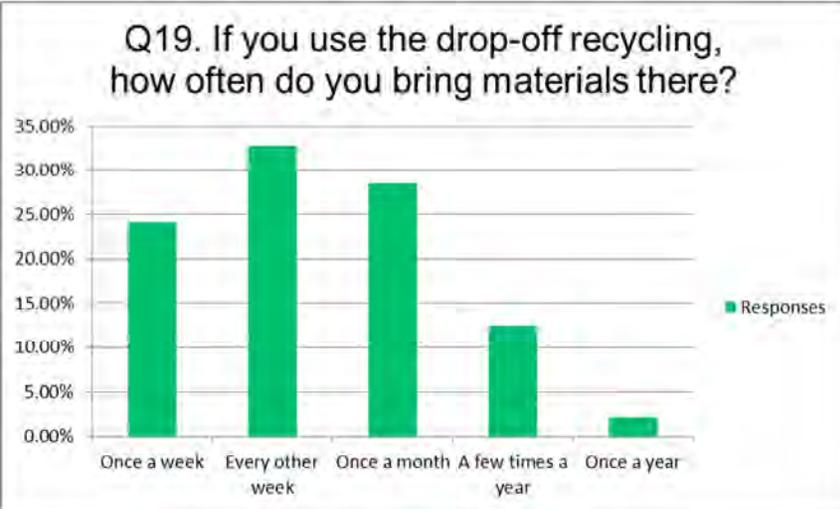
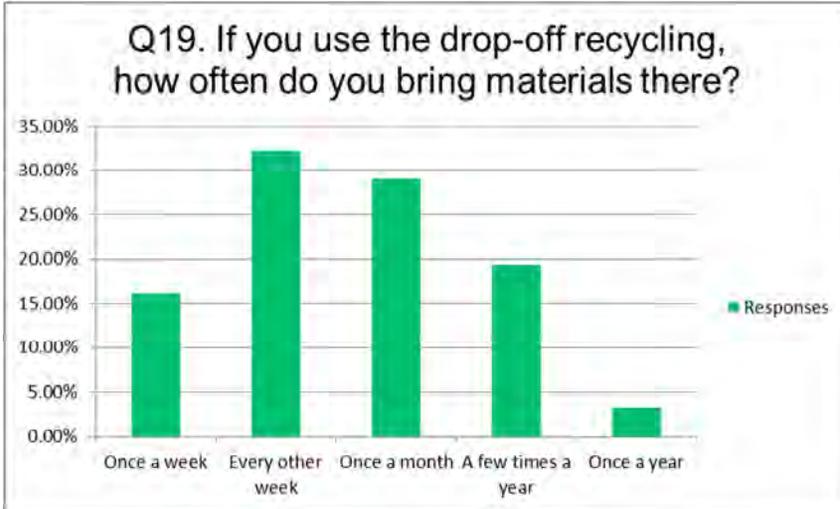
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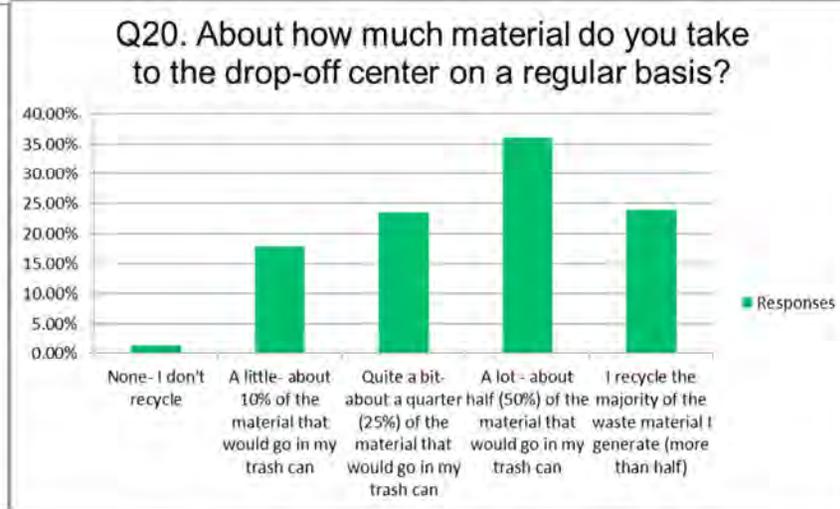
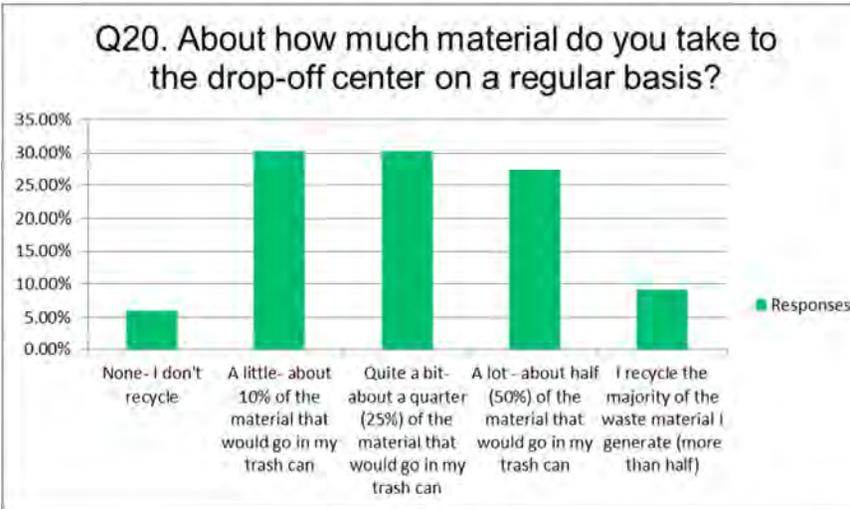


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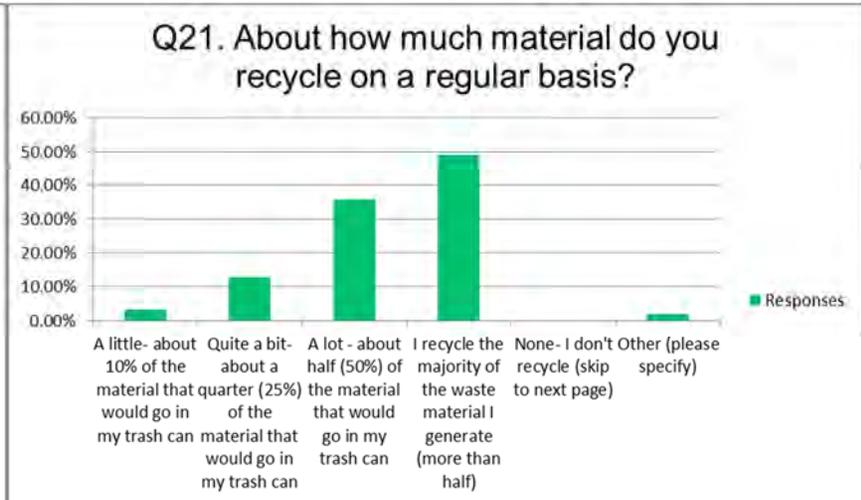
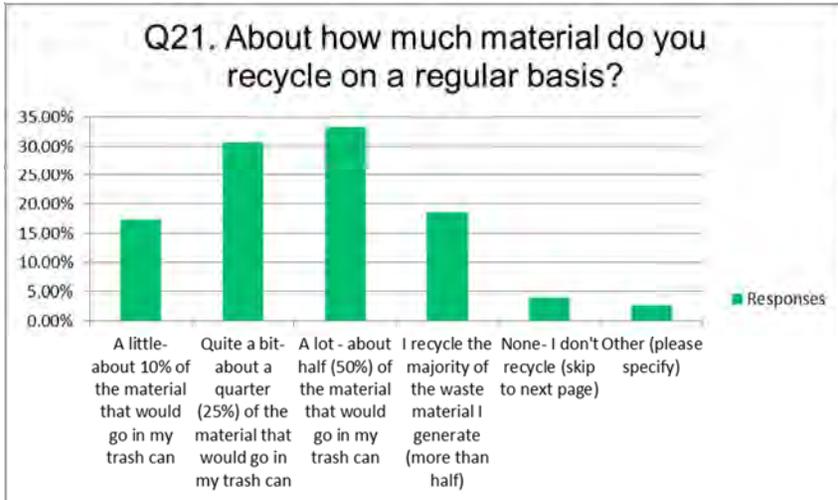
STATISTICAL

OPEN



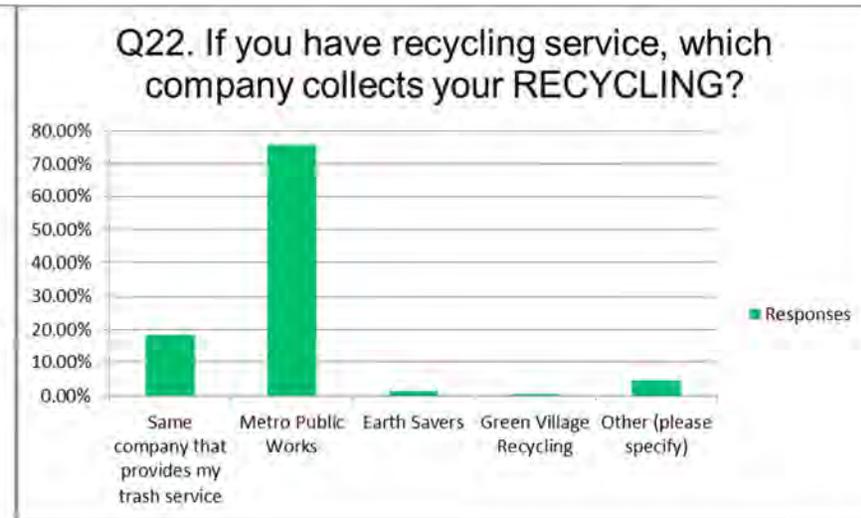
STATISTICAL

OPEN



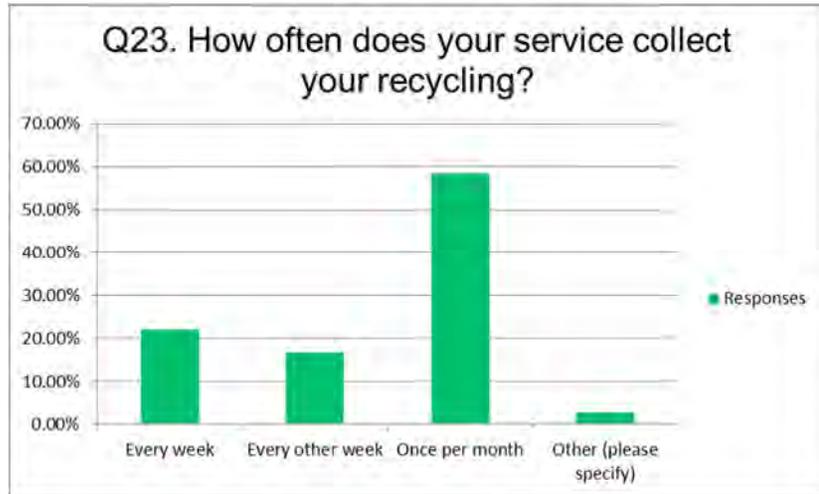
STATISTICAL

OPEN

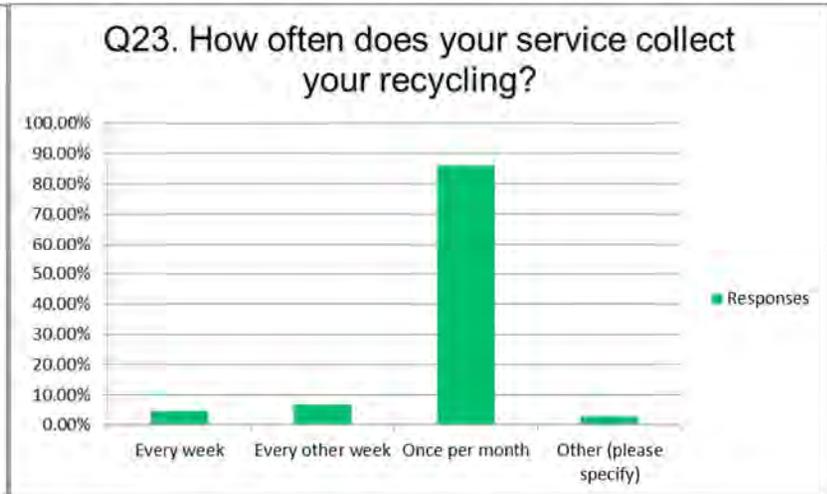


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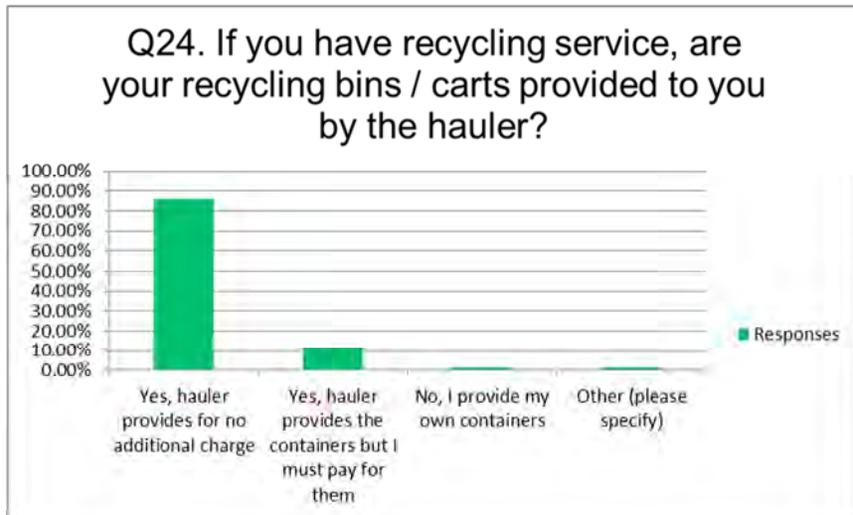
OPEN



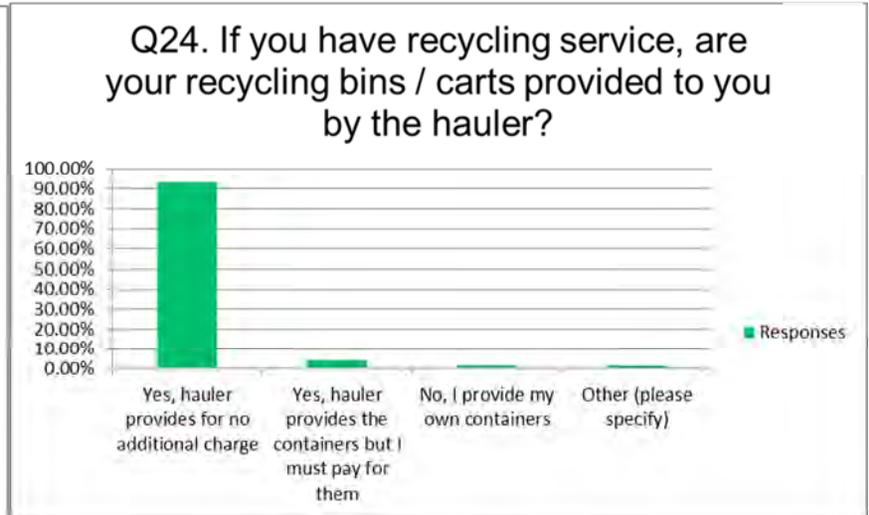
STATISTICAL



OPEN

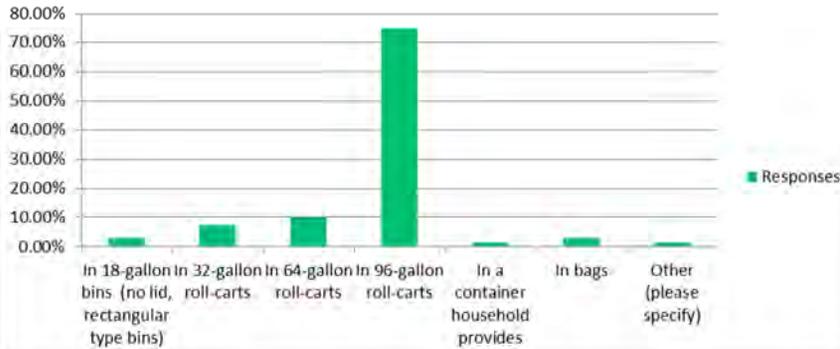


STATISTICAL

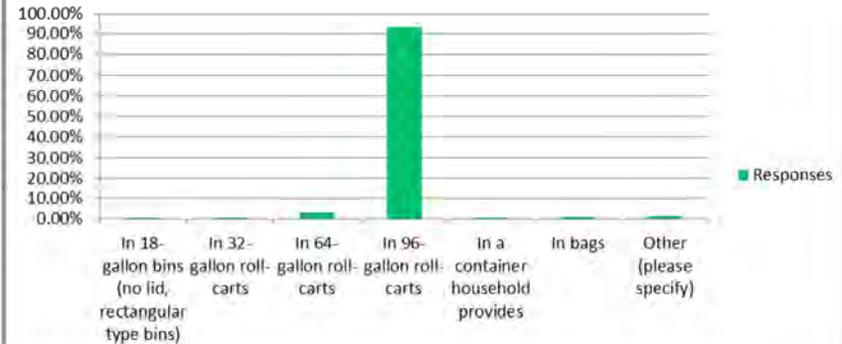


OPEN

Q25. If you have curbside recycling service provided by a hauler, how are materials collected?



Q25. If you have curbside recycling service provided by a hauler, how are materials collected?



STATISTICAL

OPEN

Q26. If you have curbside recycling service, are your materials collected in separate streams (i.e. paper in one bin, cans, plastics and other containers in a different bin) or are they collected in a single stream (all materials together in...)



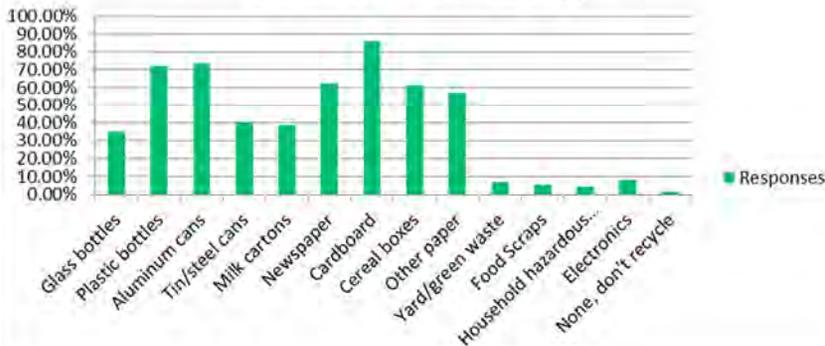
Q26. If you have curbside recycling service, are your materials collected in separate streams (i.e. paper in one bin, cans, plastics and other containers in a different bin) or are they collected in a single stream (all materials together in...)



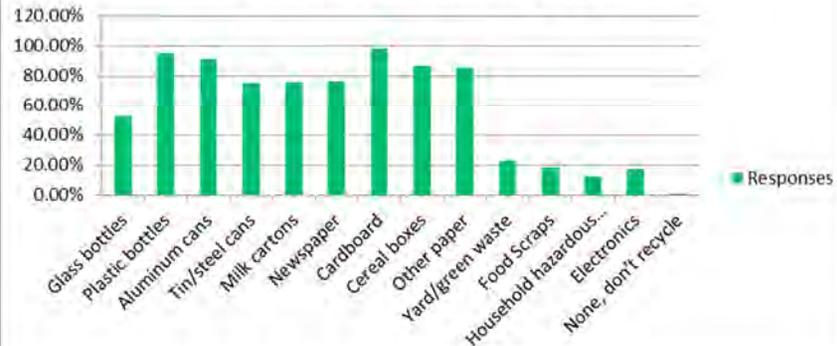
STATISTICAL

OPEN

Q27. Which of the following materials do you recycle (or compost) fairly regularly? (Select all that apply)



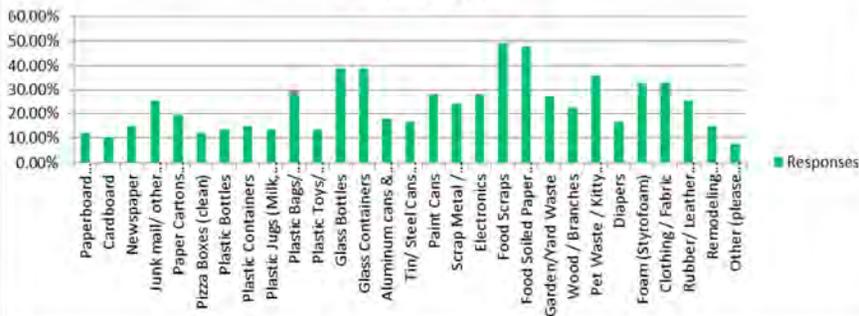
Q27. Which of the following materials do you recycle (or compost) fairly regularly? (Select all that apply)



STATISTICAL

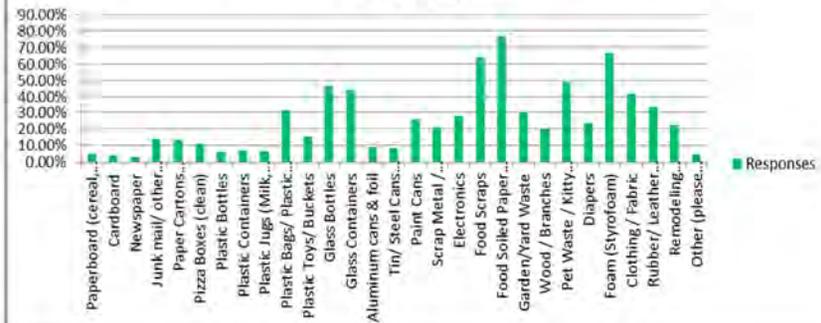
OPEN

Q28. Which materials still REMAIN in your trash after any recycling efforts that you do (check all that apply)?



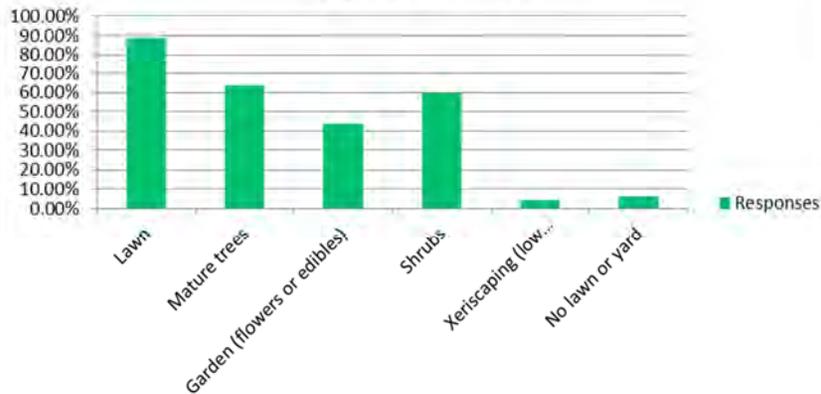
STATISTICAL

Q28. Which materials still REMAIN in your trash after any recycling efforts that you do (check all that apply)?



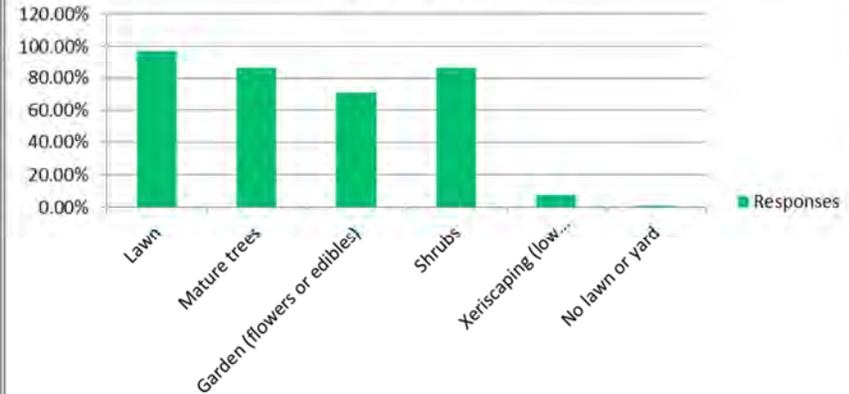
OPEN

Q29. Which of the following do you have at your house?



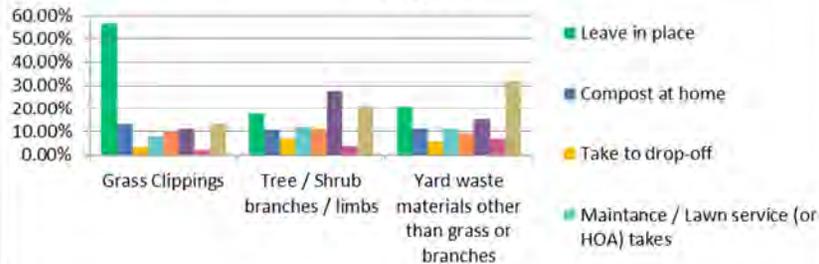
STATISTICAL

Q29. Which of the following do you have at your house?



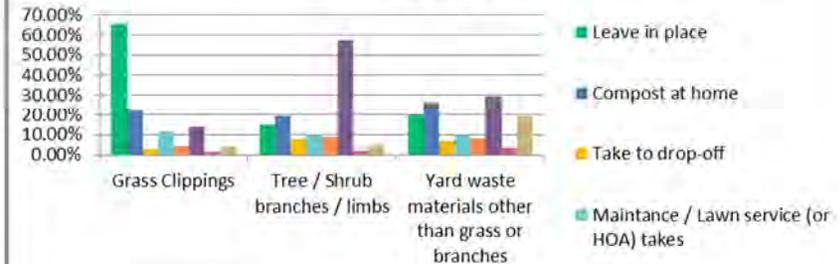
OPEN

Q30. Please select any of the following behaviors your household does with their YARD WASTE (grass, tree trimmings, leaves, plant waste, etc.) (check all that apply)

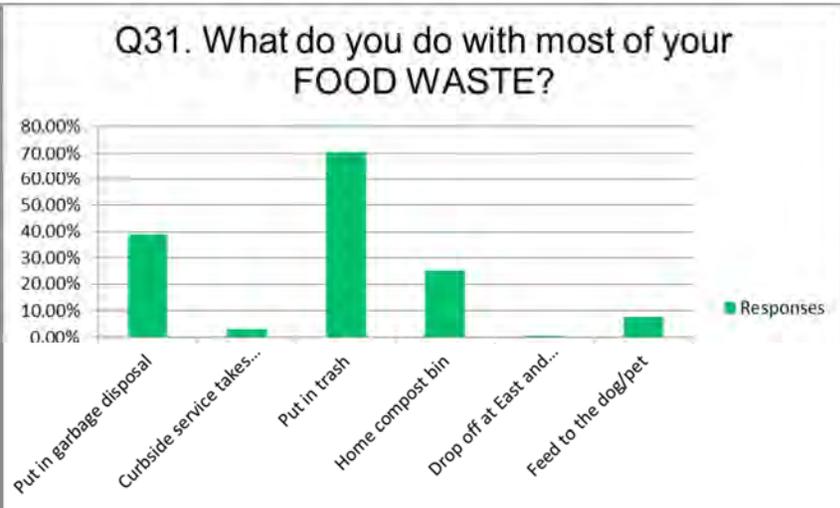
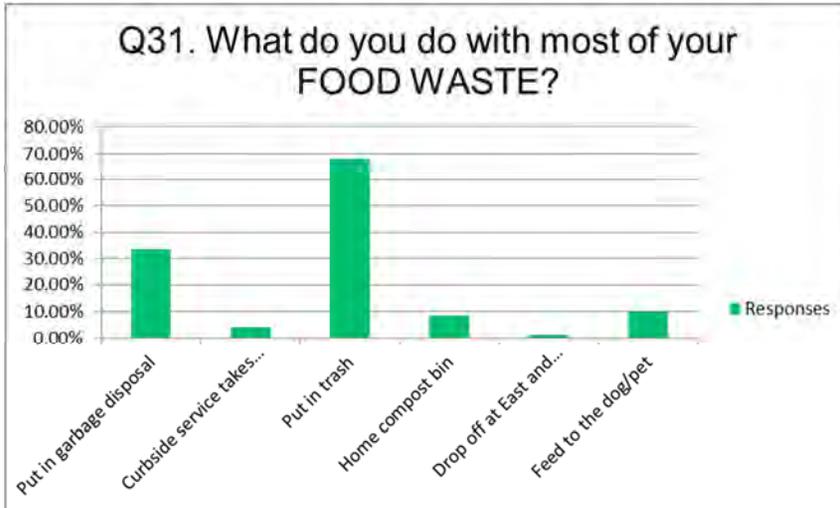


STATISTICAL

Q30. Please select any of the following behaviors your household does with their YARD WASTE (grass, tree trimmings, leaves, plant waste, etc.) (check all that apply)

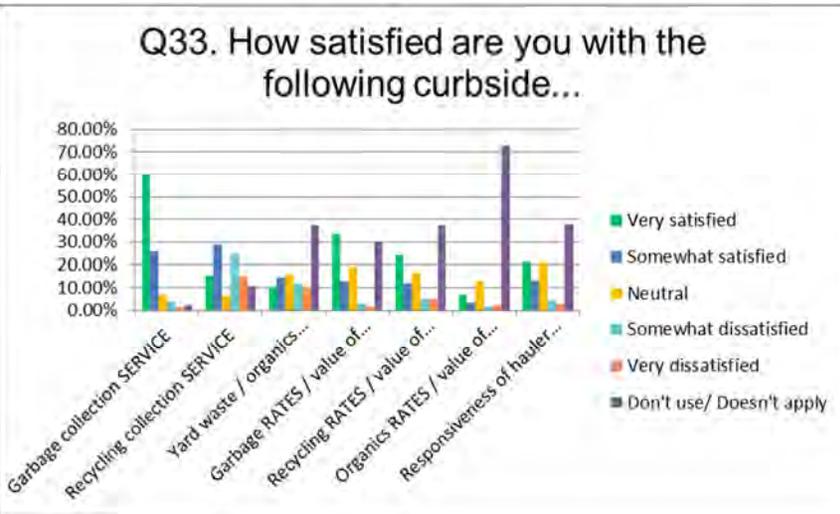
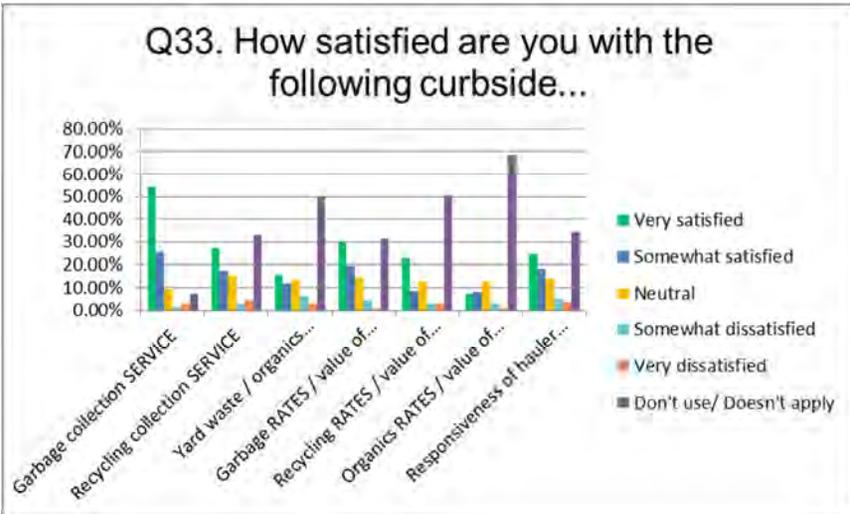


OPEN



STATISTICAL

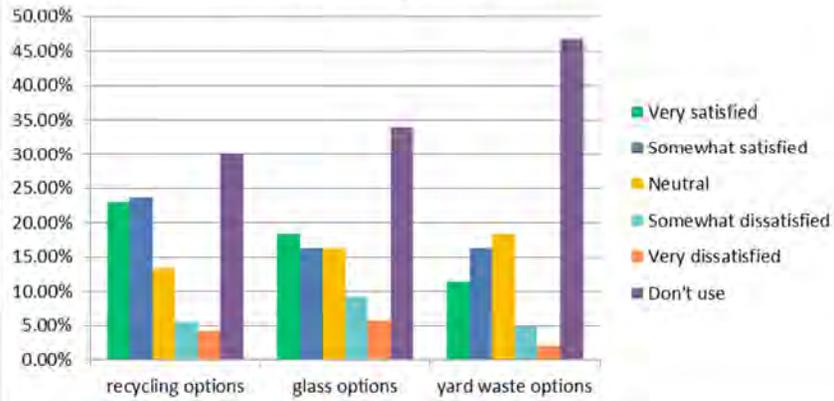
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STATISTICAL

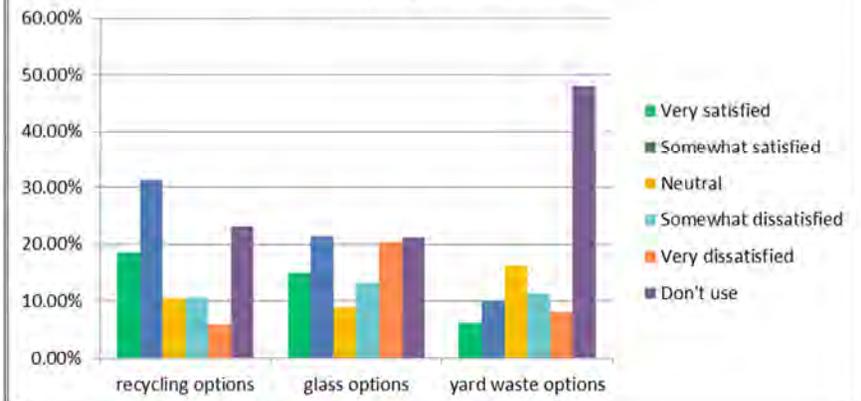
OPEN

Q34. How satisfied are you with the following drop-off...

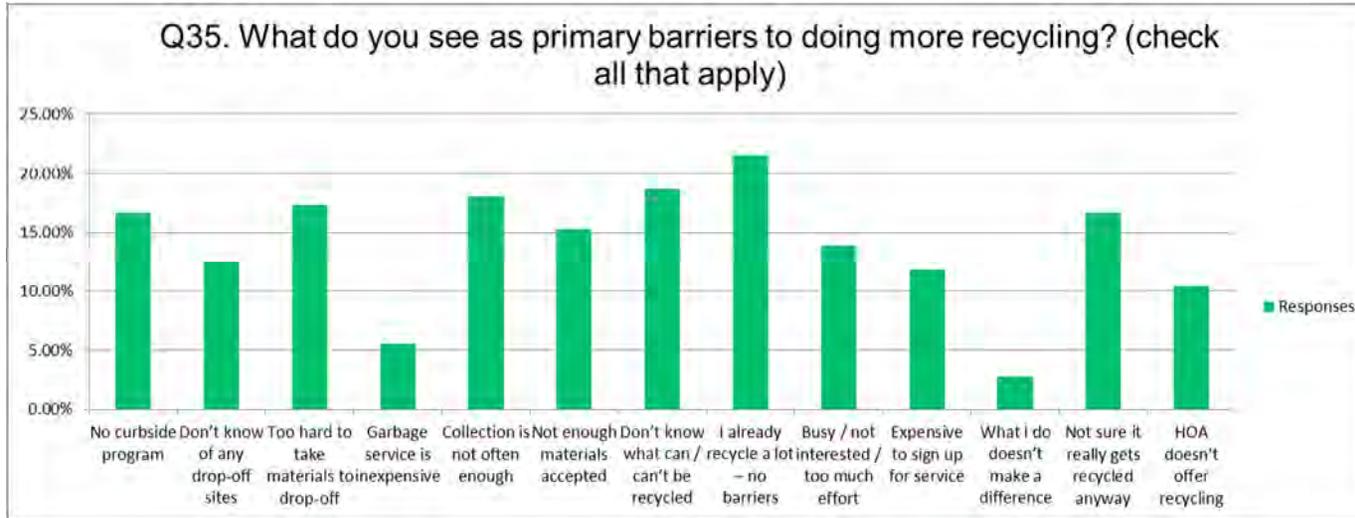


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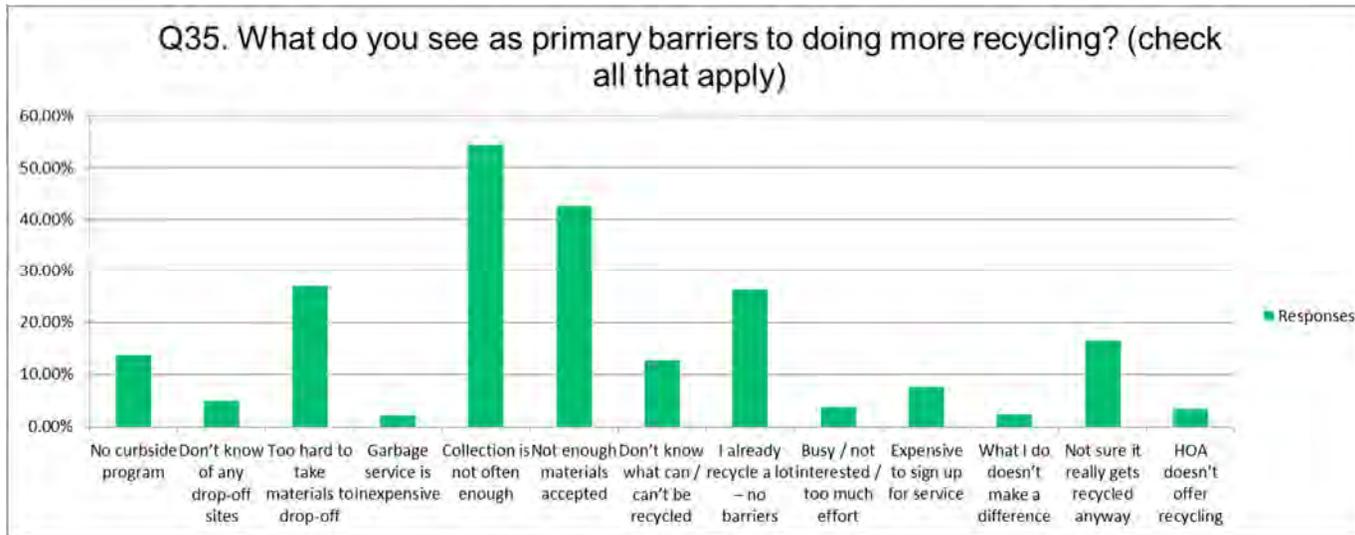
Q34. How satisfied are you with the following drop-off...



OPEN

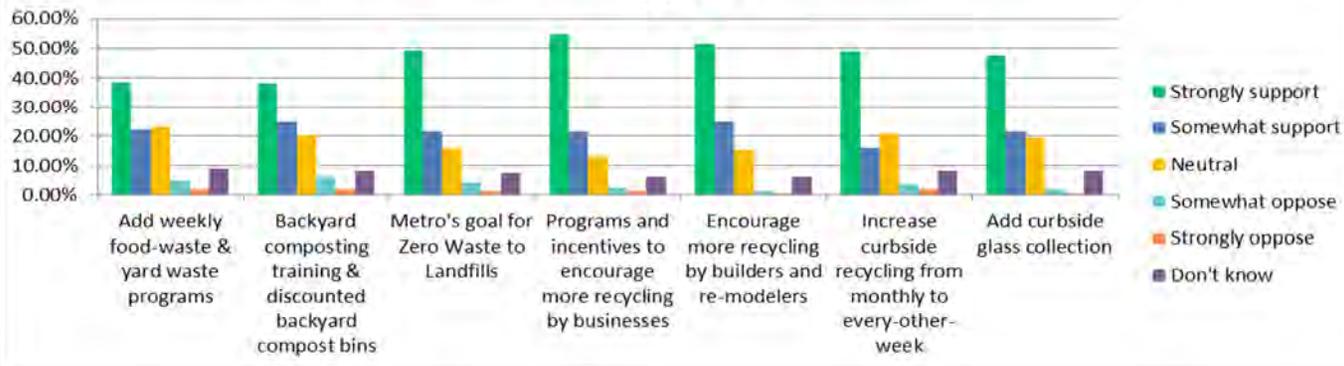


STATISTICAL



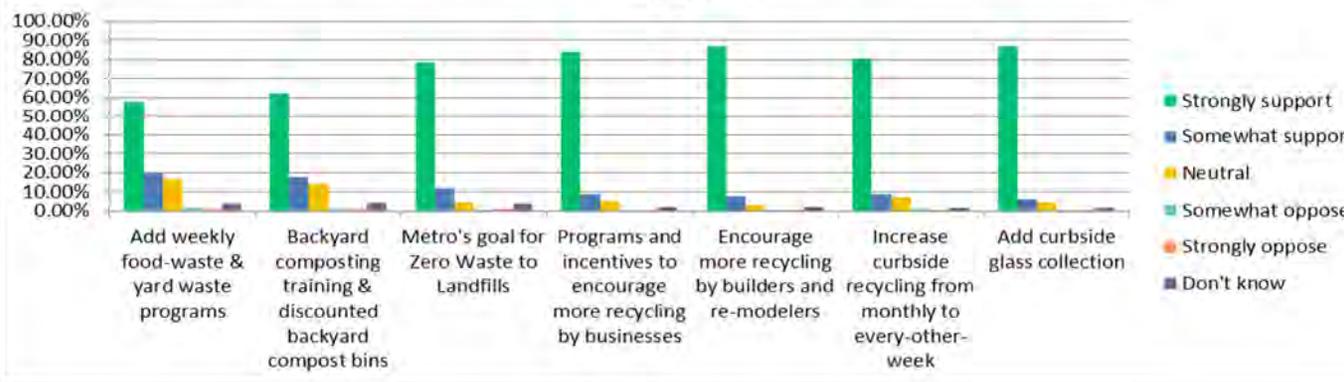
OPEN

Q36. Which of the following program and operational changes for the Metro's solid waste management would you support?



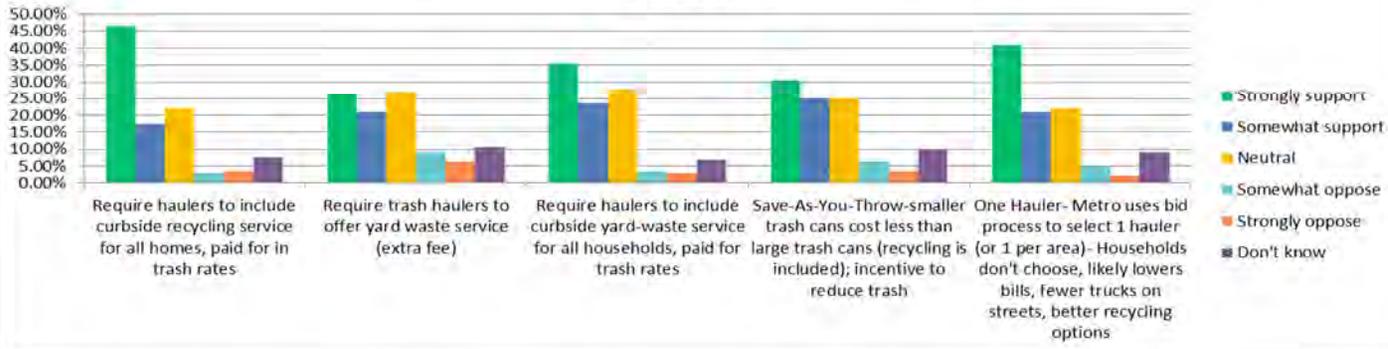
STATISTICAL

Q36. Which of the following program and operational changes for the Metro's solid waste management would you support?



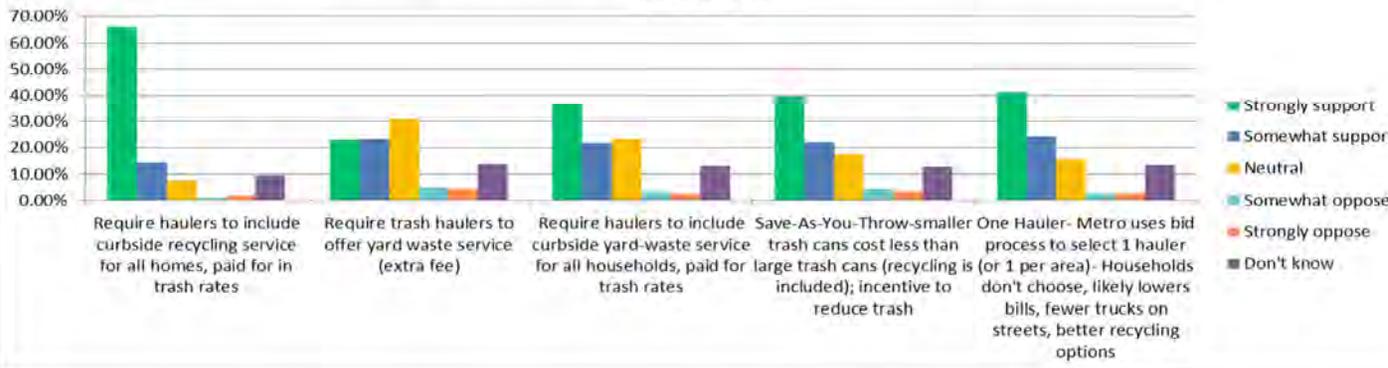
OPEN

Q37. Suppose trash service wasn't included in your taxes (or if you currently pay separately for service) -Which of the following program and operational changes for the Metro's solid waste management would you support?



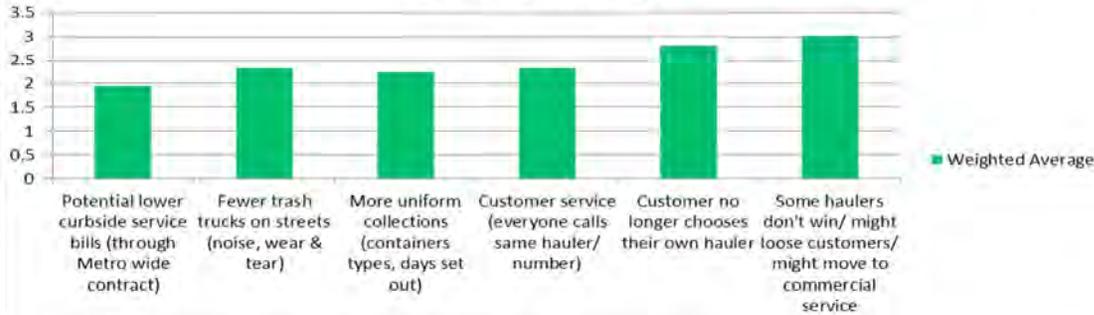
STATISTICAL

Q37. Suppose trash service wasn't included in your taxes (or if you currently pay separately for service) -Which of the following program and operational changes for the Metro's solid waste management would you support?



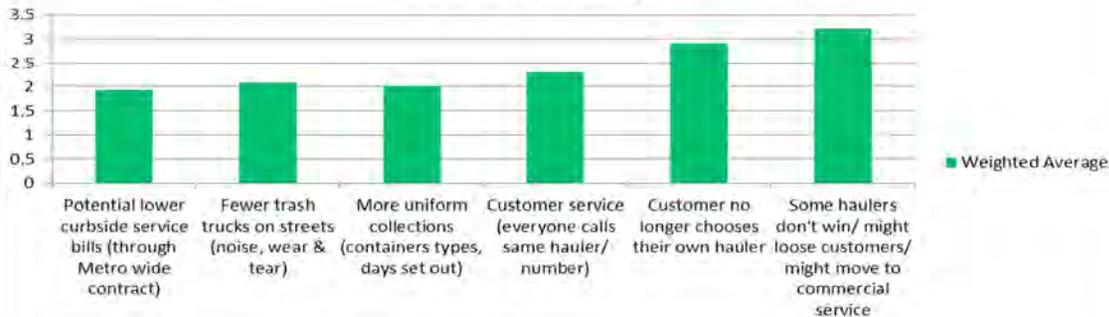
OPEN

Q38. Suppose trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section) , please tell us what you would think of the following...



STATISTICAL

Q38. Suppose trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section) , please tell us what you would think of the following...



OPEN

Q39. IF Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out...



STATISTICAL

Q39. IF Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out...



OPEN

Q40. IF Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out...



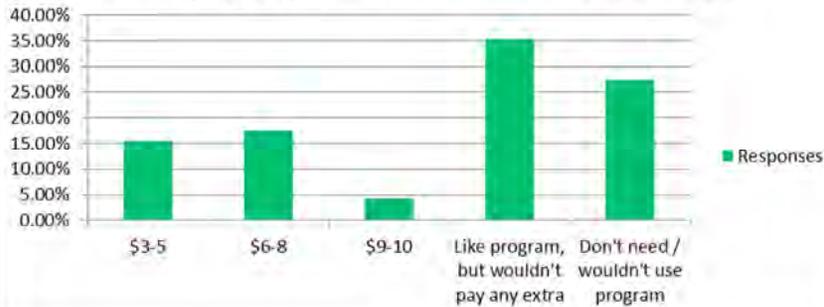
STATISTICAL

Q40. IF Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out...

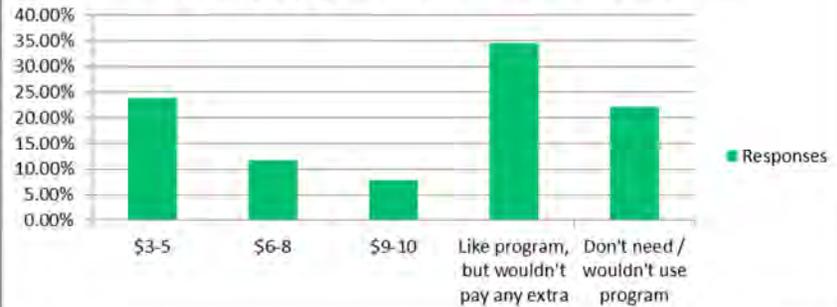


OPEN

Q41. IF Metro were to institute a curbside ORGANICS (yard waste and/ or food scraps) program, how much would you be willing to pay per month for this service?



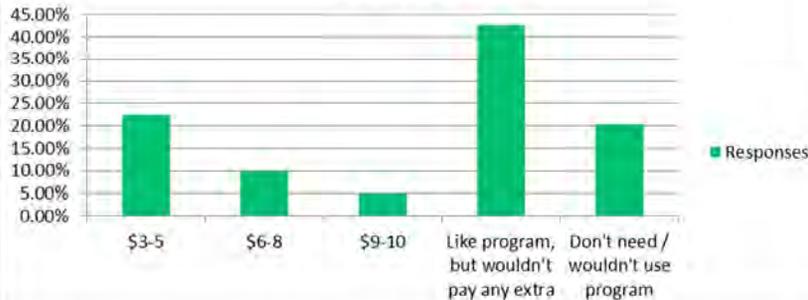
Q41. IF Metro were to institute a curbside ORGANICS (yard waste and/ or food scraps) program, how much would you be willing to pay per month for this service?



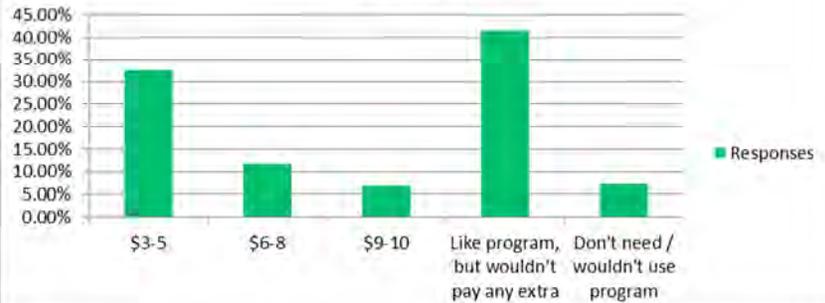
STATISTICAL

OPEN

Q42. IF Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?

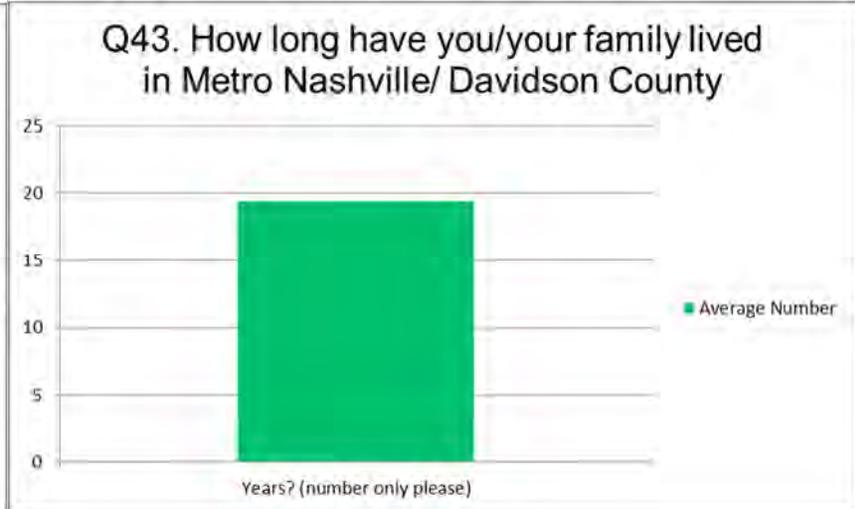
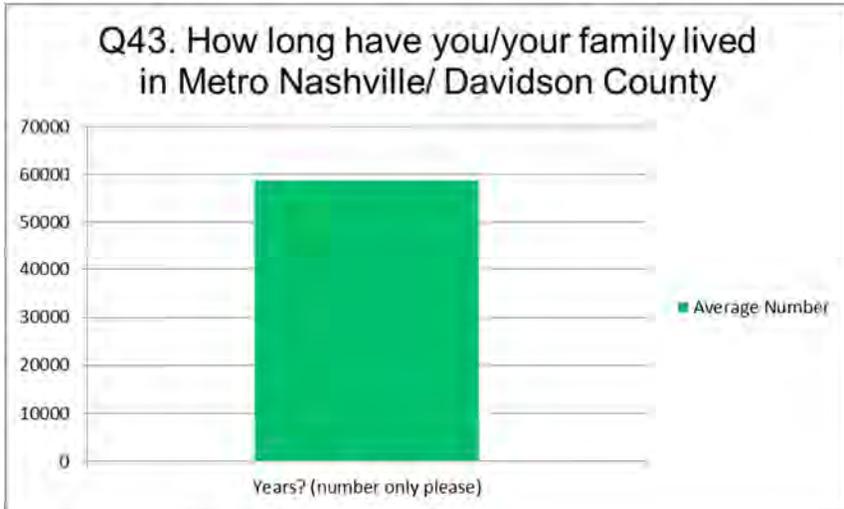


Q42. IF Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?



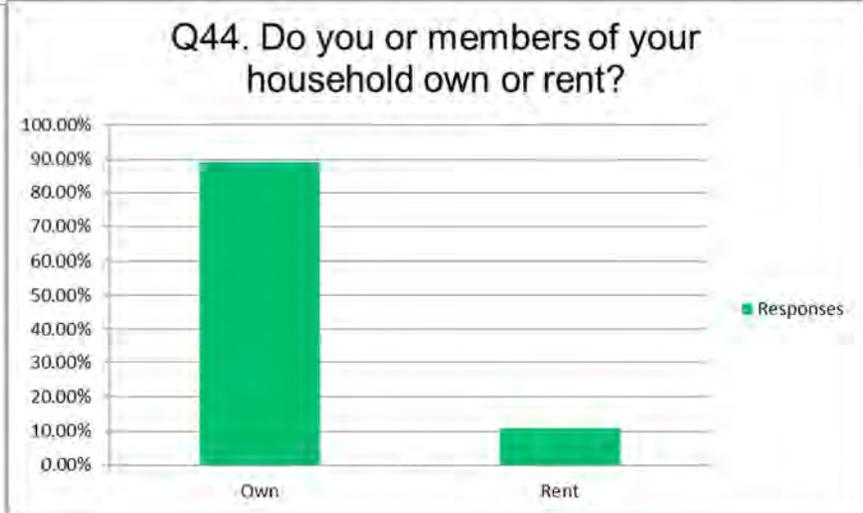
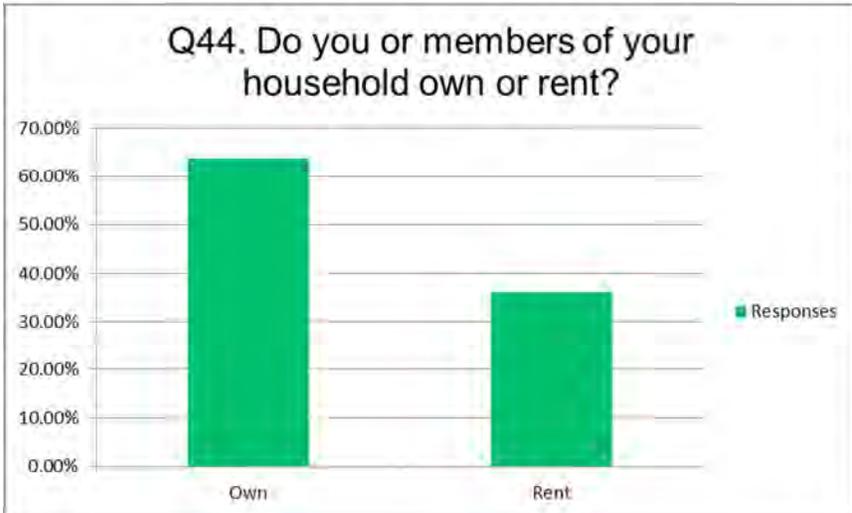
STATISTICAL

OPEN



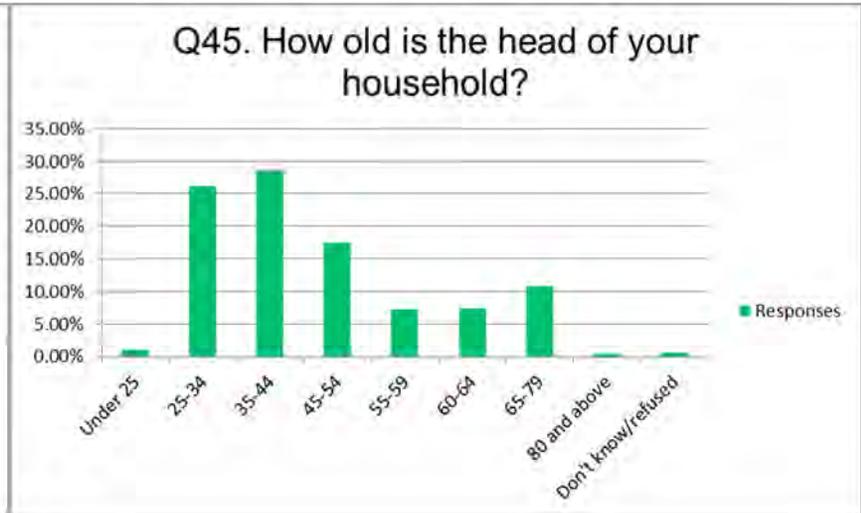
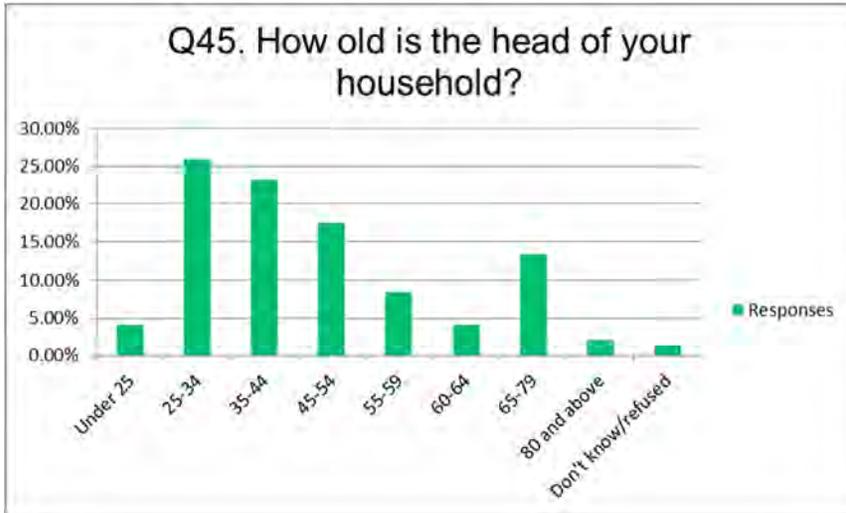
STATISTICAL

OPEN



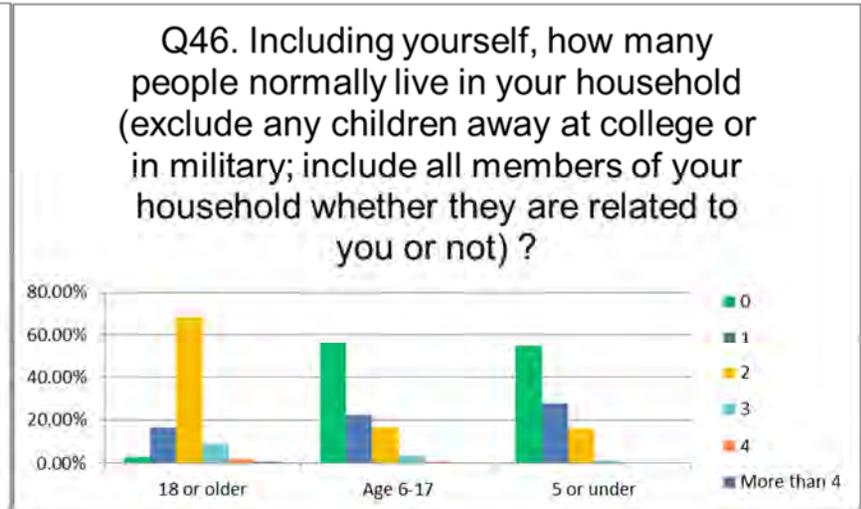
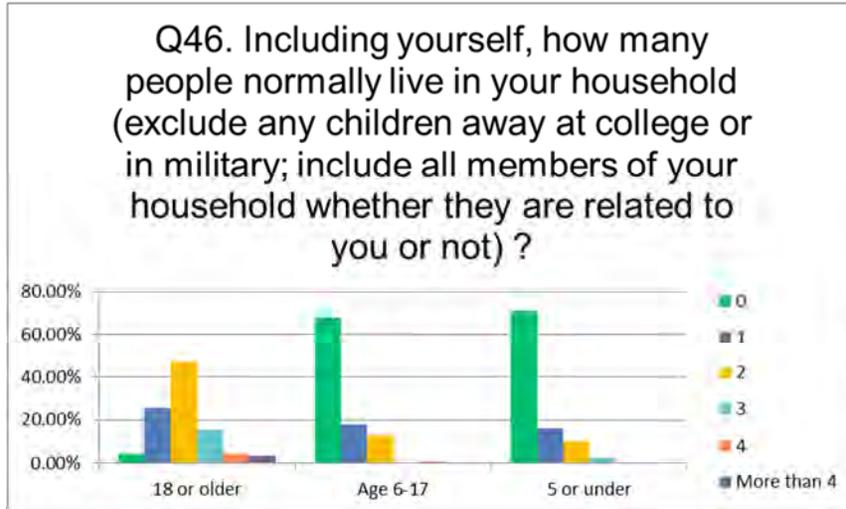
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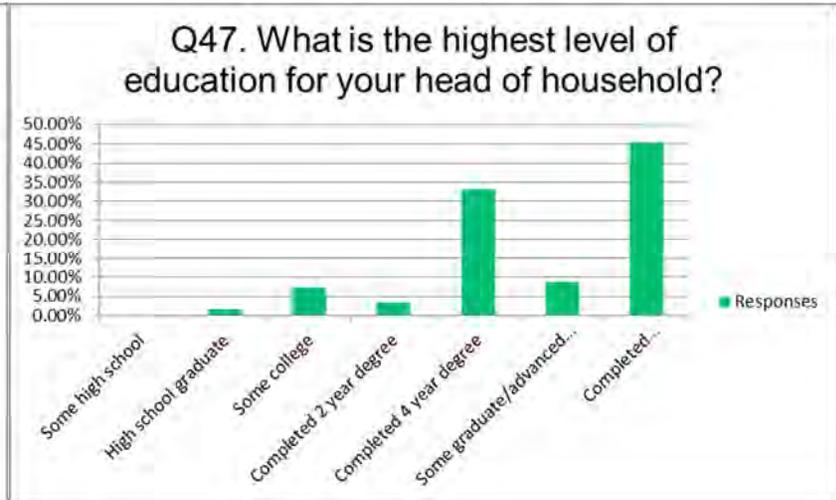
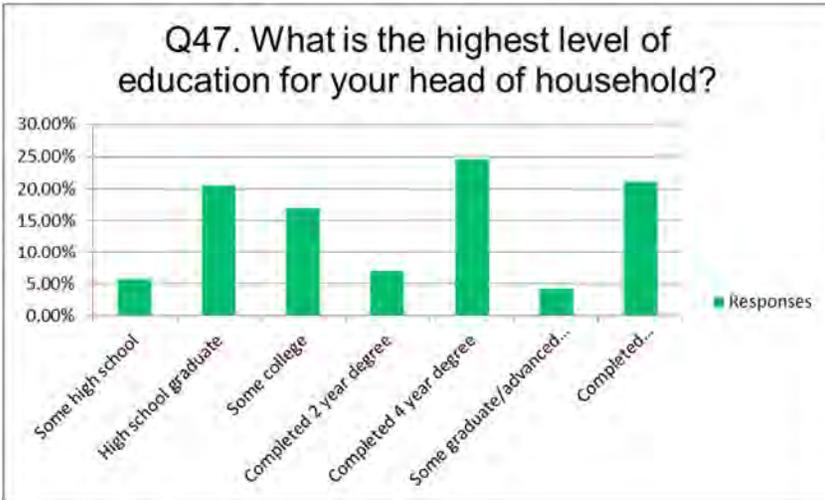
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OPEN



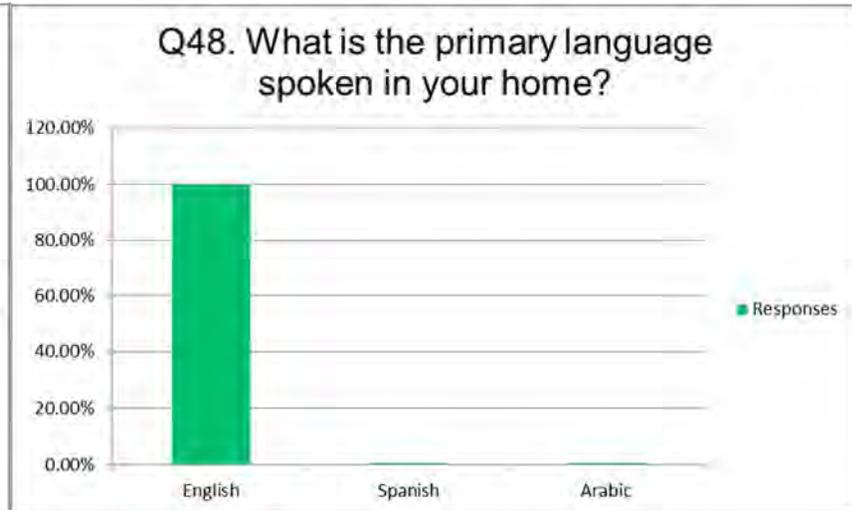
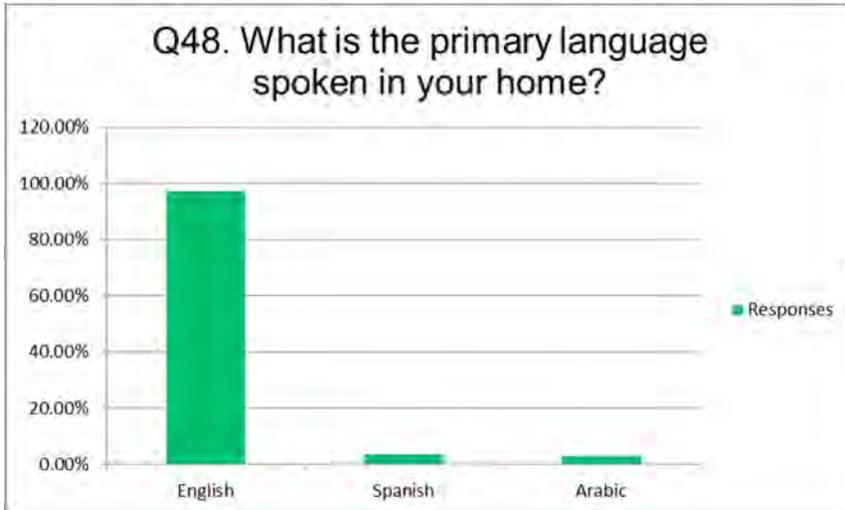
STATISTICAL

OPEN



STATISTICAL

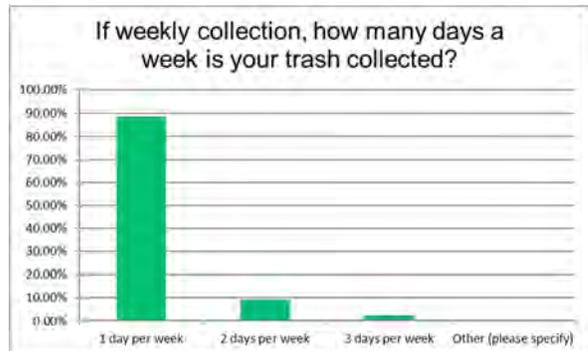
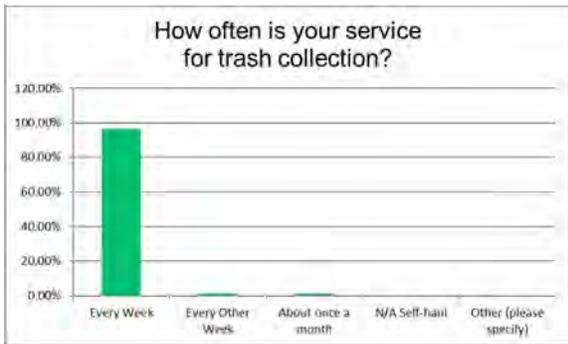
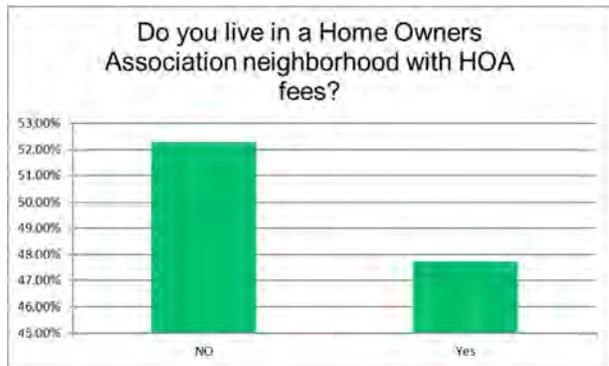
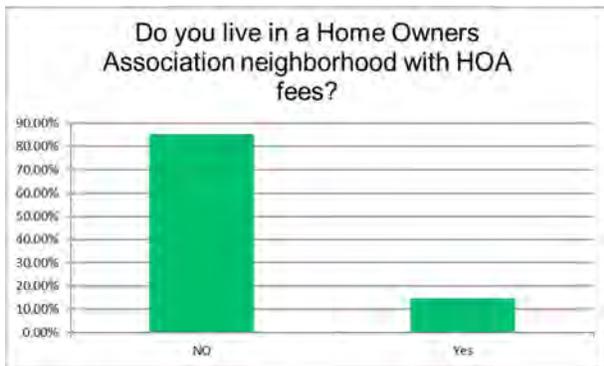
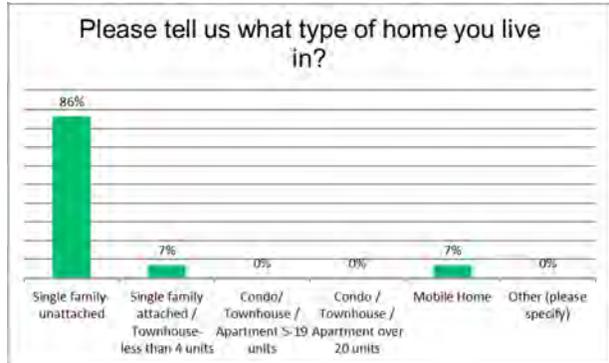
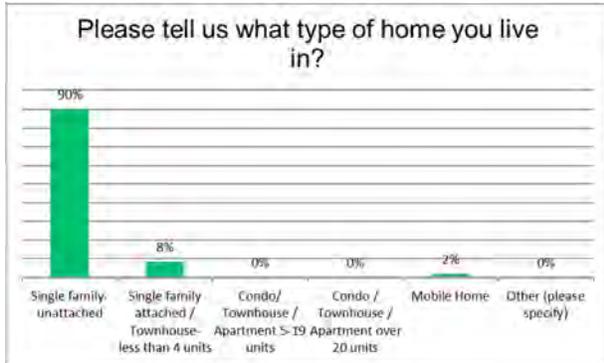
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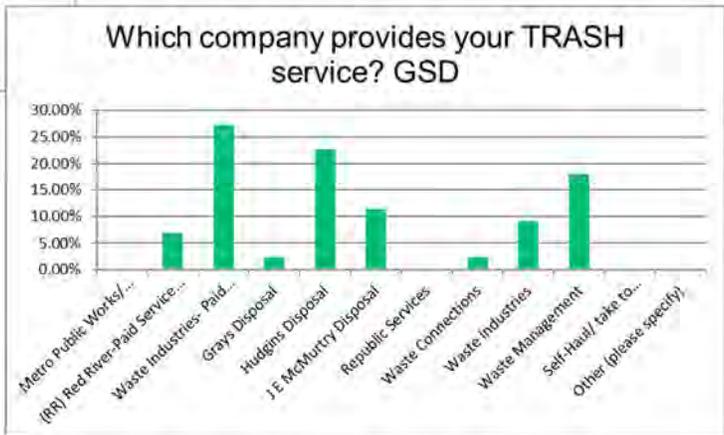
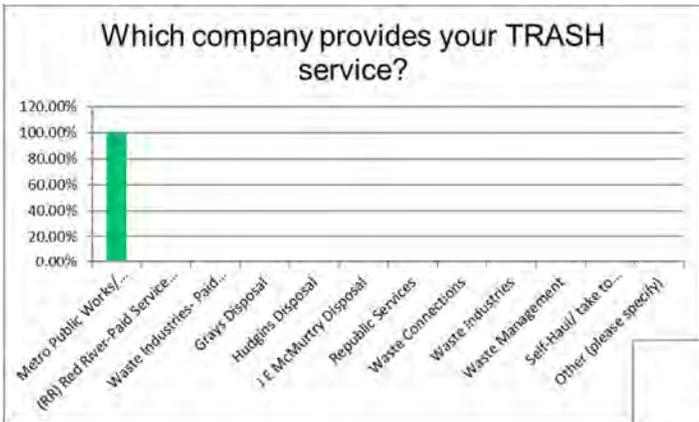
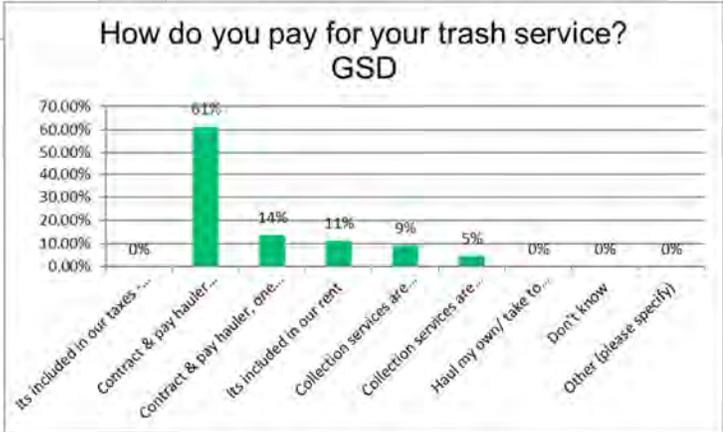
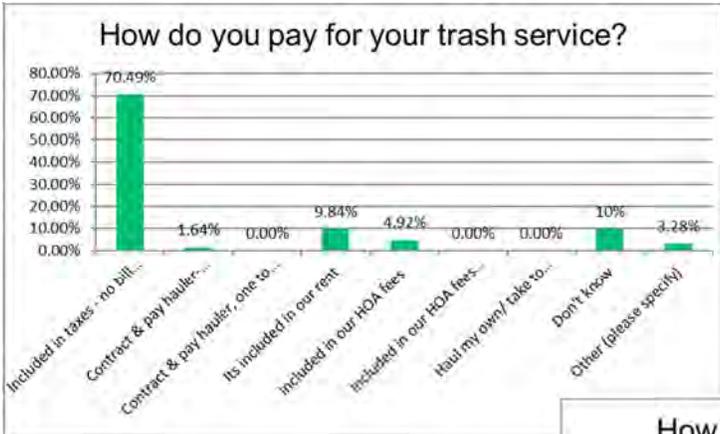


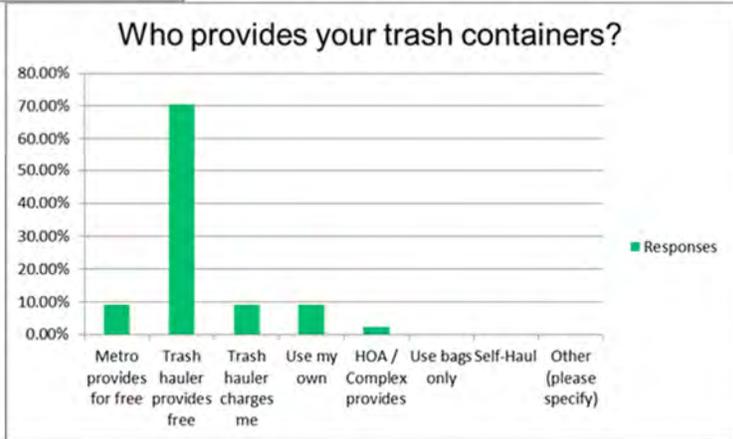
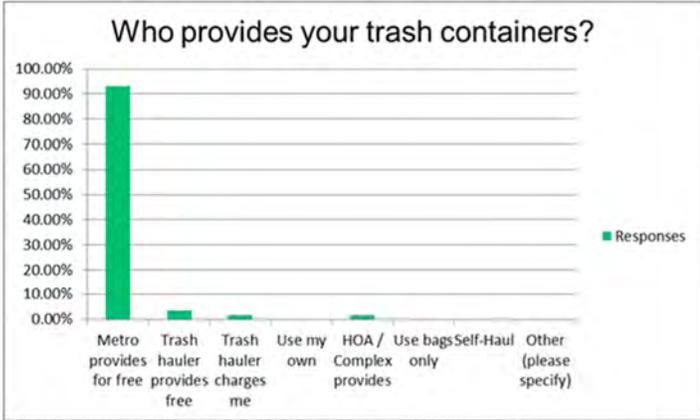
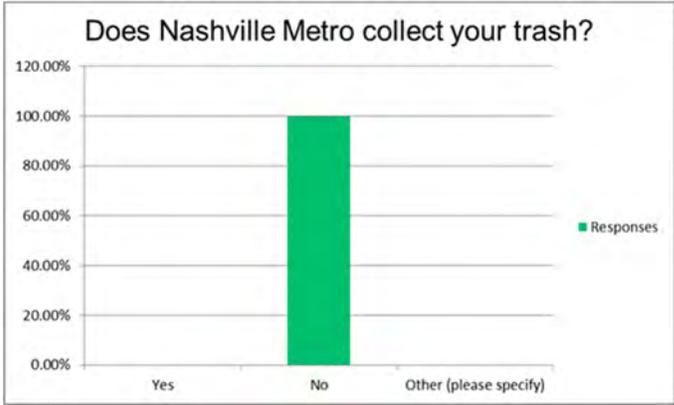
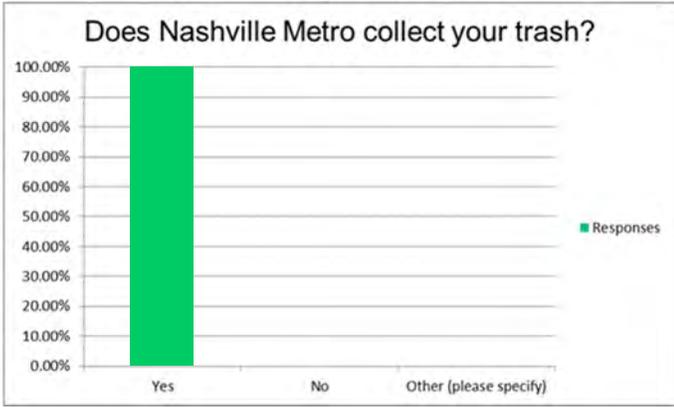
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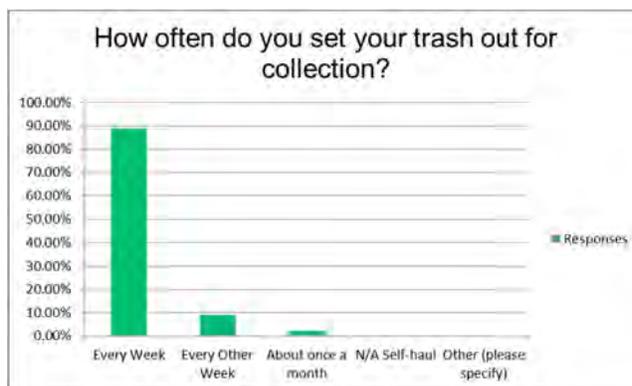
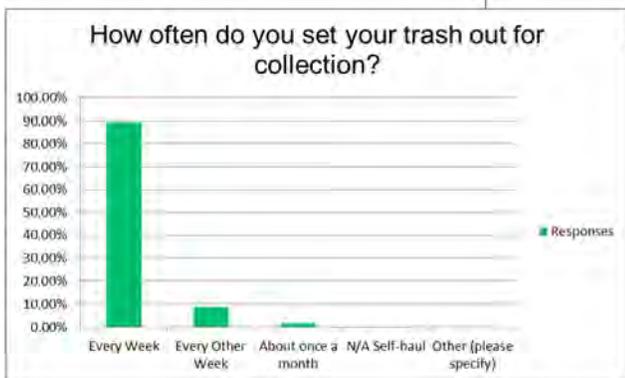
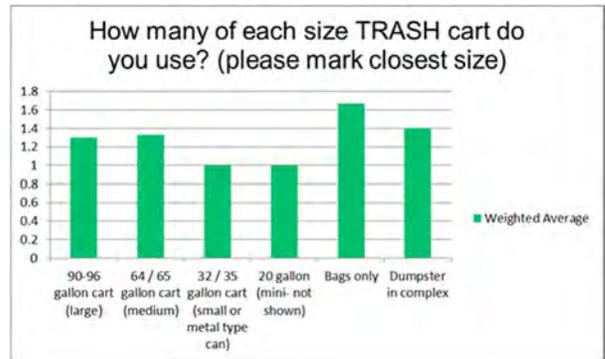
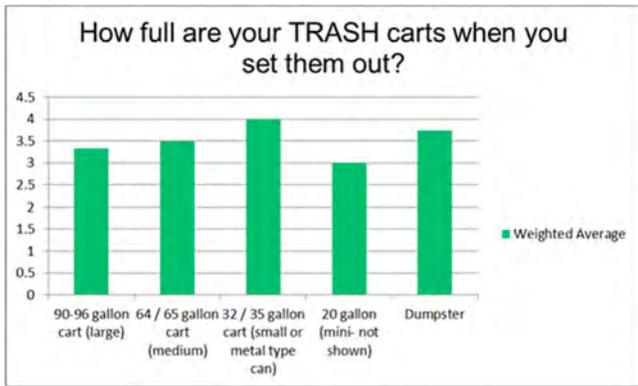
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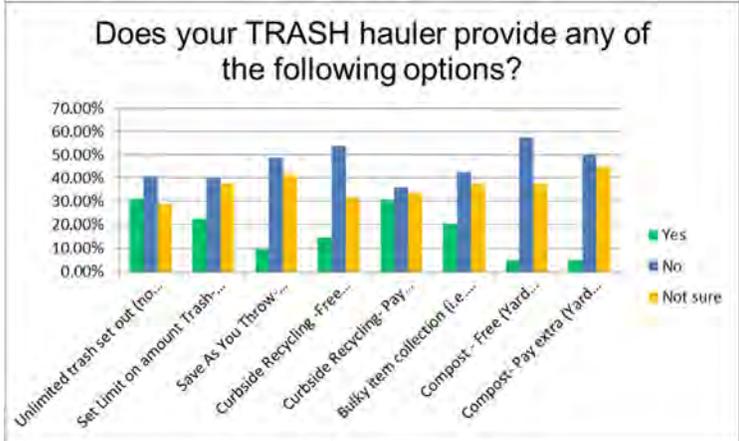
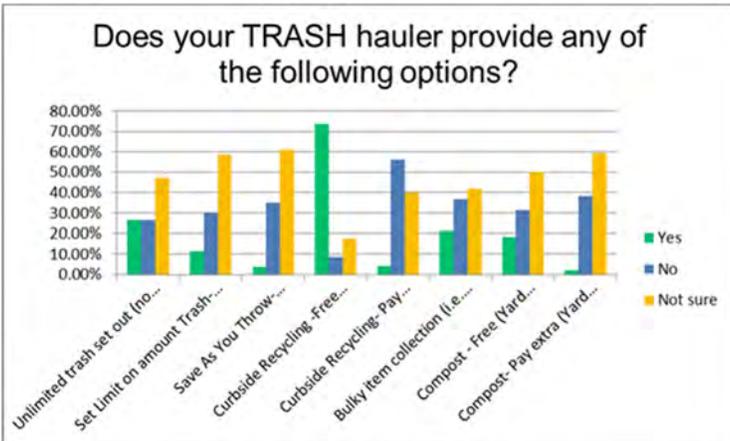
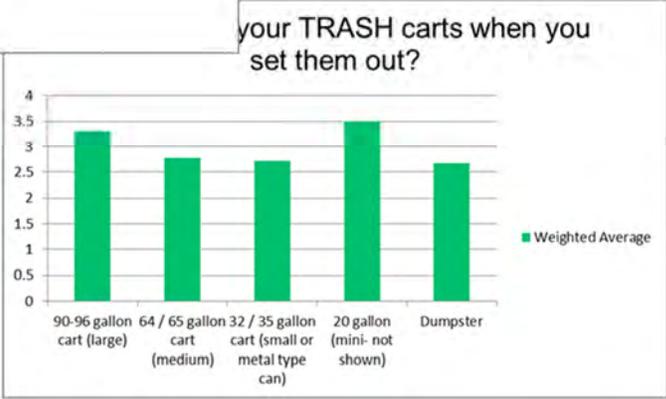
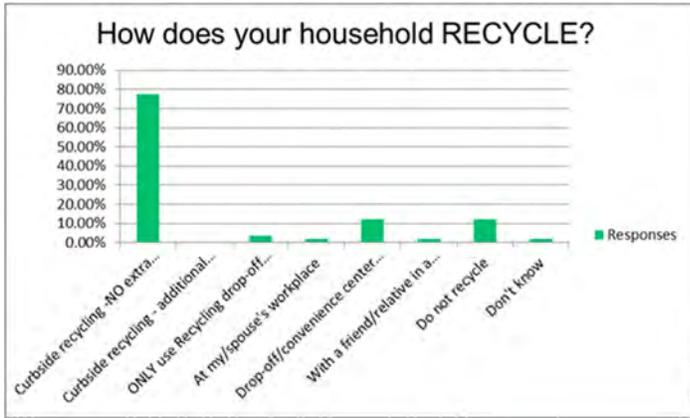
Figure D-8
Nashville Single Family Comparison
In Urban Services District (USD, left) vs. (GSD, right) In General Services District

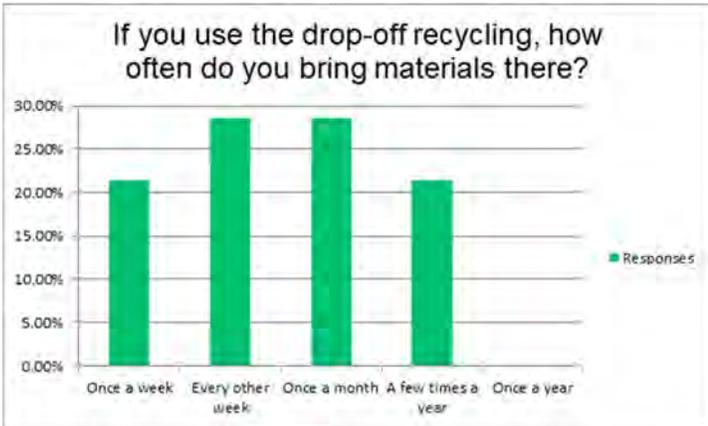
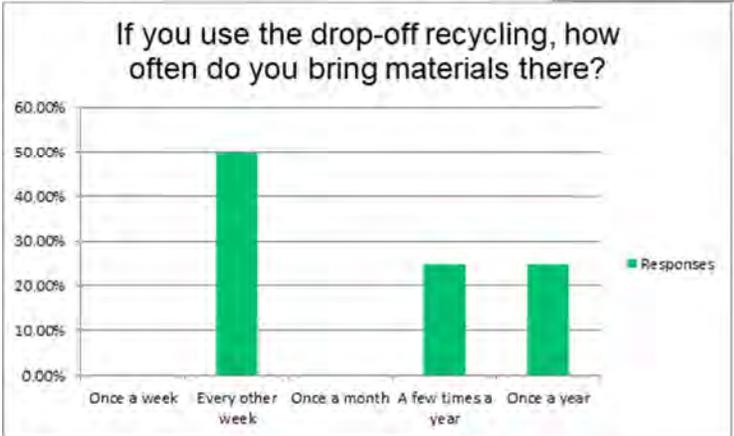
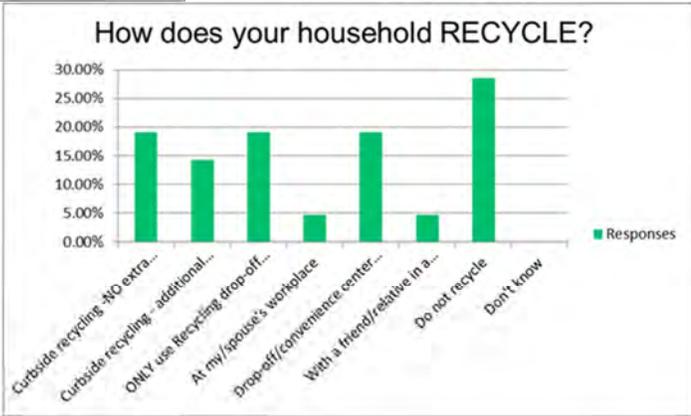
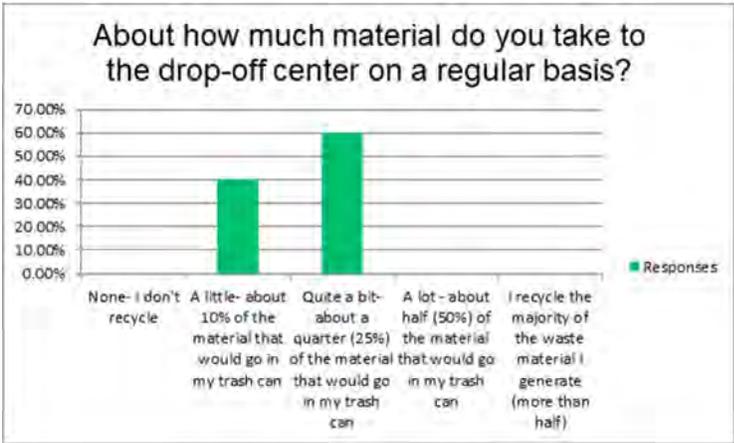




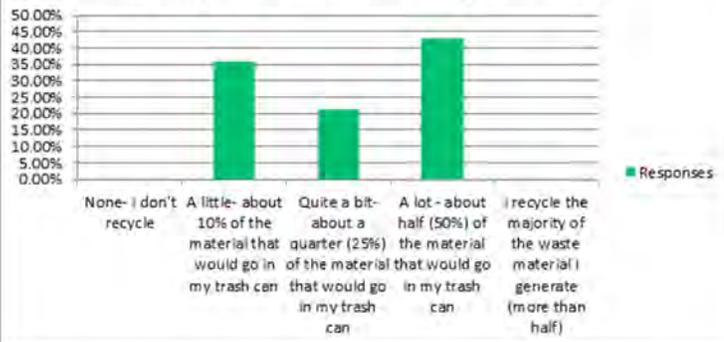




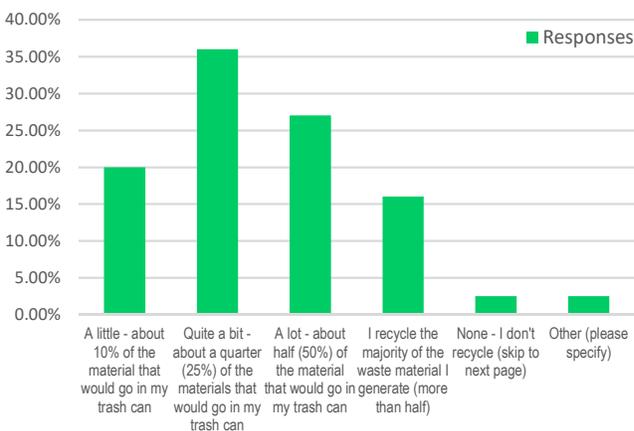




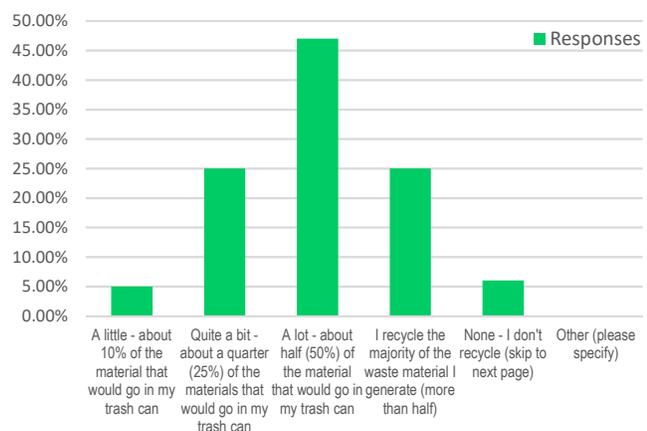
About how much material do you take to the drop-off center on a regular basis?

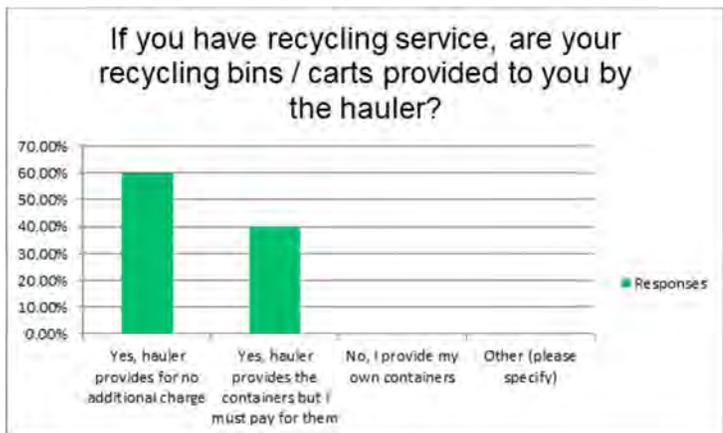


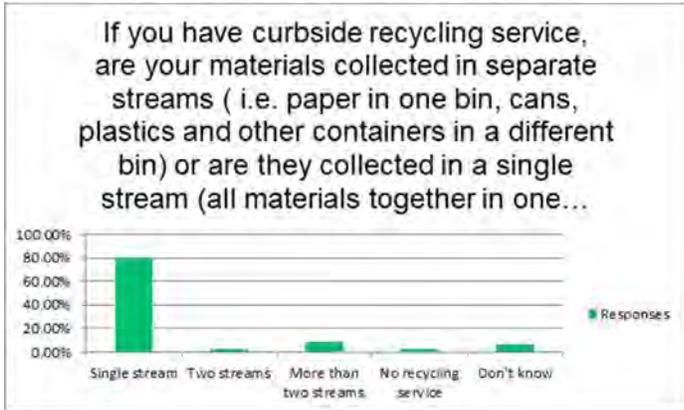
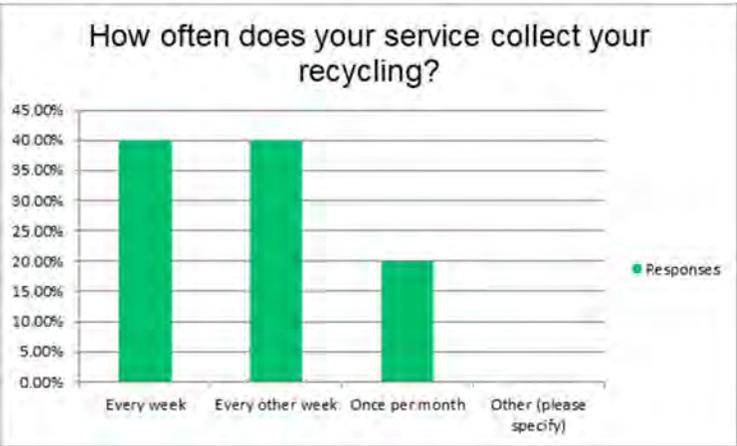
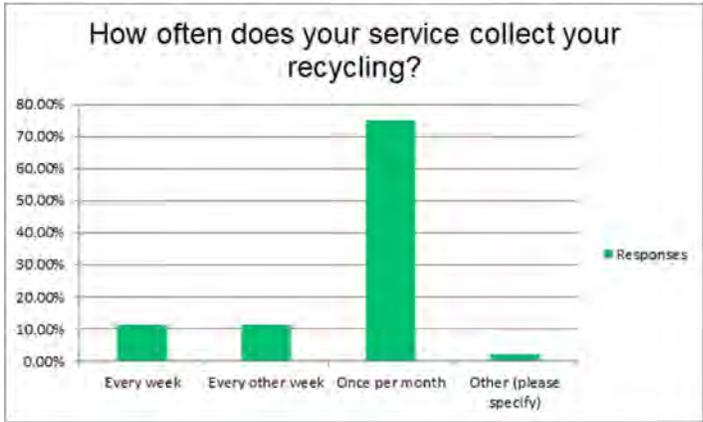
About how much material do you recycle on a regular basis?

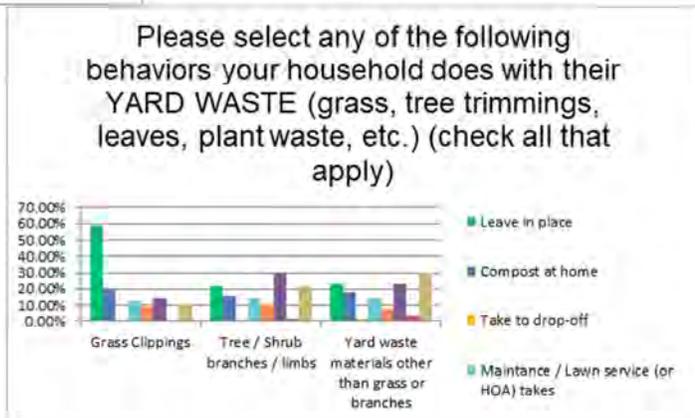
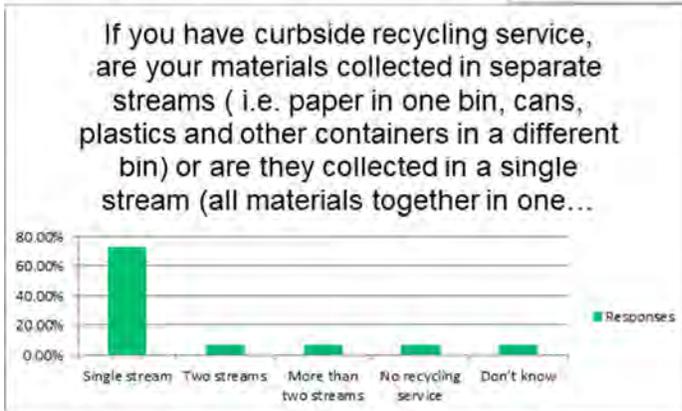
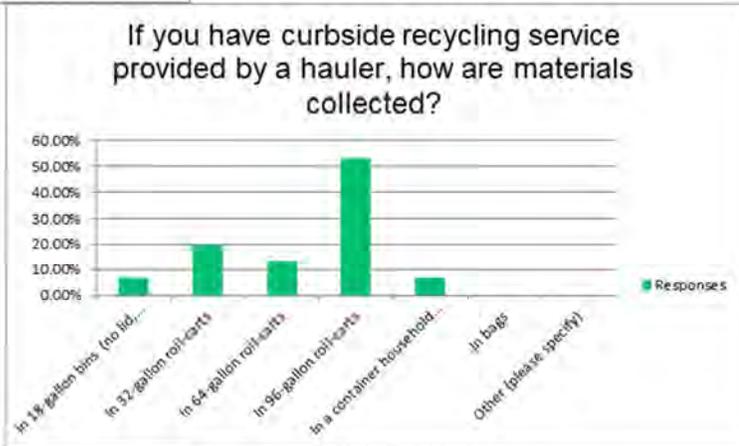
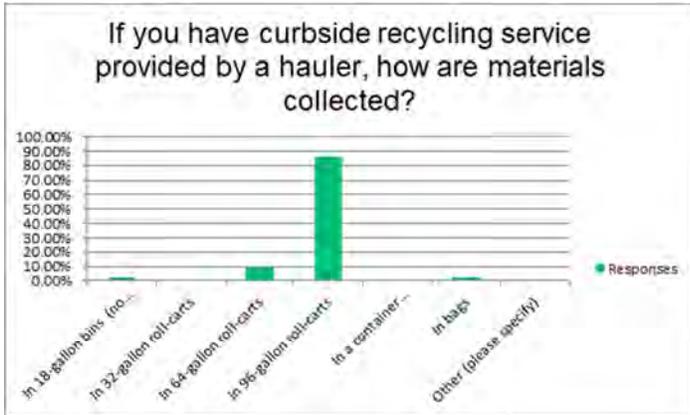


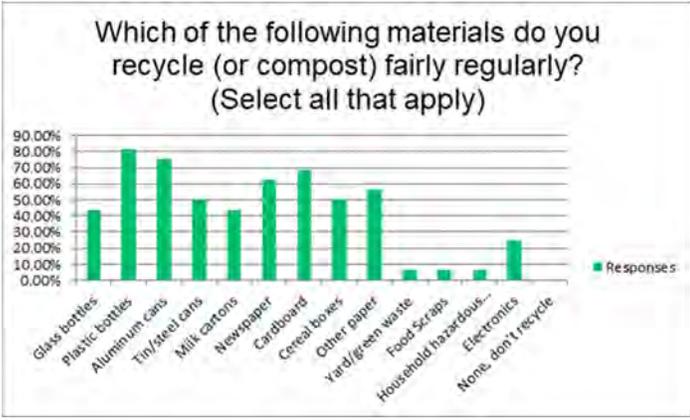
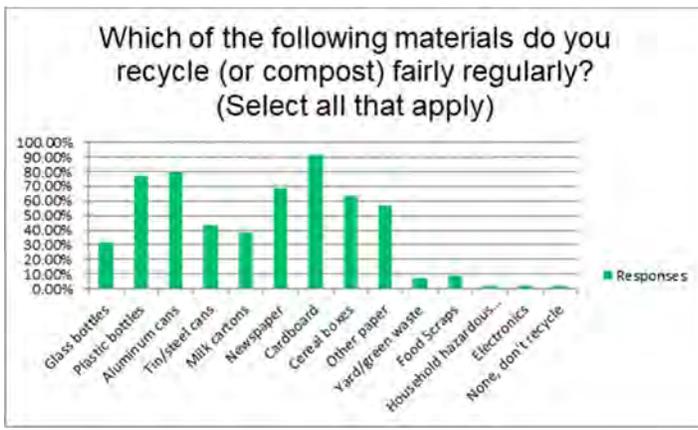
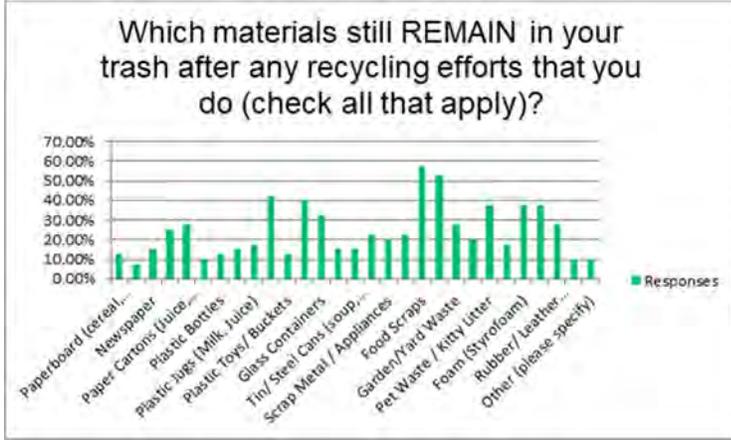
About how much material do you recycle on a regular basis?

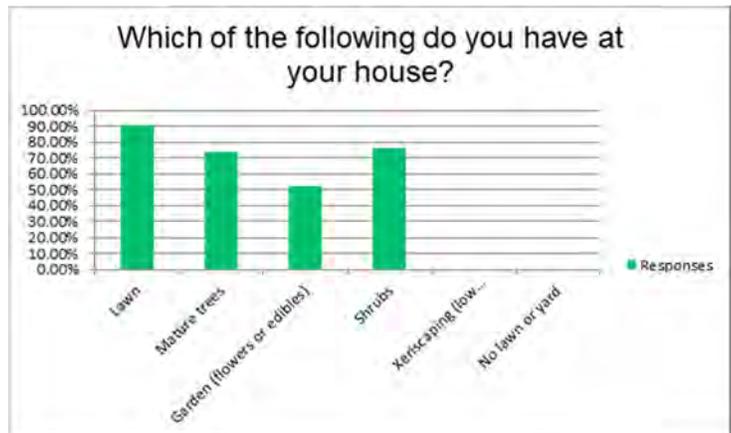
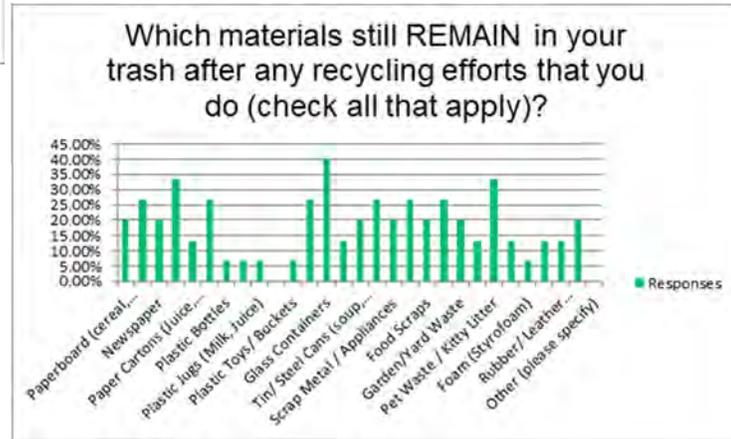
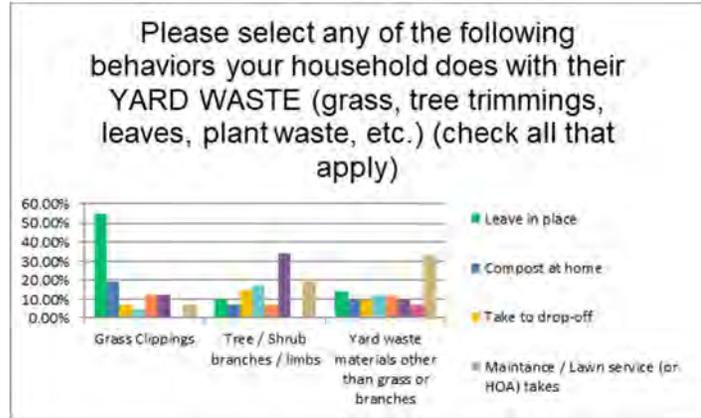
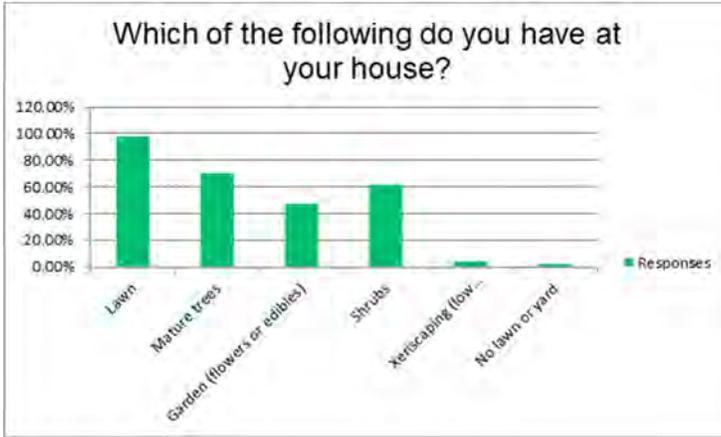


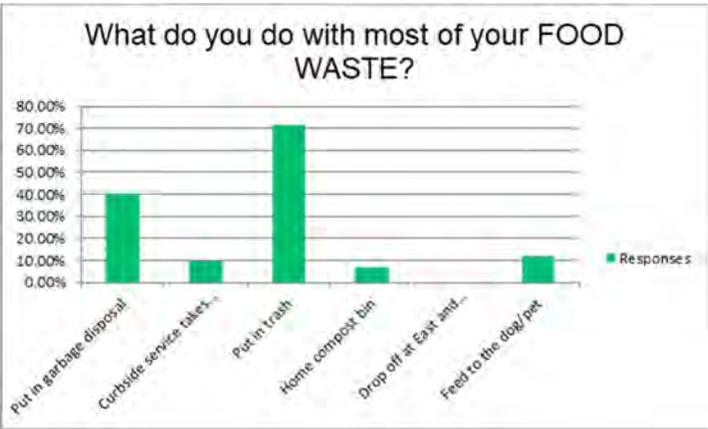
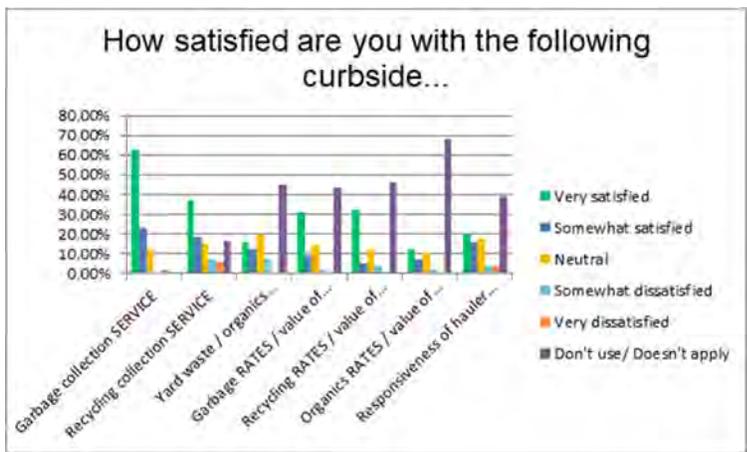


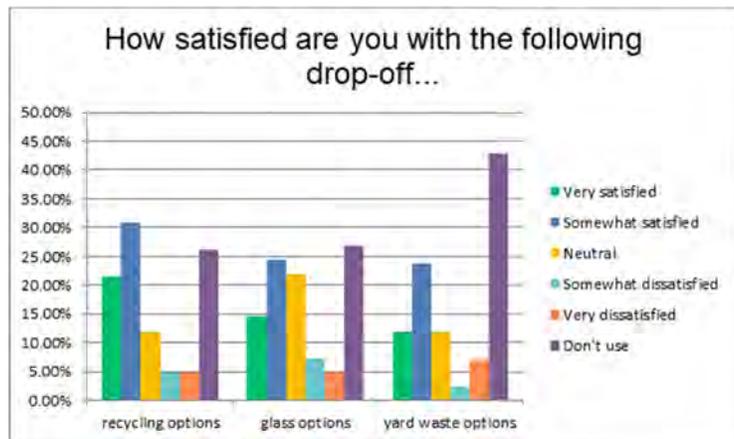
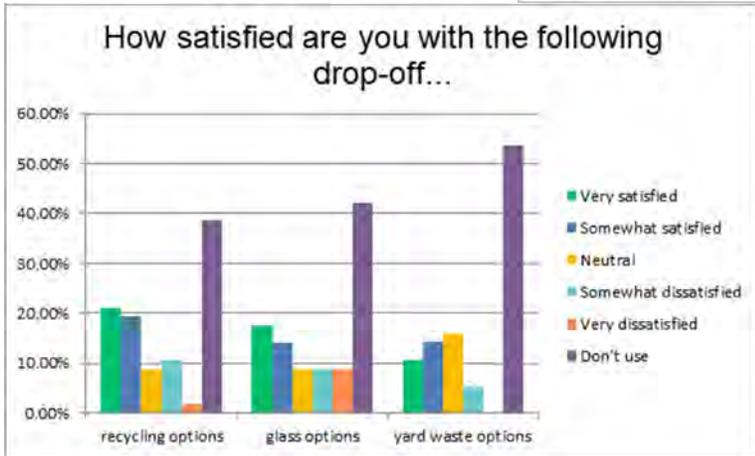
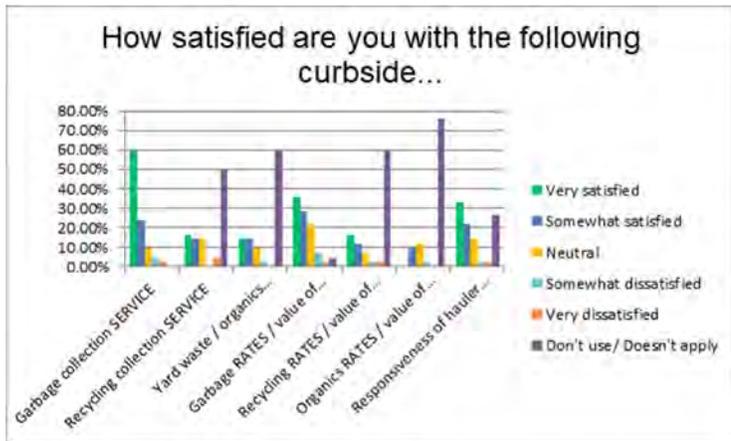
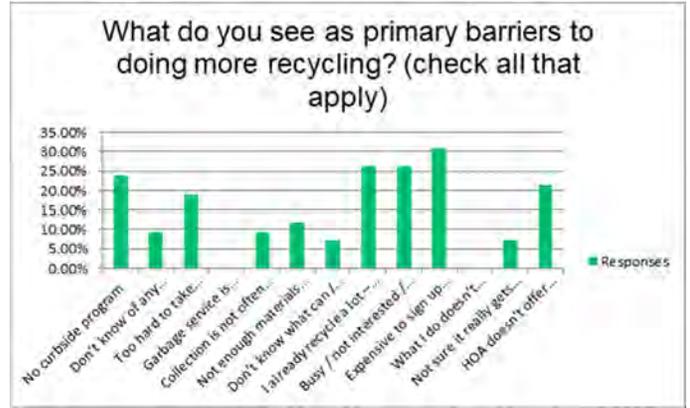
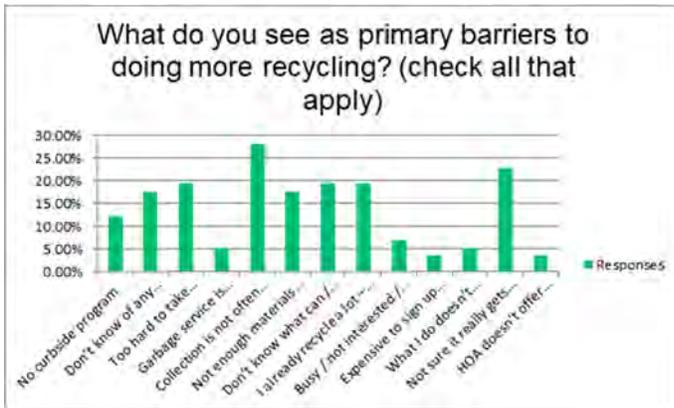




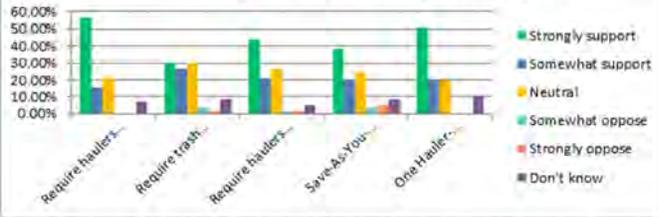




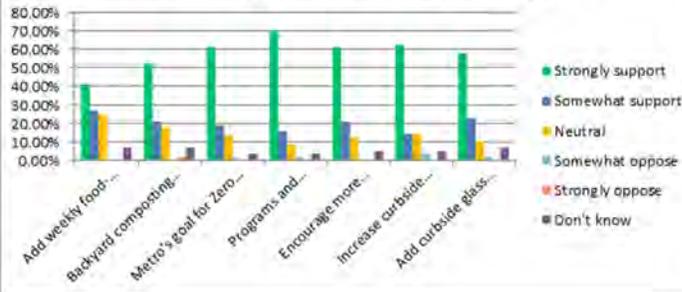




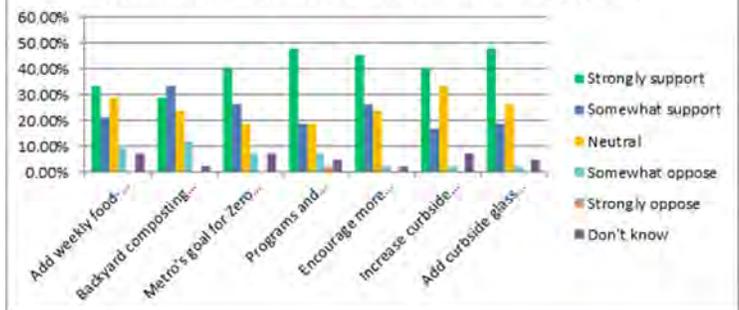
IF trash service wasn't included in your taxes (or if you pay separately for service)
 -Which of the following program and operational changes for the Metro's solid waste management would you support?



Which of the following program and operational changes for the Metro's solid waste management would you support?



Which of the following program and operational changes for the Metro's solid waste management would you support?



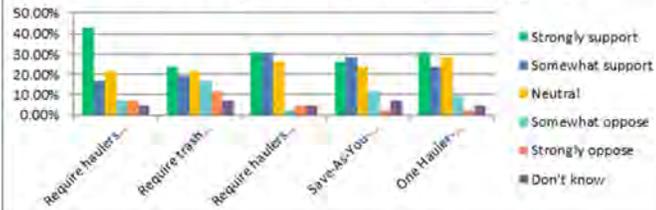
If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large...



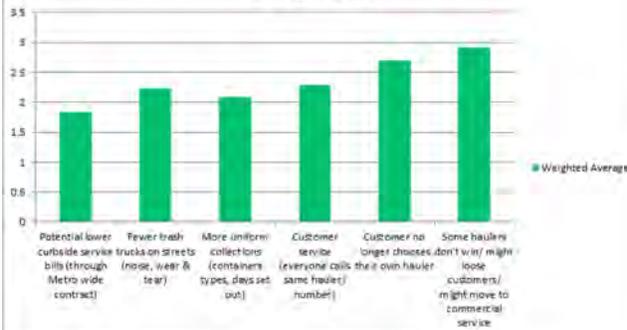
If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large...



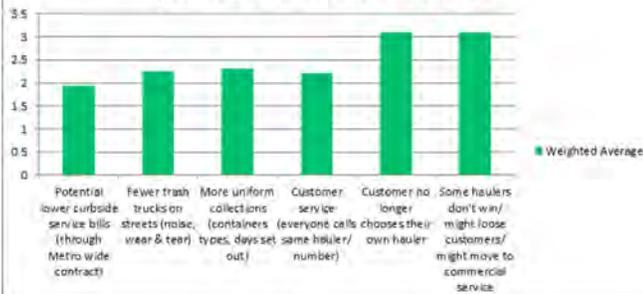
IF trash service wasn't included in your taxes (or if you pay separately for service) -Which of the following program and operational changes for the Metro's solid waste management would you support?



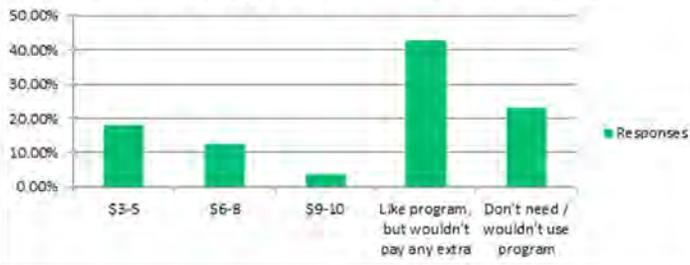
If trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section), please tell us what you would think of the following...



If trash service was NOT included in taxes and Metro were to use a bidding process to select just ONE trash hauler to provide service Metro-wide (or one hauler per section), please tell us what you would think of the following...



If Metro were to institute a curbside ORGANICS (yard waste and/ or food scraps) program, how much would you be willing to pay per month for this service?



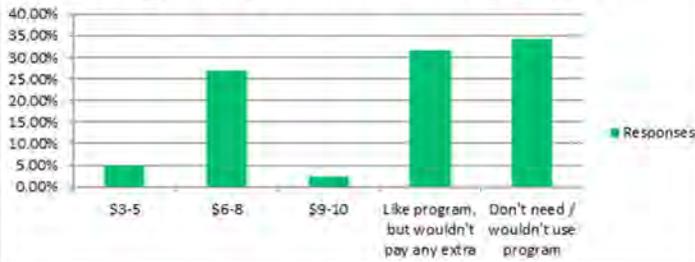
If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large...



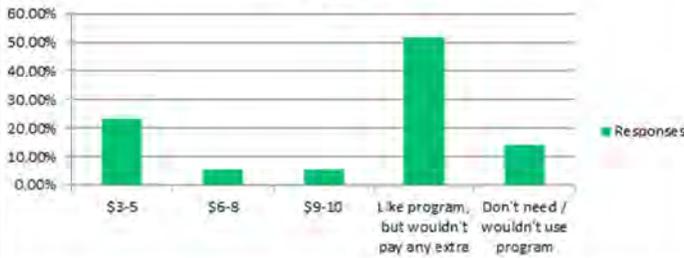
If Metro were to use a curbside Save-As-You-Throw system, recycling would be included in the service, and you would pay less per month for disposing less trash (using smaller carts). Those throwing out more trash or using large...



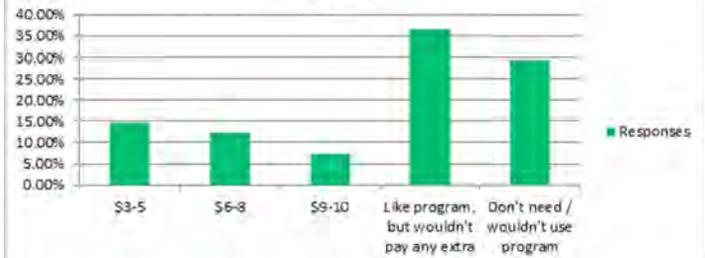
If Metro were to institute a curbside ORGANICS (yard waste and/ or food scraps) program, how much would you be willing to pay per month for this service?



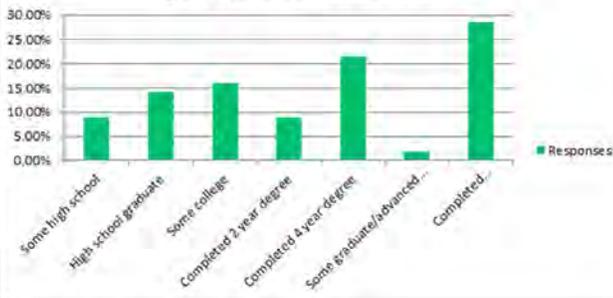
If Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?



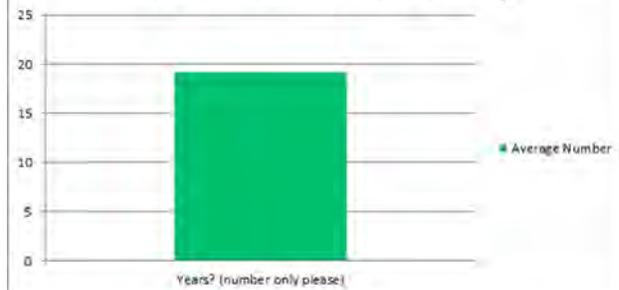
If Metro were to institute a curbside GLASS pickup program, how much would you be willing to pay per month for this service?



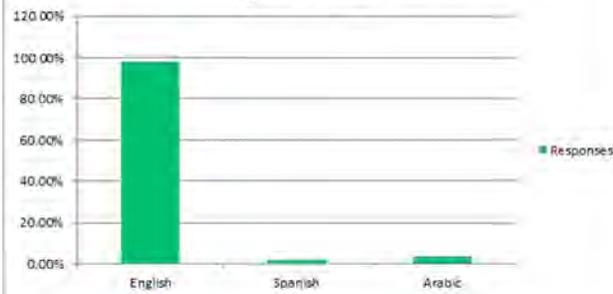
What is the highest level of education for your head of household?



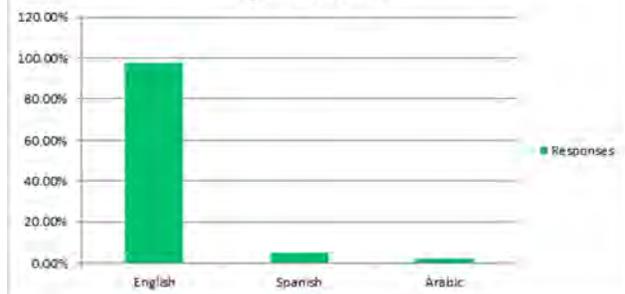
How long have you/your family lived in Metro Nashville/ Davidson County



What is the primary language spoken in your home?



What is the primary language spoken in your home?



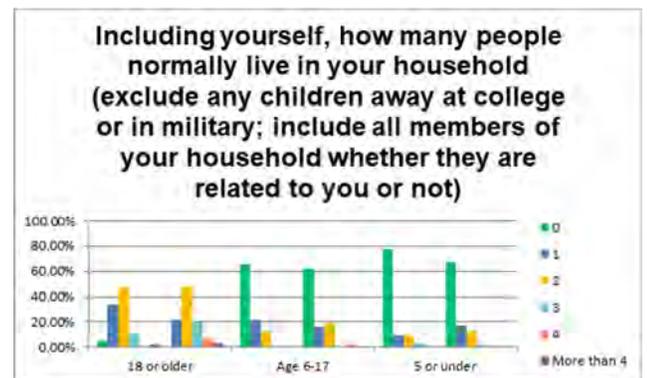
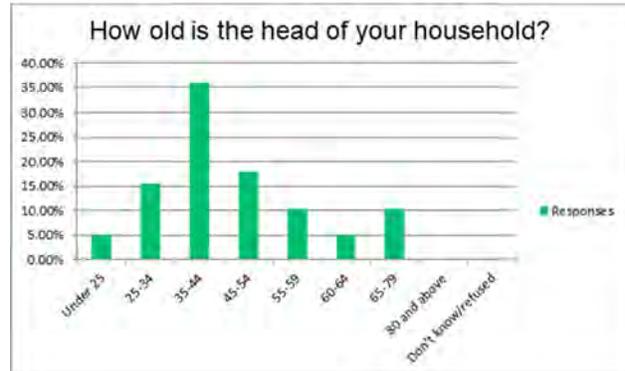
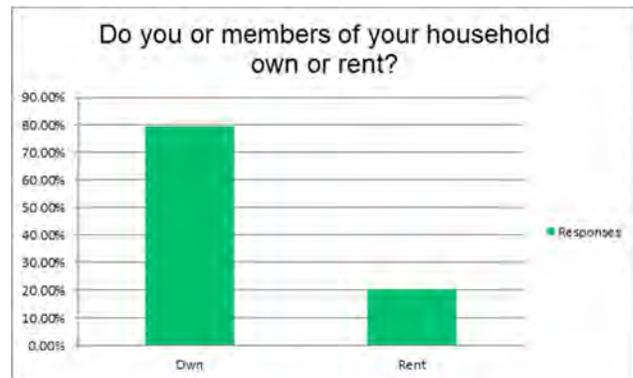
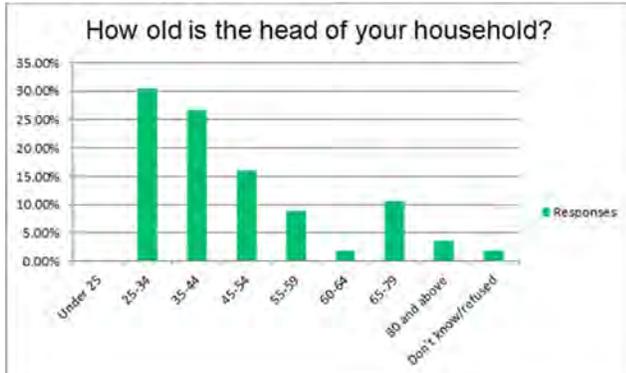
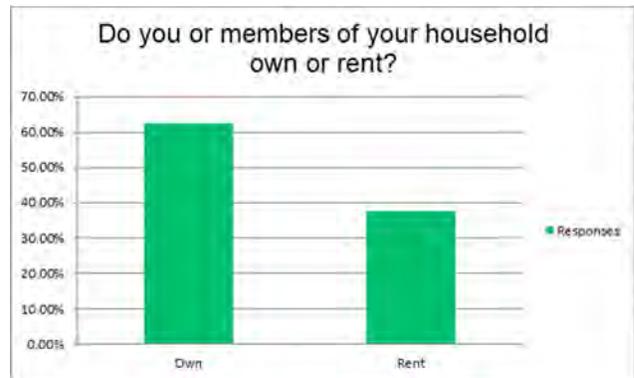
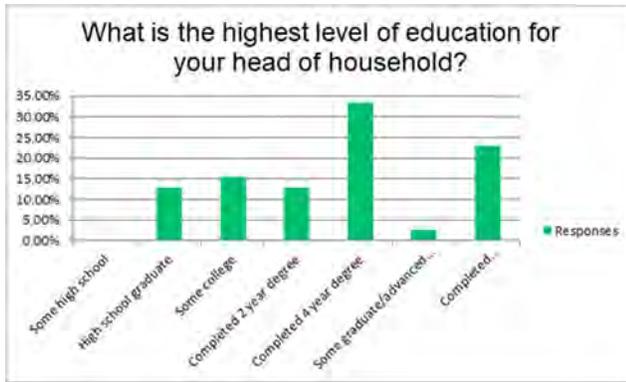
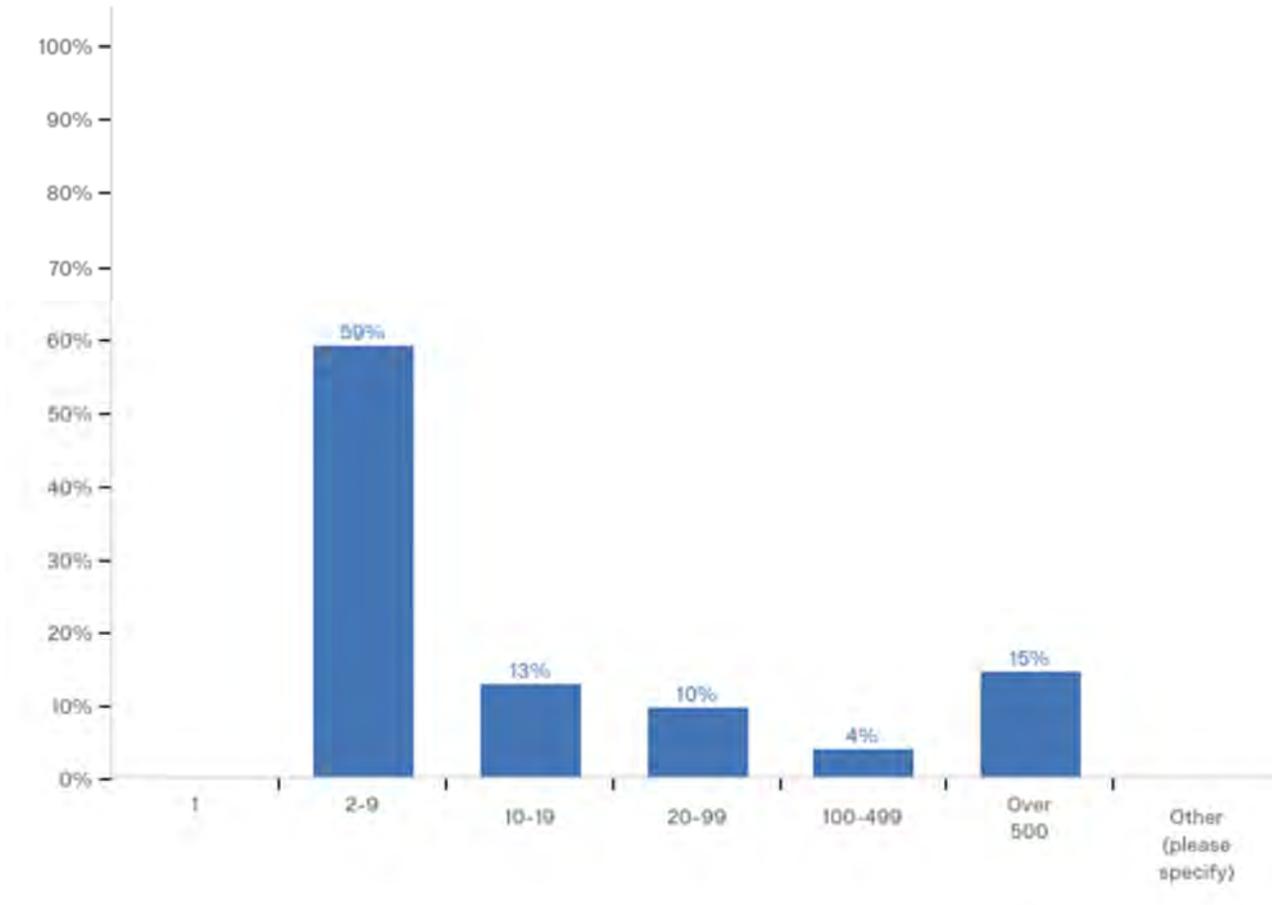


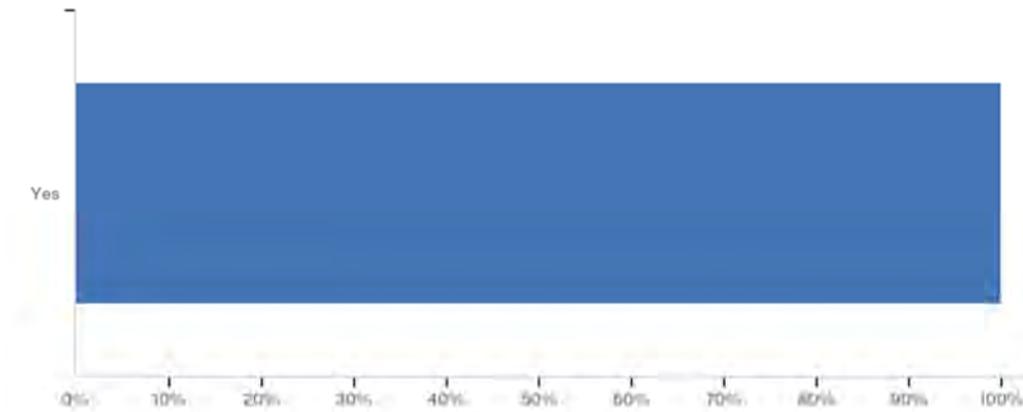
Figure D-9 Nashville Business Results

Nashville 2017 / 2018

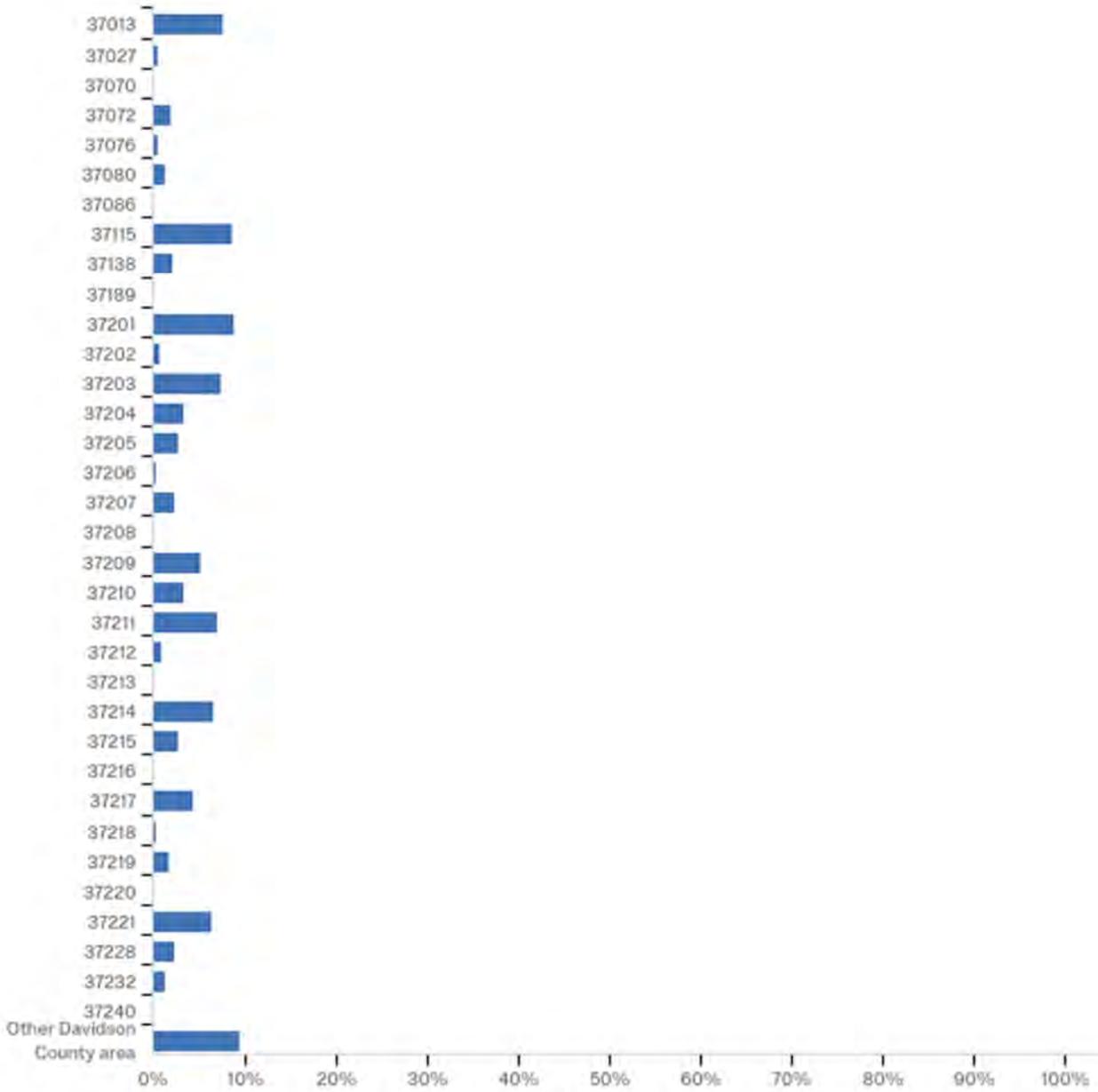
How many employees does your company have? (an approximation is fine)



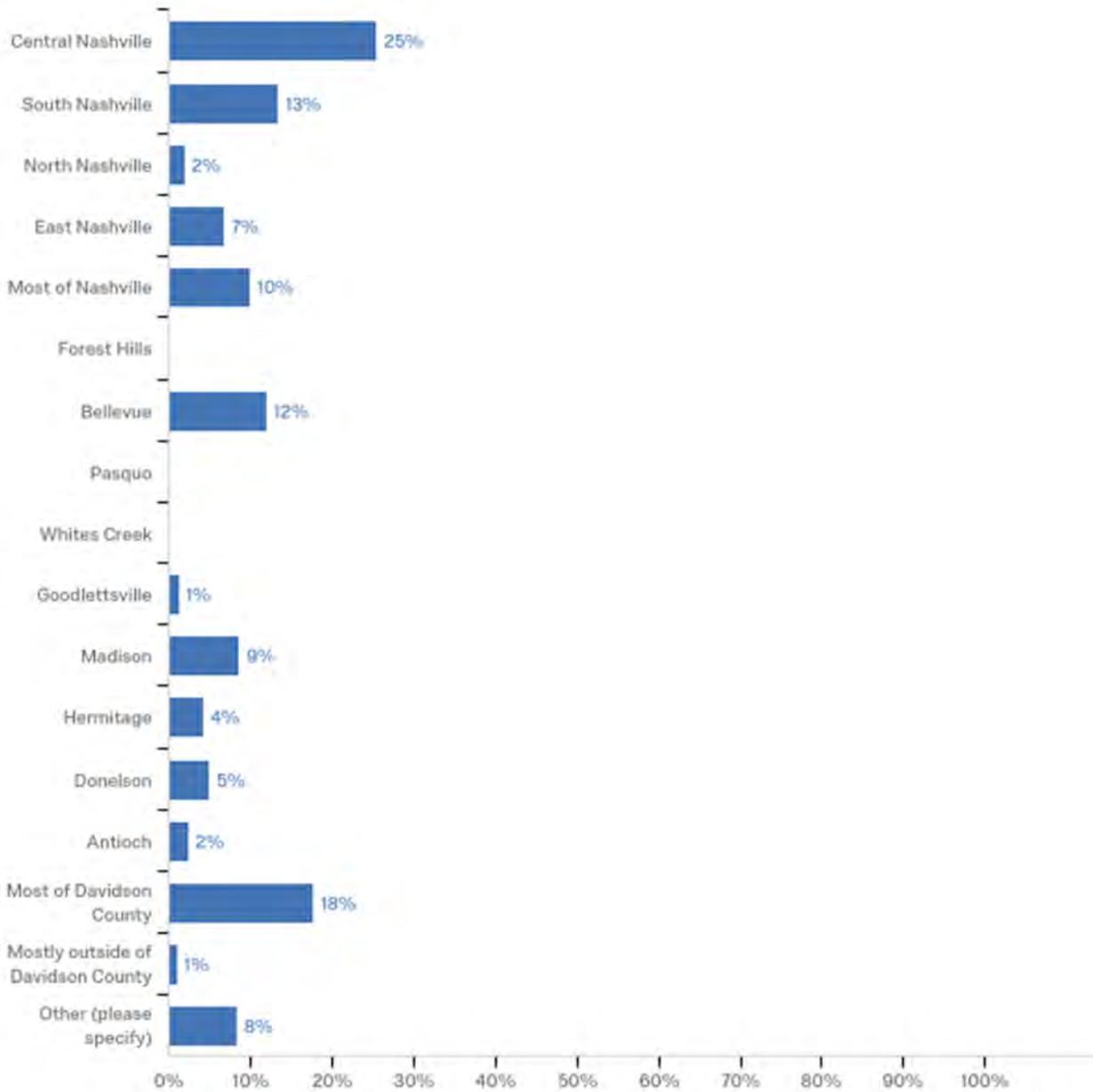
Do you make business decisions for this company or are you familiar with how trash/recycling works at your company?



What zip code do you work in?



Which area of Nashville/Davidson County do you primarily conduct your business?



Other (please specify)

West Nashville

West Side

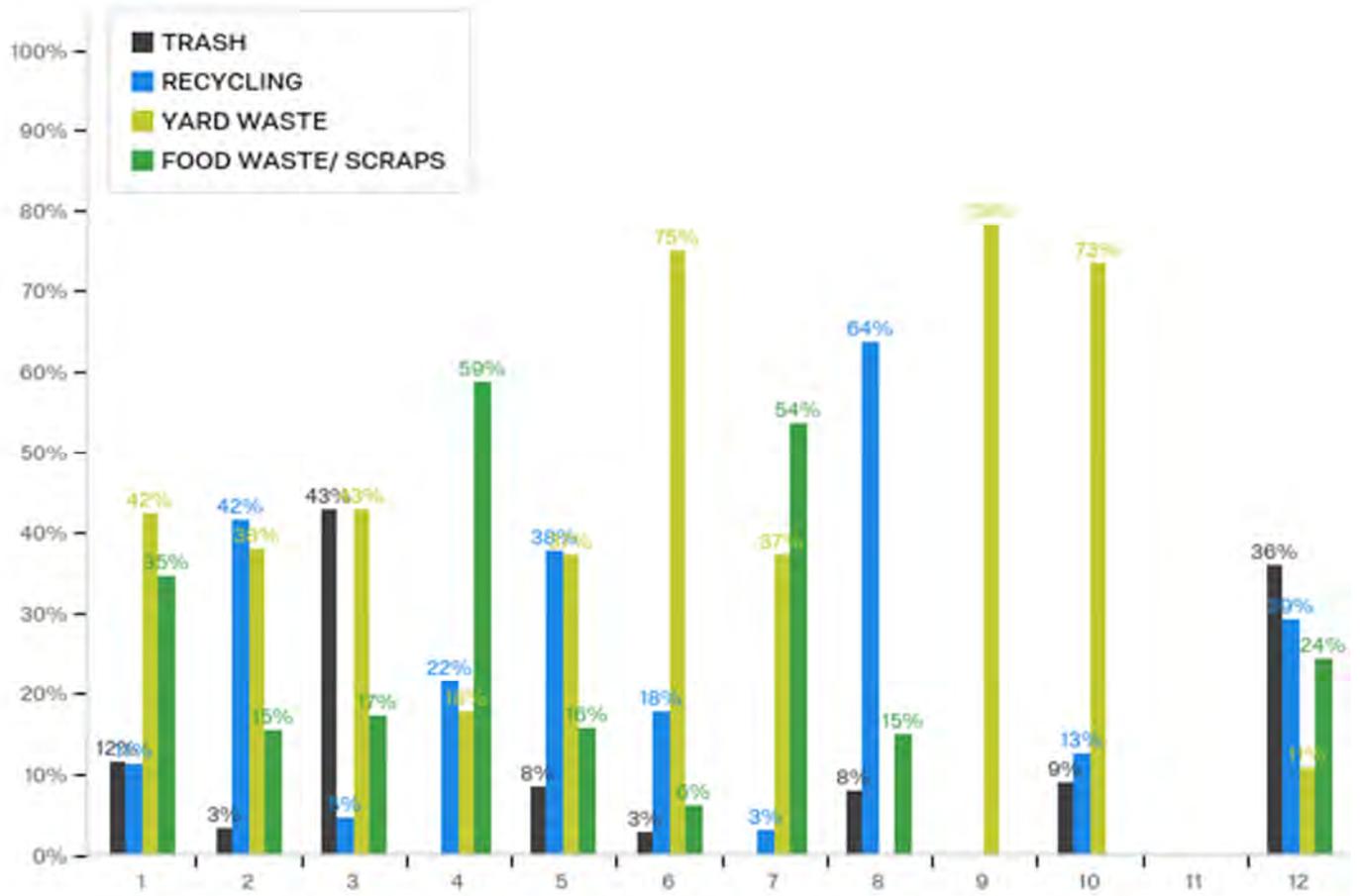
Old Hickory

All of Davidson co

elm hill pike

WEST NASHVILLE

How many months per year does your company generate...



Approximately how much per MONTH do you pay for services (or please describe- pay \$\$ for this much service every 3 months etc.)

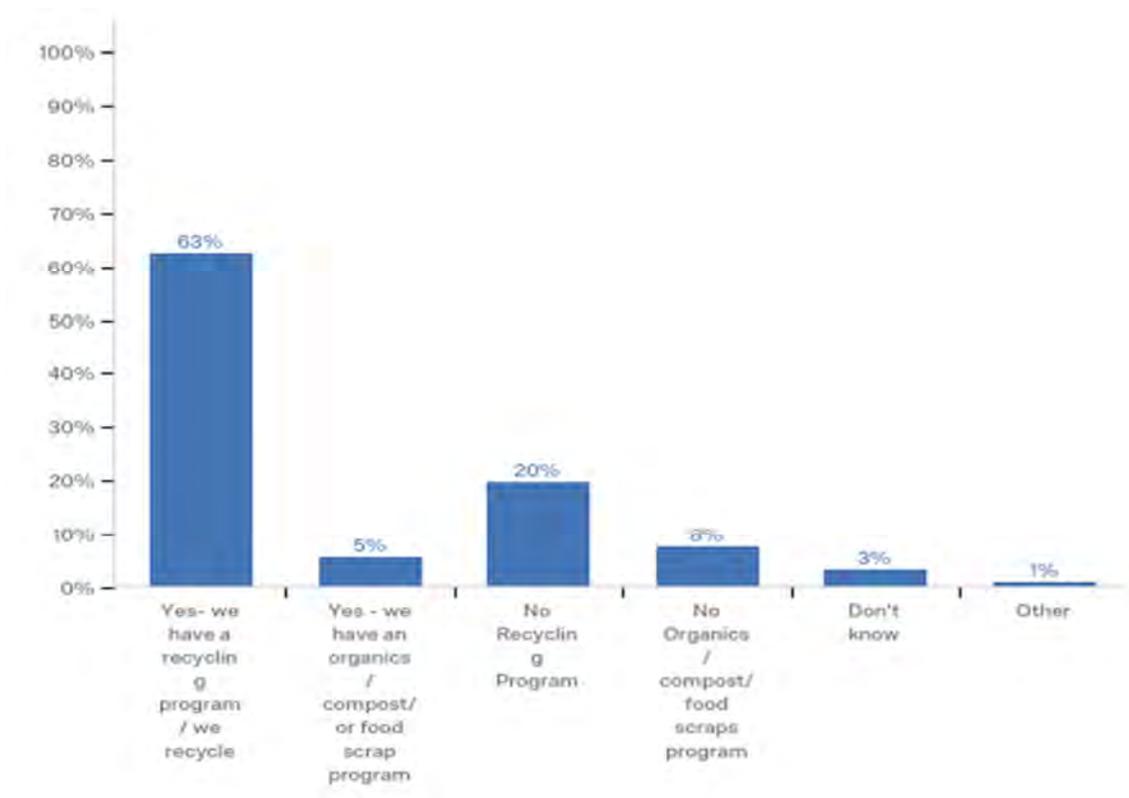
| TRASH SERVICE | RECYCLING SERVICE | ORGANICS | Other ie- we share dumpster- please describe |
|---------------|-------------------|----------|--|
| 300 | 300 | 0 | n.a |
| 125 | 120 | 0 | 0 |
| 100 | 100 | 100 | 0 |
| 50.00 | 20.00 | 0 | 0 |
| Don't know | \$0 | \$0 | \$0 |
| 0 | 0 | 0 | Rent |
| 0 | 0 | 0 | 0 |
| \$3 | \$5 | \$5 | \$4 |
| Na | Na | Na | Na |
| 150 | 0 | 0 | 0 |
| 3000 | 0 | 0 | 0 |
| 50 | 50 | 0 | we do construction and share a dumpster with other contractors |
| not sure | not sure | not sure | not sure |
| 1200 | 700 | 500 | 200 |
| 75 | 20 | 0 | 25 |
| Unknown | Unknown | Unknown | 0 |
| 600 | 0 | 0 | 0 |
| 10000 | 10000 | 0 | 0 |
| 36 | 15 | 10 | 0 |
| 50 | 30 | 20 | n/a |
| 1000 | 1000 | 500 | dumpsters |
| 0 | 0 | 0 | waste cost is rolled into other costs |
| 0 | 0 | 0 | 0 |
| 125 | 20 | 0 | 0 |
| 0.00 | 0.00 | 0.00 | We share |

| | | | |
|------------|------------|----------|---|
| ? | ? | N/A | I know we have recycling & trash services, not sure costs. |
| n/a | n/a | n/a | n/a |
| 5000 | 5000 | 1000 | N/A |
| ? | ? | ? | ? |
| 30 | 30 | 0 | 0 |
| 20 | 0 | 0 | 0 |
| 300.00 | 0 | 0 | 500.00 Roll off large dumpster |
| none | none | none | N/A |
| 2500 | 0 | 0 | 0 |
| 210 | 30 | Not sure | No |
| ? | ? | 0 | ? |
| About \$50 | About \$25 | \$0 | \$0 |
| Dumpster | Dumpster | 0 | We have dumpsters for recycling and trash |
| 30 | none | none | yes |
| \$100 | \$100 | \$0 | \$0 |
| \$300.00 | \$300.00 | \$0.0' | \$0.0 |
| 0 | 0 | 0 | 240- both office and living space |
| \$0 | \$0 | \$0 | Shared dumpster included in rent |
| 90 | 0 | 0 | 0 |
| 150 | Free | 100 | 0 |
| \$3,500 | 0 | 0 | 0 |
| Unsure | Unsure | Unsure | Dumpster |
| 500.00 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 |
| Unknown | Unknown | Unknown | Unknown |
| 800 | 100 | 0 | 120 |
| 0 | 0 | 0 | 0 |
| ok | ok | ok | ok |
| 52 | 0 | 0 | 0 |

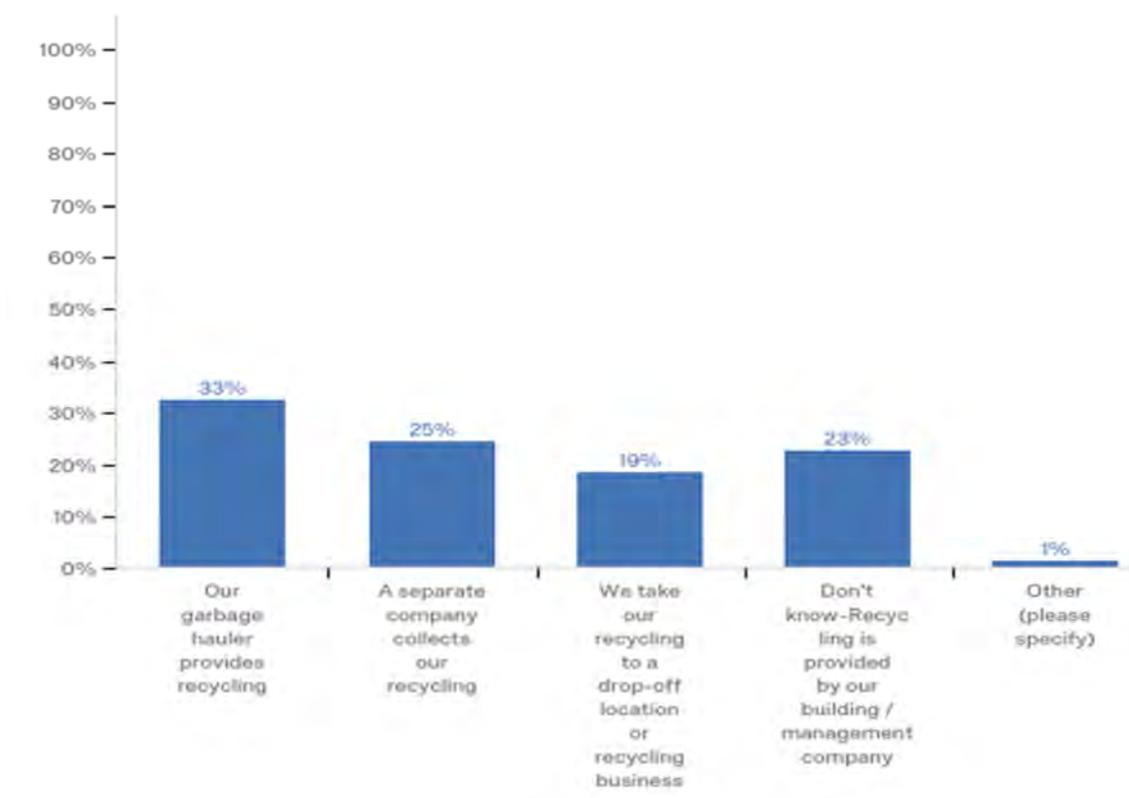
| | | | |
|--|--|------------|---|
| ?? | ?? | ?? | We share a dumpster with 3 other businesses |
| 1000 | 1000 | 5000 | 500 |
| 1200 | 400 | 200 | na |
| don't know | don't know | don't know | don't know |
| 4 | 2 | 1 | 7 |
| 30 | 0 | 0 | 0 |
| Unknown | Unknown | Unknown | Unknown |
| 100 | 100 | 0 | 0 |
| 250 | 100 | 0 | 0 |
| 99 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | \$20 |
| 175 | 73 | 73 | 73 |
| 0.00 | 0.00 | 0.00 | 0.00 |
| 500 | 1000 | 500 | 0 |
| 300 | 150 | 0 | 0 |
| 200 | 300 | 200 | 150 |
| Don't know | 0 | 0 | Shared with other buildings occupants |
| 130.00 monthly | 0.00 | 0.00 | 0.00 |
| no idea | no idea | no idea | no idea |
| 100 | 200 | 100 | Sewage |
| 0.00 | 0.00 | 0.00 | N/A |
| 50 | 50 | 0 | 0 |
| 100 | 60 | 0 | 0 |
| 100 | 0 | 0 | Dumpster |
| 200 | 300 | 300 | 200 |
| This paid through our corporate office | This paid through our corporate office | N/A | N/A |
| 100 | 100 | 0 | 0 |
| 100 | 150 | 200 | 300 |
| 120 | 0 | 0 | 0 |

| | | | |
|------------|------------|------------|--|
| 100 | 100 | 100 | 100 |
| 0 | 0 | 30 | 0 |
| Don't know | Don't know | Don't know | Don't know |
| 500 | 400 | 250 | 0 |
| 0 | 0 | 0 | we share dumpsters. the price is included in the lease |
| 65 | 75 | 55 | 26 |

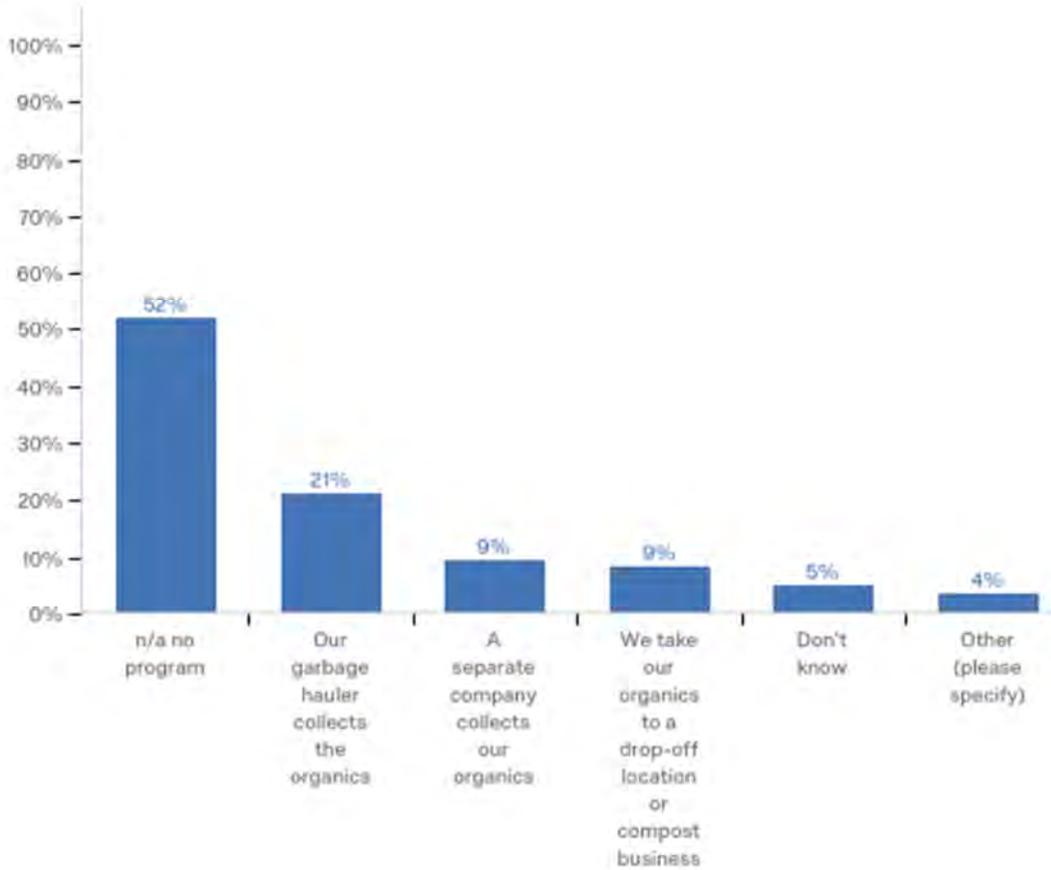
Please mark if you have a recycling program or a compost/food scraps program at your business?



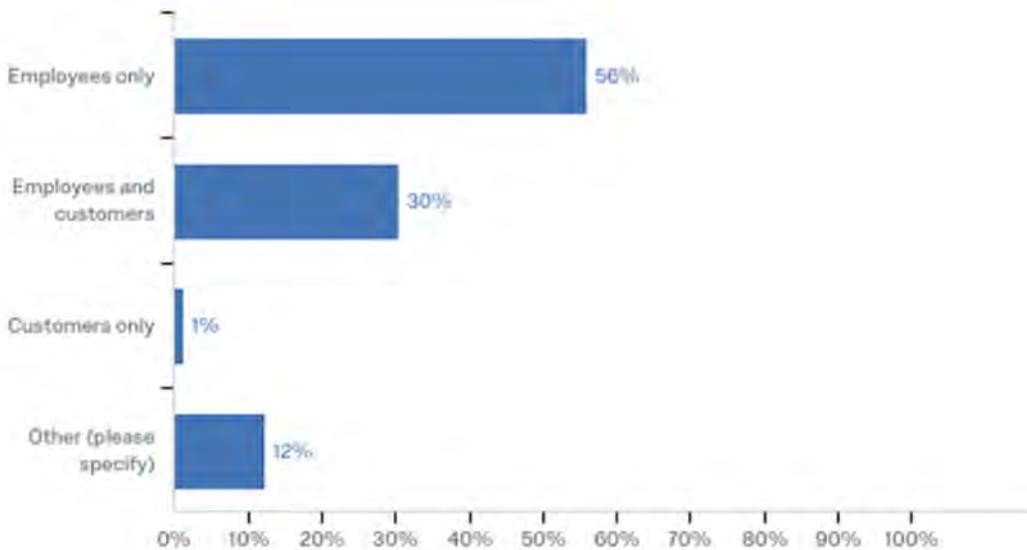
How does RECYCLING operate at your business?



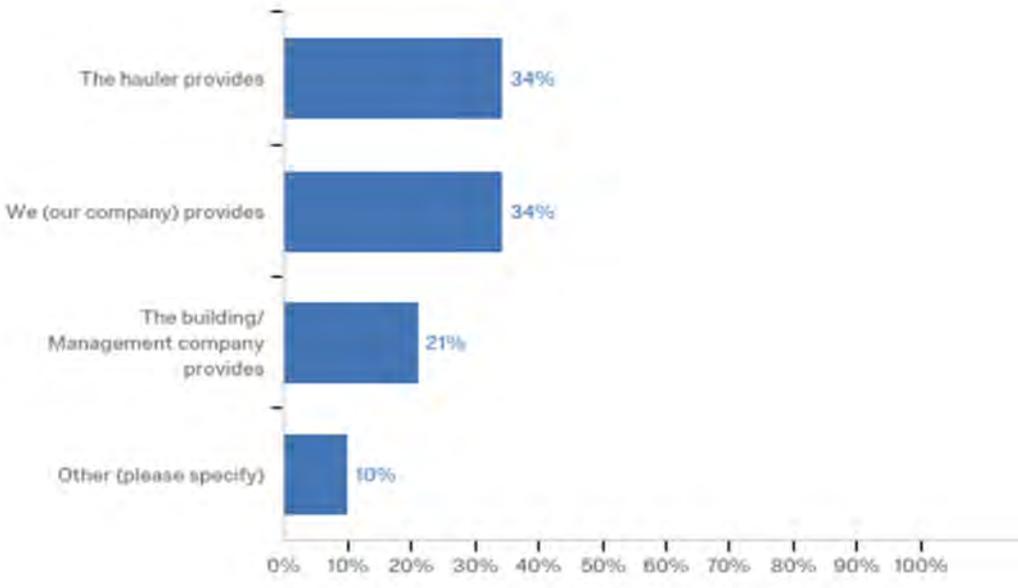
How does the ORGANICS / FOOD SCRAPS program operate at your business



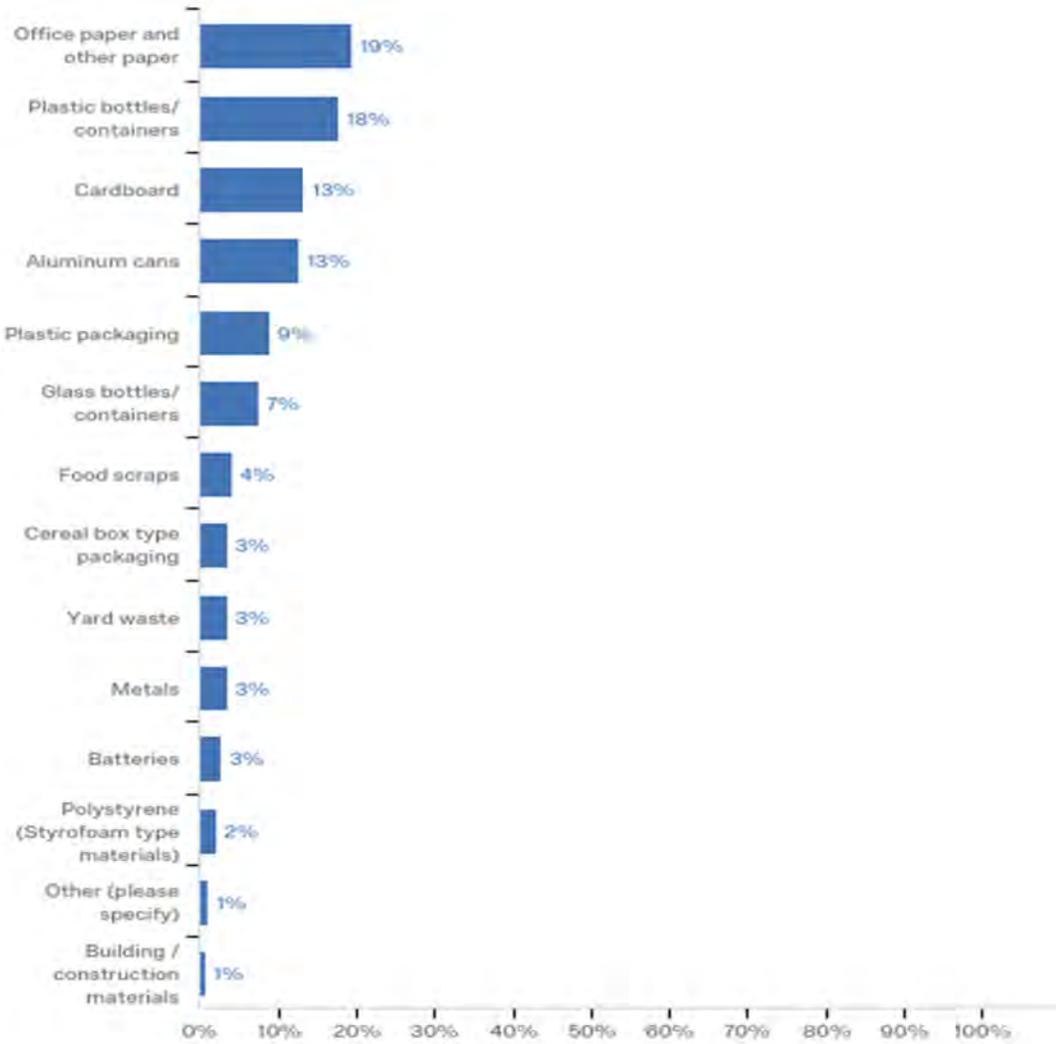
Our recycling / organics program is for...



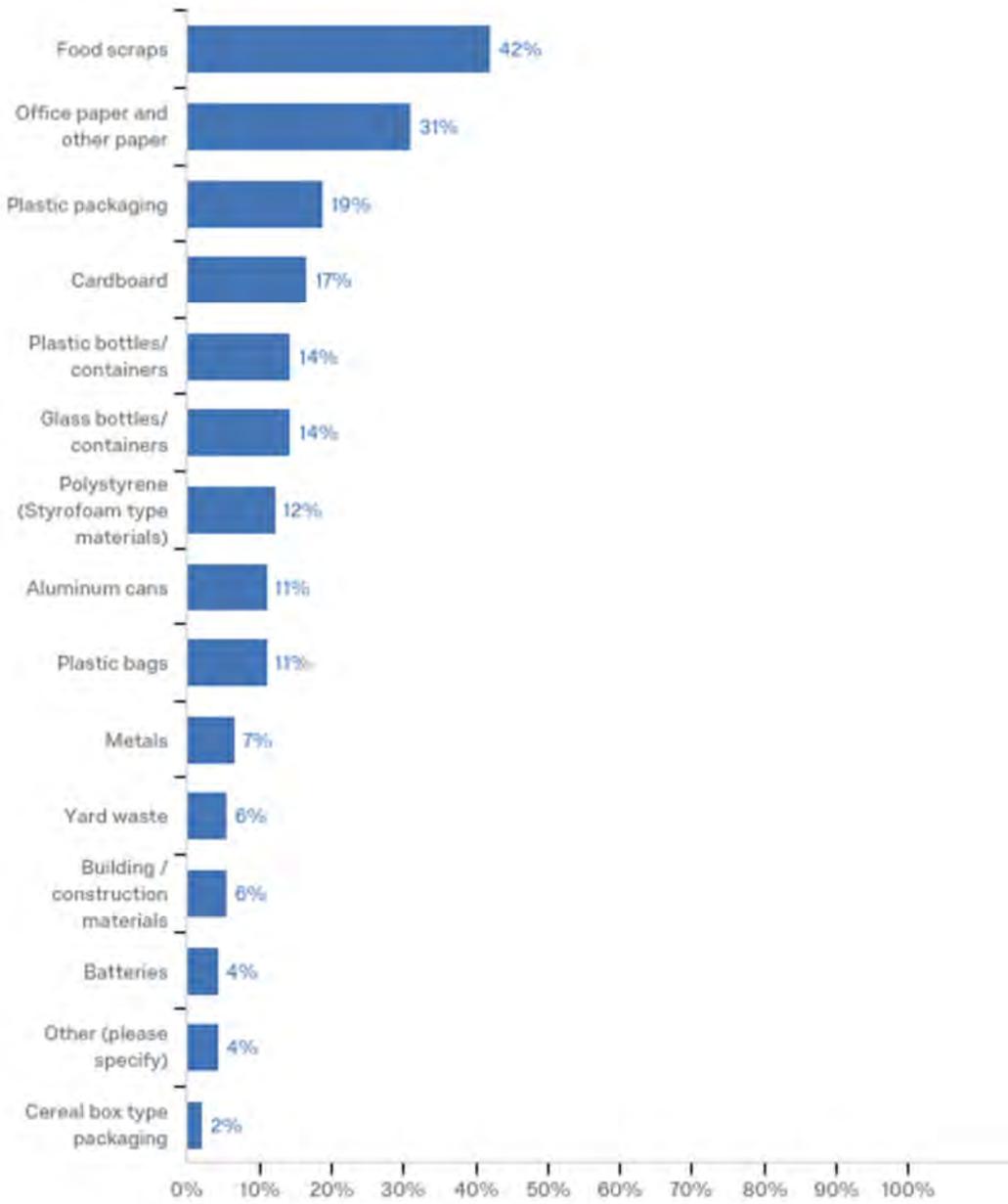
Who provides the recycling / organics containers?



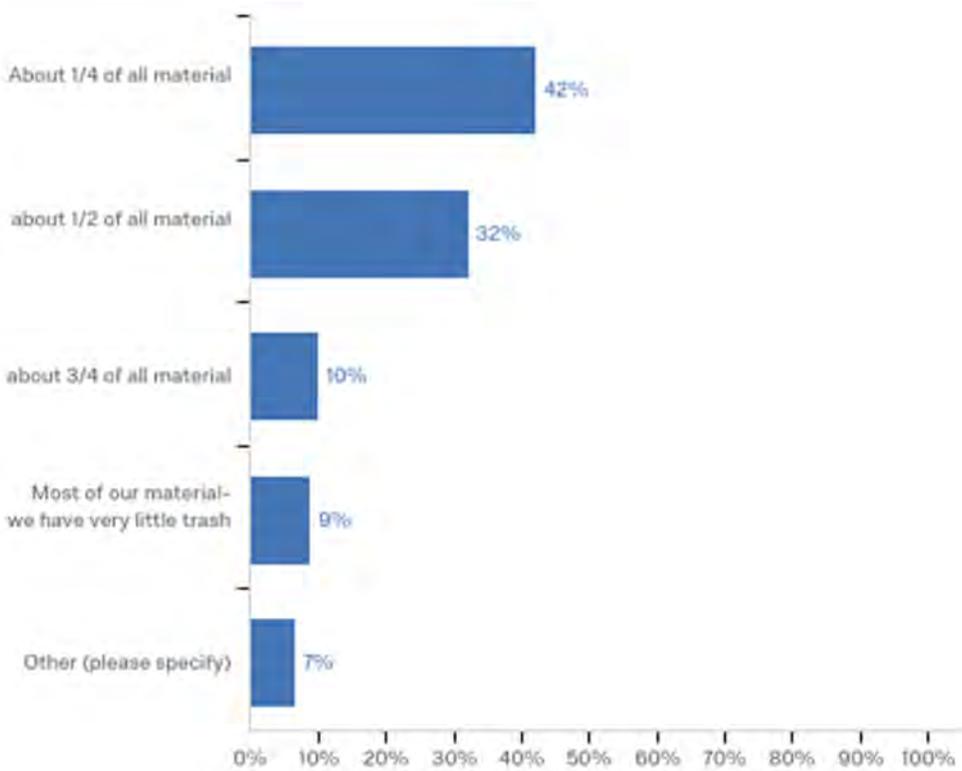
What are the most commonly recycled (diverted) materials in your business?



Which materials make up the largest percent of what REMAINS in your trash?



About how much of the waste generated at your business would you say is recycled or diverted from your trash?



**What would you say are the largest barriers/ problems to RECYCLING at your business?
(choose all that apply)**



- No problems- our program works great! (31%)
 No space for containers indoors (15%)

- No space for containers outside (11%)

- We don't generate enough materials for a program (5%)

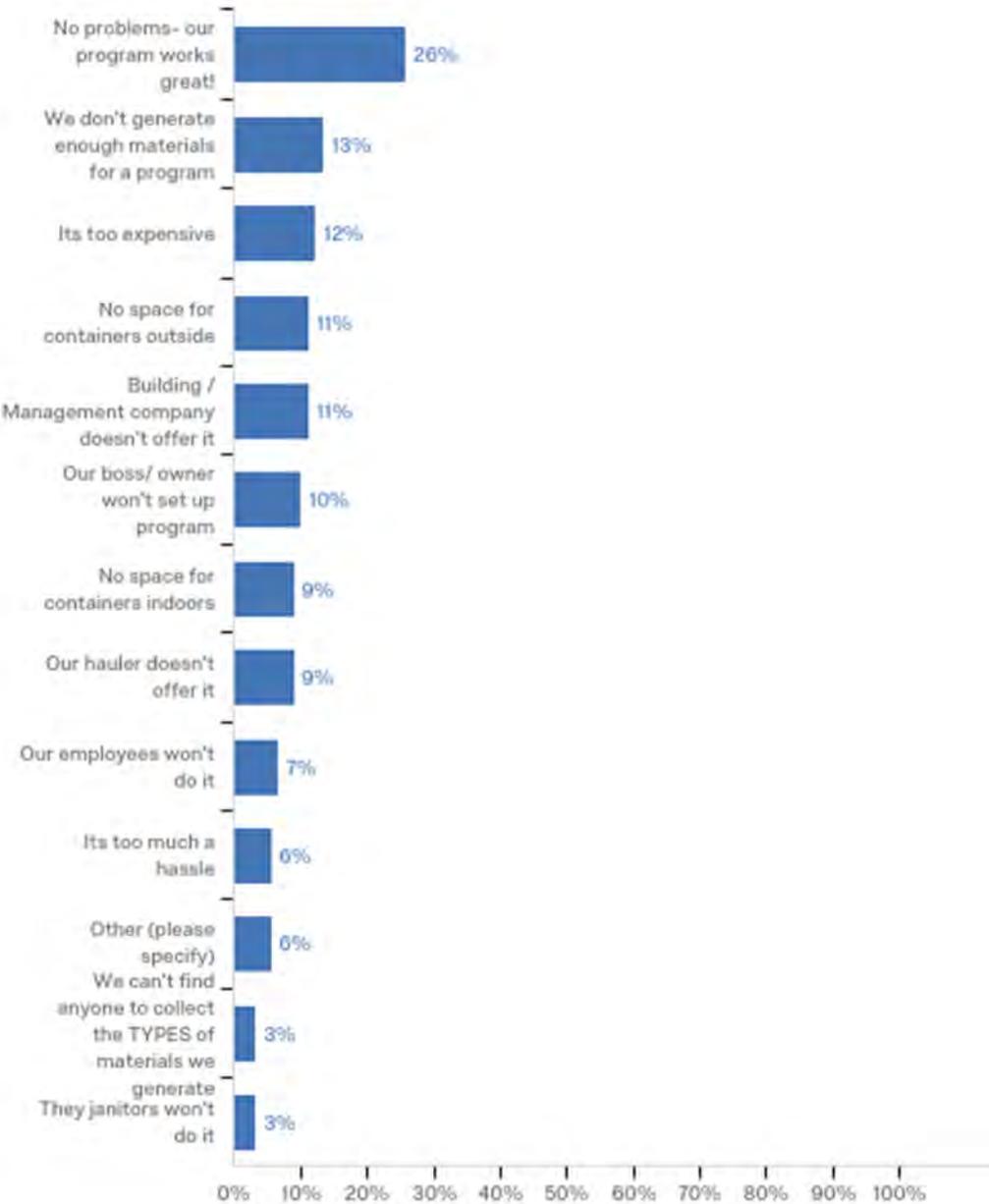
- We can't find anyone to collect the TYPES of materials we generate (3%)

- Its too expensive (8%)
 Its too much a hassle (6%)
 They janitors won't do it (3%)

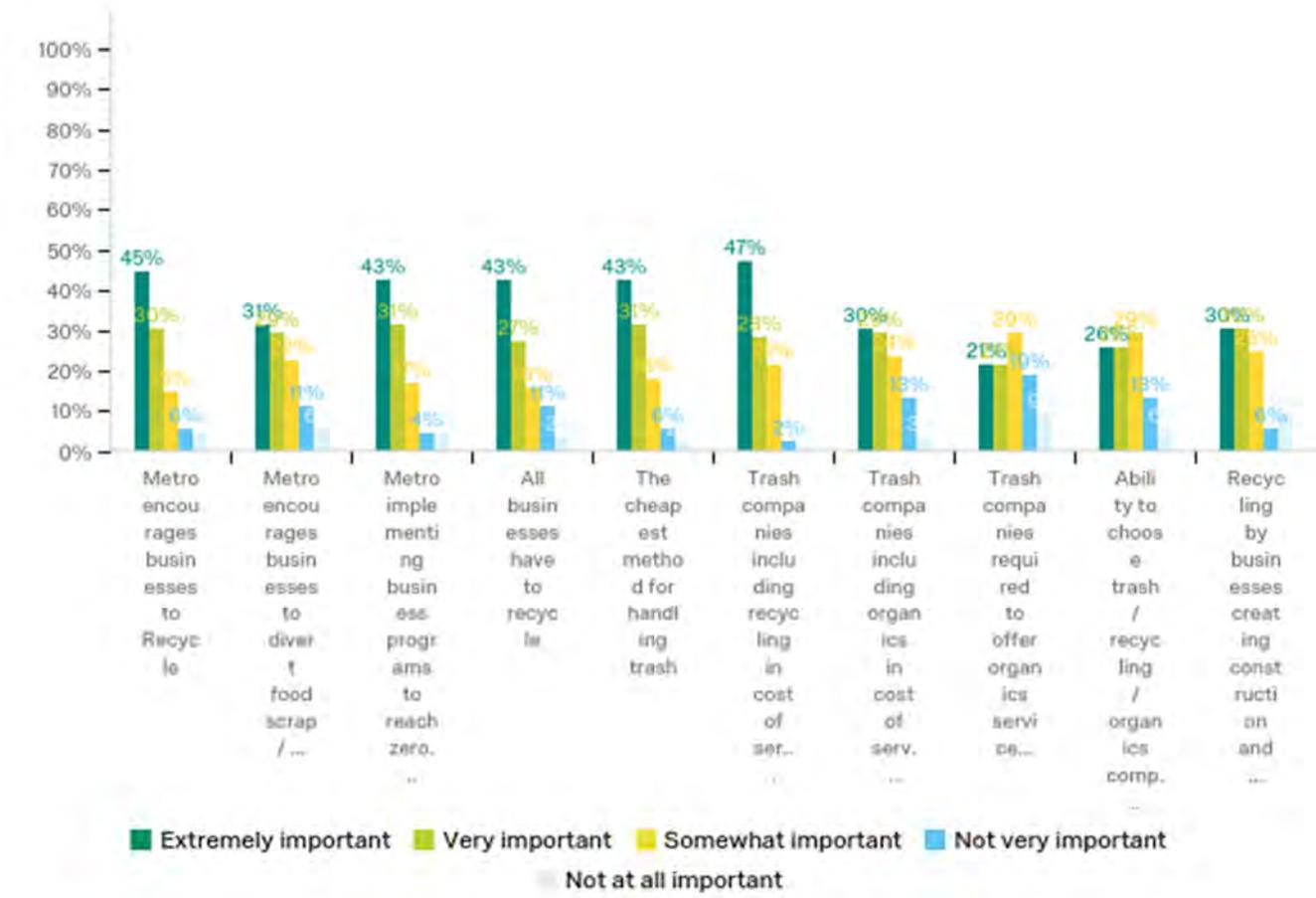
- Our boss/ owner won't set up program (5%)
 Our employees won't do it (10%)

- Building / Management company doesn't offer it (2%)
 Our hauler doesn't offer it (0%)

What would you say are the largest barriers/ problems for an ORGANICS / FOOD SCRAPS/ COMPOST program at your business? (choose all that apply)



Q67 - How important to you/ your business are the following?



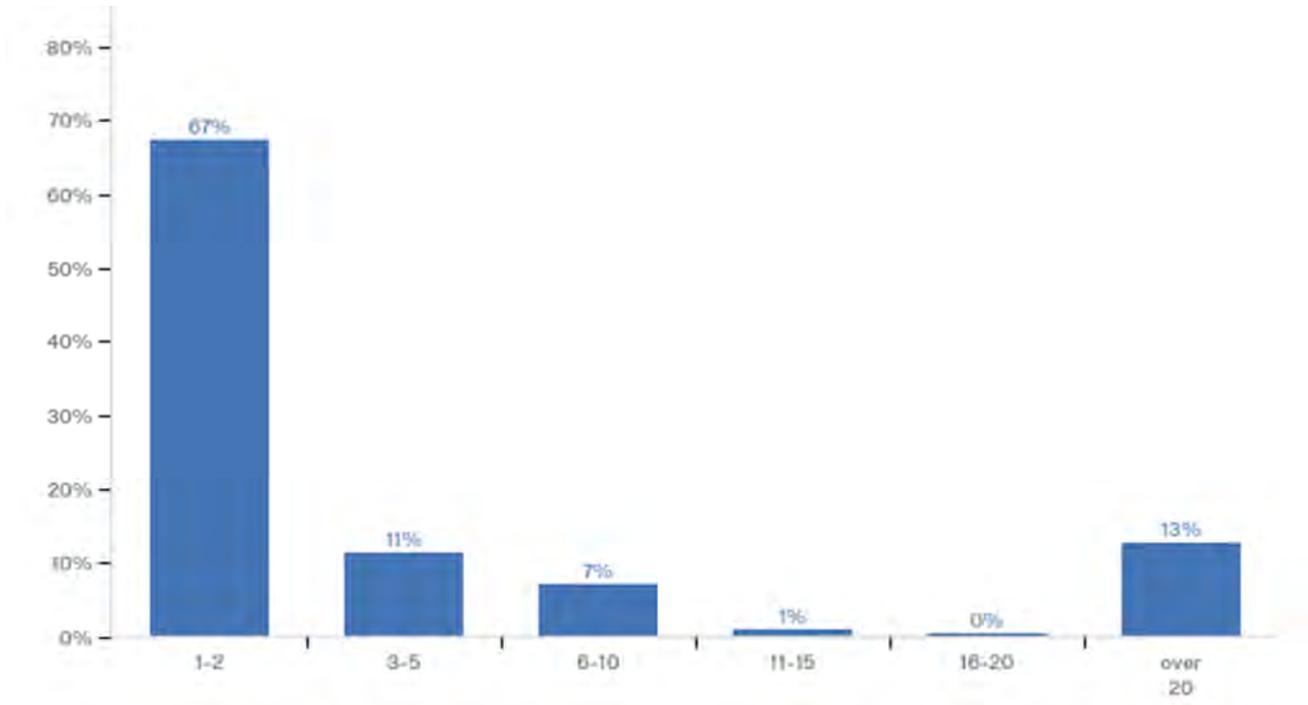
Other programs/ ideas not listed

Tax break for businesses that participate in all recycling programs

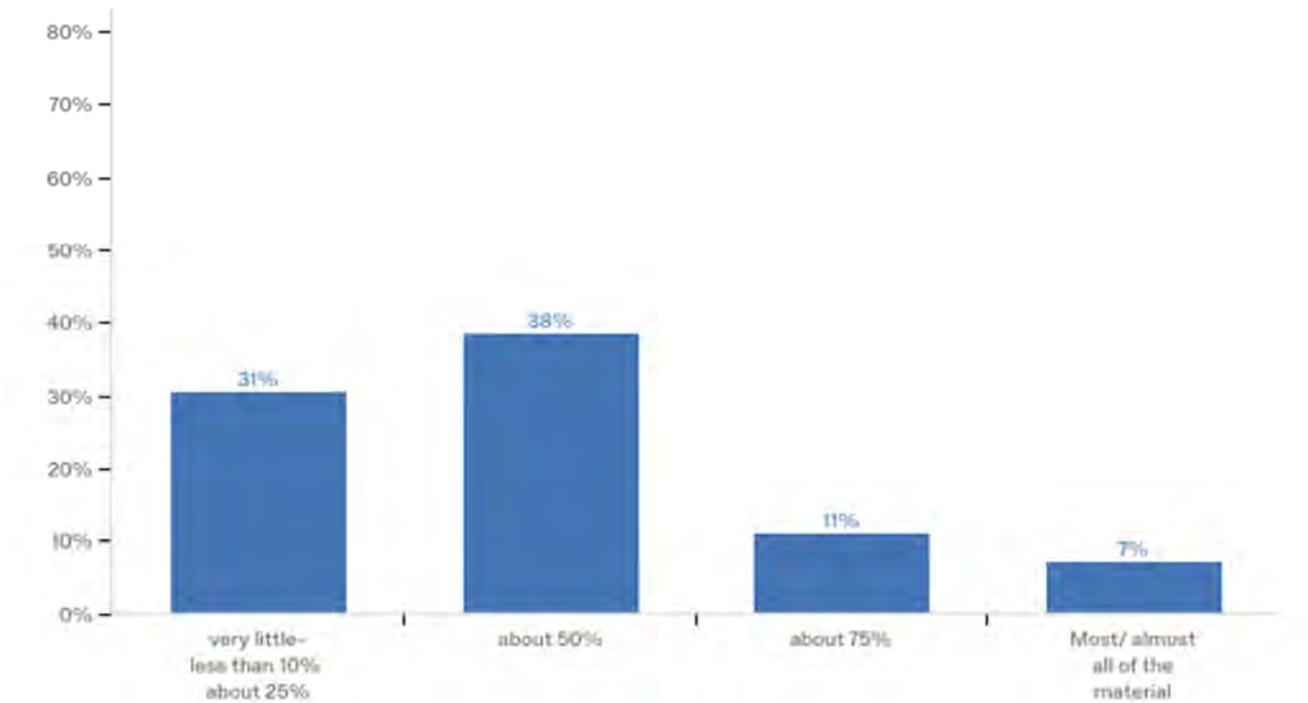
MAINTENANCE

If an company can provide a service that is cheap and able to work w bars

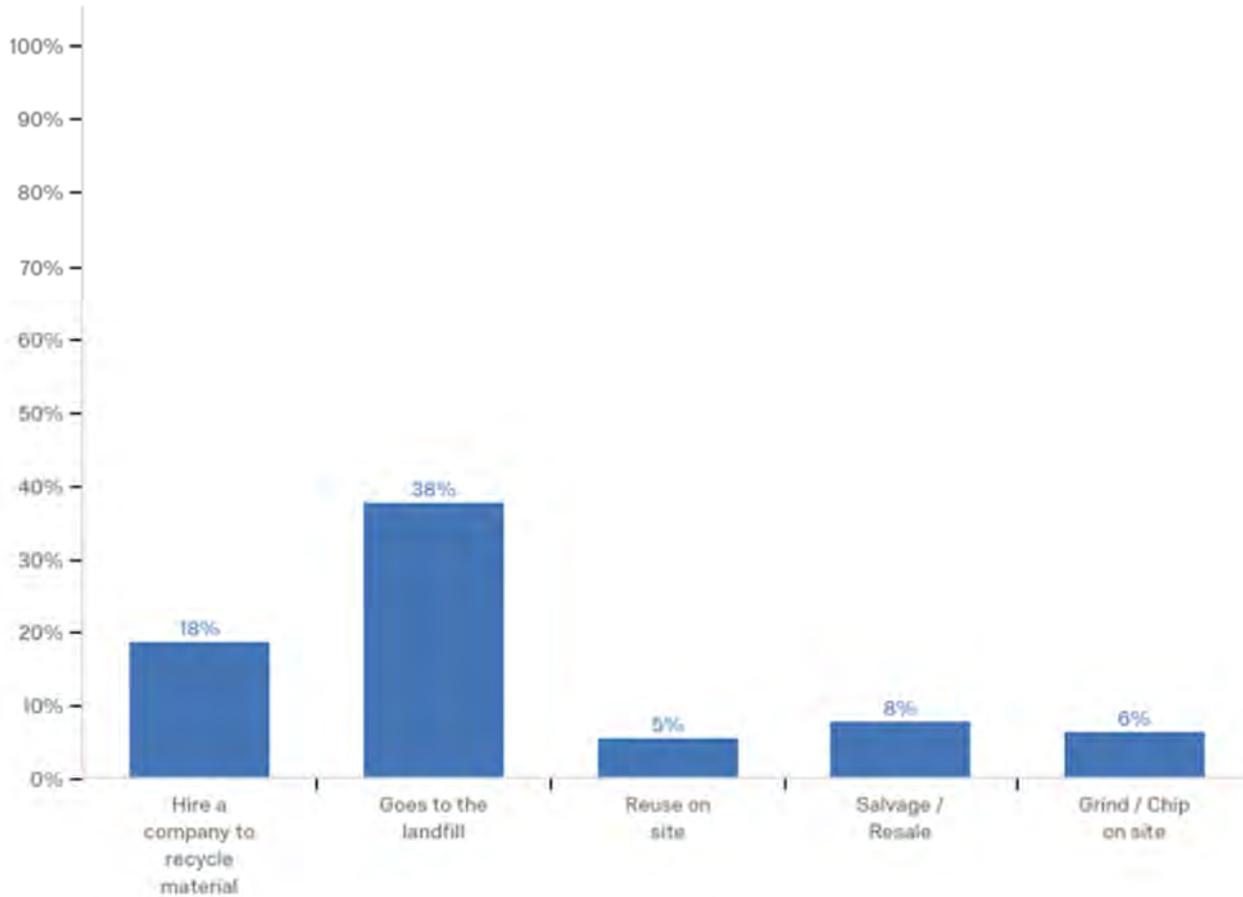
On average, how many jobs sites do you/ your company work on per year?



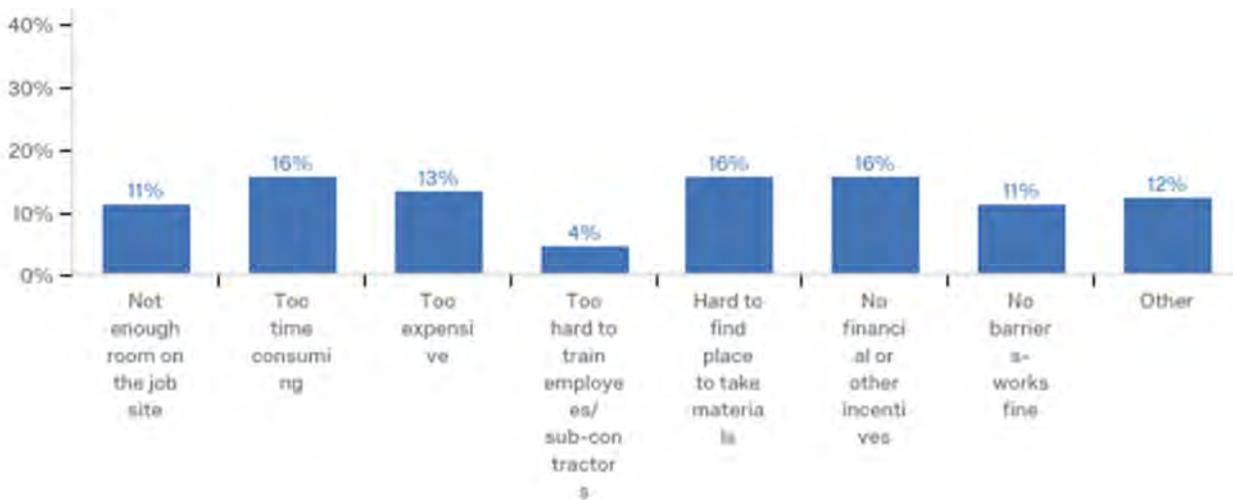
What percentage of your job site materials would you say are recycled or reused?



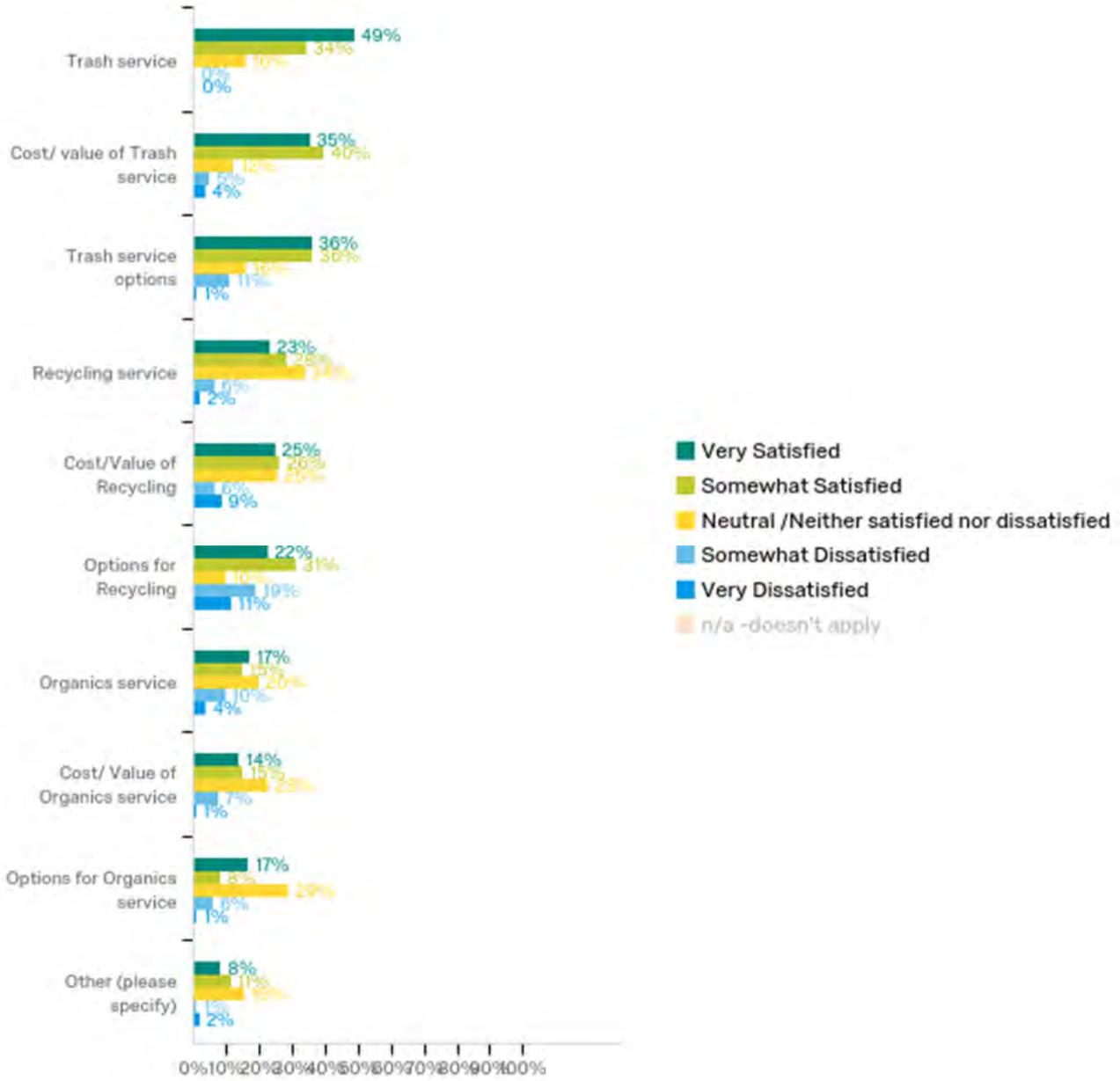
What generally happens to most of your job site debris?



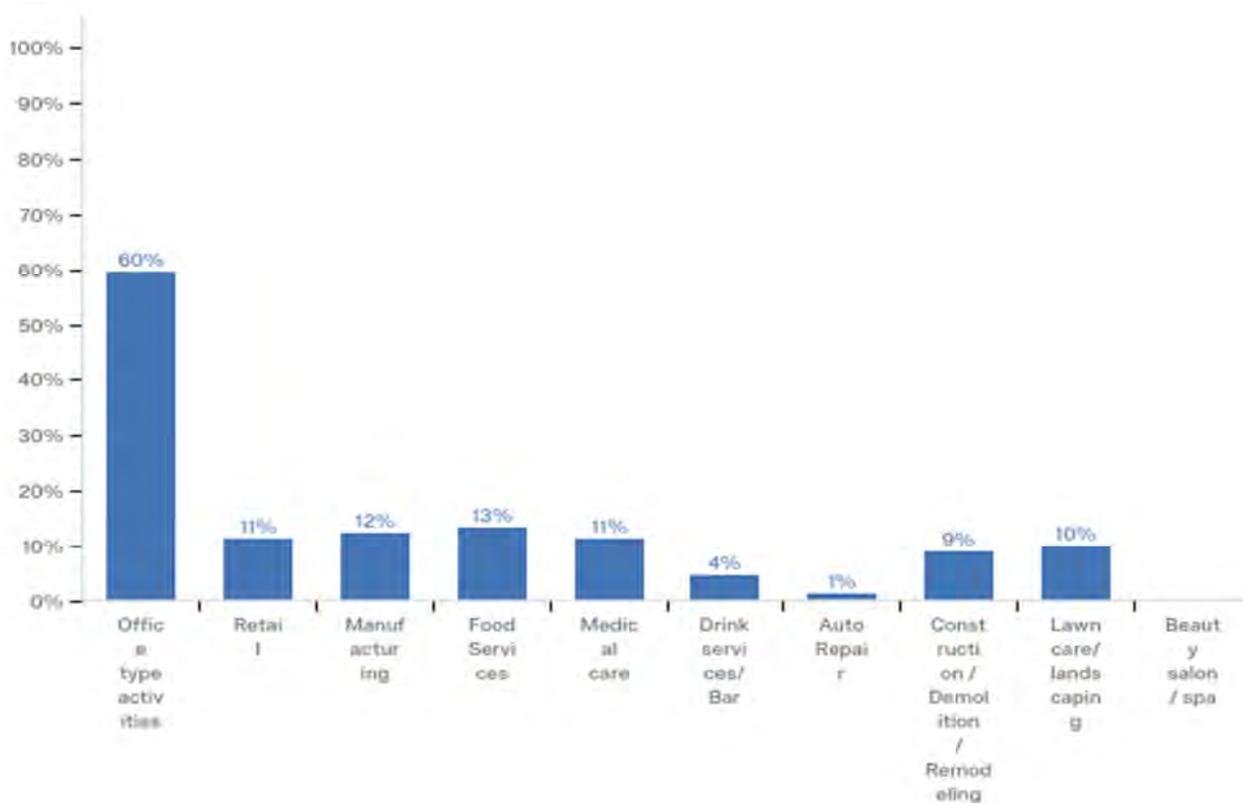
What do you see as barriers or problems for recycling construction and demolition materials?



How satisfied is your business with its current....



What are the main activities conducted at your business? (check more than one if applicable)



Other (please specify)

Social Services

Transportation

house cleaning

Metals distribution

Education

A/V Production

Education

Consulting

education

Education

Environmental education

Exercise

Child Care

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Appendix E

Research and Screening of Diversion Strategies

E.1 Screening Criteria for Strategies

The first task conducted in developing the Plan was to research solid waste management diversion strategies. The research covered collection, processing, and alternative end-use market options for the diversion of MSW and C&D materials from landfills.

Criteria utilized to screen strategies included:

- **Sustainability** – strategies that are affordable while also providing environmental protection.
- **Cost** – anticipated costs to be incurred by Metro and waste generators to implement and maintain programs.
- **Diversion potential** – quantification of a strategy’s short term and long-term diversion capability and consideration of the types of materials diverted based on tonnage, market value and environmental benefits.
- **Suitability to waste sectors and service districts** – determine the appropriateness of a strategy for waste sectors such as residential or commercial, and ability to implement in the USD and GSD.
- **Proven effectiveness** – strategies were screened based on demonstrated success in other communities over an extended period of time.

E.2 Prioritizing Strategies by Waste Stream, Value, and Emissions

Results of the waste characterization study, shown in **Figure E-1**, were used to identify recyclables and organics still being landfilled and to determine the “Percent of Recoverables Remaining” or PRR¹ in the waste stream. The PRR can be addressed in three ways as described in **Figure E-2**. The three priority assessment metrics are – tonnage, dollar value, and GHG emissions. **Table E-1** shows the results for the residential, and industrial, commercial, and institutional (ICI) sectors with the top materials for each metric highlighted in red text.

¹ See Skumatz, Lisa A., “Percent Recoverables Remaining: measuring what isn’t diverted”, *Resource Recycling*, 2016.

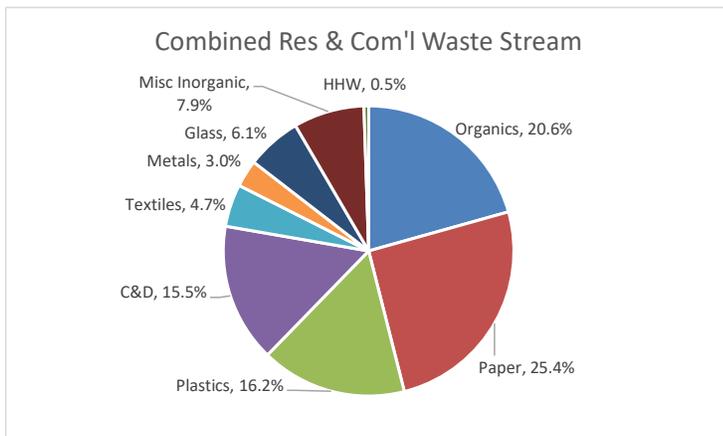
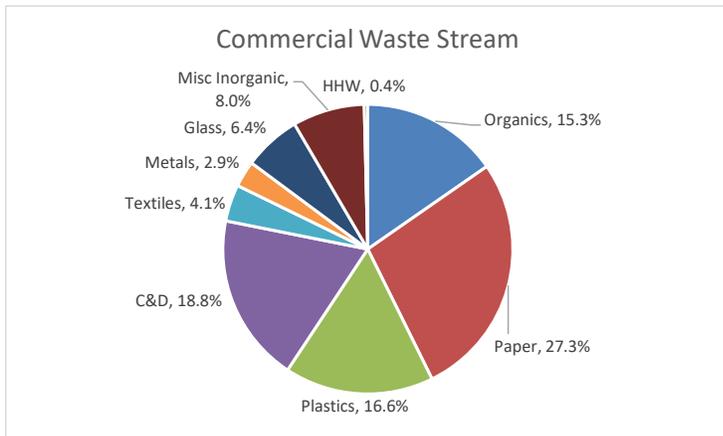
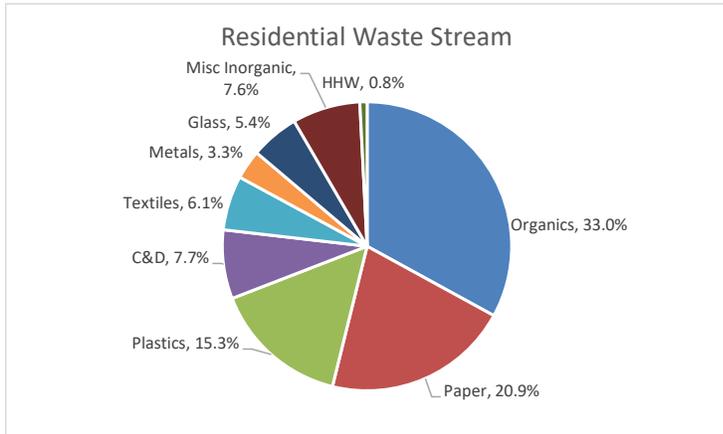


Figure E-1
Waste Composition for Metro



Figure E-2
Three Metrics for Percent Recoverables Remaining (PRR) Metric

Table E-1 Calculating Priority Materials for Recovery for Nashville Metro Using PRR

Key to the Table: Residential (Res) and Commercial (ICI)% are based on tonnage shares (Basic Percent Recoverables Remaining PRR); Value is based on material market value (Value PRR), and PRR-GHG is based on the GHG emissions related to the materials (using factors from EPA's WaRM model).

| Percent Recoverables Remaining Assessment of Priority Materials | Residential % of Tons (PRR) | Market Value (PRR-\$) | GHG Avoided (PRR-E) | Commercial (ICI) % of Tons | Market Value (PRR-\$) | GHG Avoided (PRR-E) |
|---|-----------------------------|-----------------------|---------------------|----------------------------|-----------------------|---------------------|
| Yard Waste & Food | 33% | | -33 | 15% | | -15 |
| Compostable/Other Paper | 9% | \$801 | -6 | 10% | \$882 | |
| Construction & Demolit. | 8% | | -5 | 19% | | -7 |
| Other Organics | 4% | -\$39 | -4 | | | -12 |
| Aluminum | 3% | \$5,115 | 0 | 3% | \$4,495 | |
| Cardboard, uncoated | 3% | \$688 | -1 | 12% | \$2,553 | |
| Glass Bottles & Jars | 3% | \$78 | -1 | | | -4 |
| Composite Plastics | 0% | | 0 | 3% | \$1,088 | |
| Com'l/Indust. Film | 0% | | 0 | 3% | \$1,131 | |

Material diversion priorities based on these assessments, include:

- Residential Sector: yard waste and food scraps, compostable paper, aluminum, cardboard, and C&D.
- Commercial Sector: C&D, yard waste and food scraps, cardboard, compostable paper, aluminum, composite plastics and film.

Development of programs and diversion options discussed in Sections 6 and 7 of this Plan focus on these priority materials.

E.3 Diversion Strategies Eliminated During the Screening Process

The following strategies were eliminated during the screening process as discussed below.

Single Family Residential Strategies Not Included:

- *Promoting use of in-sink disposals for food scraps:* Since Nashville is growing very quickly it was determined that the wastewater infrastructure excess capacity should be preserved as much as possible by not allowing increased volumes from use of in-sink disposers. Therefore, this option was not pursued as a viable option.
- *Wet-dry collection system:* This strategy is discussed below in paragraph 5.4.
- *CNG powered residential collection trucks:* The move to CNG as a fuel option does help with the reduction of GHG emissions; however, the conversion is costly and does not affect diversion amounts, capture efficiencies or volumes collected of any of the priority materials identified above.
- *Recycling credits using RecycleBank™:* RecycleBank is a company that partners with communities, private haulers, and product brands to create incentives for residents to recycle. The incentives are structured around reward points that are redeemed for discounts on products from local and national business. A detailed analysis shows this strategy is less effective and less cost-effective than SAYT (referred to as PAYT in the referenced study), the recommendation included in the Plan.² This study shows three main reasons recycling credits are less effective. First, SAYT provides incentives for recycling, organics collection, and waste reduction, while recycling credits divert substantially less material because they only incentivize recycling. Second, the system most commonly implemented only tracked whether recycling was set out or not, providing no incentive for the actual quantity of waste recycled. Third, the system was expensive for some cities; the cost deals negotiated in various cities varied from 40 cents per household per month to more than \$4 per household per month above and beyond the monthly recycling collection cost. SAYT was both more effective and less expensive.
- *Rural strategies:* Rural-suited strategies were omitted from further consideration because they were not suitable for the predominately urban/suburban environment of Metro. Examples of rural strategies include hub and spoke, donated backhauls of collected recyclables, and other options.

Multifamily Building Strategies Not Included:

Multifamily strategies, in general, have been shown to be unsuccessful in communities implementing zero waste programs. For this reason, they are considered low priority for application of limited funds and we believe that programs tailored for success in Nashville will be developed through a new City proposal-based grants program proposed in Chapter 6. The most common challenges associated with the multifamily sector include high levels of contamination in recycling and organics bins, low participation rates, and inadequate space for additional containers. These challenges are attributed to the lack of individual responsibility resulting from there being no financial link to resident's monthly bills. Specific multifamily strategies were

² See Skumatz, Lisa A., "PAYT vs. Recycling Incentives", *Resource Recycling*, 2011.

excluded from further consideration in the Plan. However, the following strategies have been utilized by other municipalities and may serve as ideas for future grant applications.

- Mandate for all multifamily buildings to recycle.
- Promote recycling champions in buildings.
- Hauler incentives for achieving participation or diversion goals.
- SAYT in multifamily, using bags or other strategies.

Commercial Strategies Not Included:

The following strategies were deemed to be less successful than the strategies recommended in Chapters 6 and 7.

- Special commercial routing for City or haulers.
- Diversion requirements of haulers.
- Requirements for all hotels, rentals, and similar establishments to include recycling containers in rooms.

Regulatory Strategies Not Included:

A number of state level strategies, as described below, were not included due to the inability of Nashville to assure their implementation. However, these strategies should be supported by Nashville since they are effective diversion strategies.

- Multi-tier goal: Establishing multiple levels for goals is most suited to states, where areas of the state vary widely in density, or have varying levels of access to programs and markets.
- Bottle bill / deposit legislation: This strategy was not included because this is most suited to a state-level initiative.
- Broad State-wide Diversion Regulations: Vermont recently passed regulations that are comprehensive, phase in a series of options in a logical manner and will be expected to lead to very high levels of diversion (See Table D-2). This strategy was not included because it is best suited to state-level implementation.
- Minimum content standards (MCS): This requires use of a minimum amount of (post-consumer or other) recycled materials in products produced or used. Examples include MCS for newsprint or office paper. Again, this is difficult at the local level, and potentially more suitable at a state level.

Table E-2 Vermont Diversion Legislation

| | |
|---|---|
| <p>Year 1:</p> <ul style="list-style-type: none"> • Transfer stations and drop-offs must accept recyclables at no fee • Food scrap generators of 104 TPY must divert material to any certified facility within 20 miles <p>Year 2:</p> <ul style="list-style-type: none"> • PAYT statewide (volume or weight) • Recyclables banned from landfill • Transfer stations/drop-offs must accept leaf and yard debris • Haulers must offer residential recycling at no extra charge (embedded) • Public buildings must provide recycling containers adjacent to solid waste containers (except restrooms) • Food scrap generators of 52 TPY must divert material to any certified facility within 20 miles. | <p>Year 3:</p> <ul style="list-style-type: none"> • Leaf, yard and clean wood waste banned from landfill • Haulers must offer leaf and yard debris collection • Food scrap generator threshold at 26 TPY. <p>Year 4:</p> <ul style="list-style-type: none"> • Transfer stations and drop-offs must accept food scraps • Haulers must offer food scrap collection • Food scrap generator threshold to 18 TPY <p>Year 5:</p> <ul style="list-style-type: none"> • Food scraps banned from landfill. |
|---|---|

As mentioned, these options were not included in the Plan. However, nearly four dozen other high performing diversion strategies are included and analyzed in detail in Section 6.

E.4 Combustion and Landfill Disposal Technologies

Almost all waste left after recycling and composting, also known as residual waste, in the U.S. has been landfilled untreated³. Neither landfills nor combustion incinerators are an appropriate response to the challenge of implementing Zero Waste strategies. Combustion technologies are inconsistent with the pursuit of Zero Waste. “Burning or burying” are not options under the definition of Zero Waste. Instead, the principles of Zero Waste require reducing GHG emissions and other environmental impacts.

E.5 Wet/Dry Collection and Processing System

A wet/dry collection system involves two-bins; one for dry material and one for wet material. The material list for the “dry” container includes all non-organics, including recyclables and non-recyclables. The material list for the “wet” container includes organic material such as food scraps, yard waste, and food soiled paper. All plastics are prohibited in the “wet” container, and food scrap is prohibited in the “dry” container. Proponents note that the two-bin approach captures all forms of residential and commercial waste streams, through a cost-efficient two bin system.

The “dry” material is delivered to a material recovery facility (MRF) to sort the recyclables from the non-recyclables. The “wet” material is sent to an anaerobic digester to produce captured methane as a fuel source or to a composting facility. The most cited wet-dry system is Duelp, Ontario. Guelph was one of the first communities in North America to implement a two-bin wet/dry system in the mid-1990s. Participation was high, but over time the facility that handled the material fell into disrepair, experienced structural problems and odor complaints, and was closed in 2006. The facility also experienced problems with increasing levels of incoming material contamination and residual disposal. A newly designed replacement sorting facility was

³ Source: Technical descriptions for the remainder of this chapter researched by Bob Gedert (2011), Evaluation for Nashville Metro planning purposes offered by RRS (2018).

opened in September 2011, and organics were sent to a WTE facility in New York. Residents were asked to separate materials into three bags in a system called “Wet/Dry+”: Trash, Recycling, and Organics. When the new organics site opened it would not accept material in plastic bags, and through the Ontario CIP fund, the City switched to a more traditional cart-based automated collection system and saved money⁴ (see **Table E-3** for Guelph’s current -bin system). The two-bin system has not been used elsewhere in North America for any large-scale collection operation.

Table E-3 Guelph’s Current Three Bin Residential Collection System

| Green (organics) | Blue (recyclables) | Grey (garbage) |
|---|--|---|
| <ul style="list-style-type: none"> • Food items (scraps, peels, bones, shells) • Tea bags, coffee grounds and filters • Paper towels and tissues • Household plants • Pet waste and litter – no plastic bags, except those labelled with the certified compostable logo. • | <ul style="list-style-type: none"> • Aluminum • Boxboard and cardboard (flattened) • Glass (all colors) • Newsprint and paper • Plastic bottles and containers (all numbers) • Polycoat/Tetra Pak (milk cartons/juice boxes) • Shredded paper (in a transparent plastic bag) • Steel cans • Containers must be empty. | <p>Items that are:</p> <ul style="list-style-type: none"> • Not compostable • Not recyclable • Not hazardous <p>Now including:</p> <ul style="list-style-type: none"> • Diapers and hygiene products • Styrofoam • Coffee cups |

Source: <https://guelph.ca/living/garbage-and-recycling/resources/waste-frequentlyaskedquestions/>

Some cities are using the two-bin approach in their central business district, such as Louisville, Kentucky, but with Guelph’s change to a three-bin system, no identified cities in North America are currently servicing single-family and multifamily residential customers with this collection system.

Based on current recycling markets, this process would yield 50% residual trash (or more) to be disposed of in a landfill. In addition, today’s MRF operations would not be able to filter out contaminating materials in the fiber and glass to yield marketable product streams. The organic fraction also would yield a high residual level, causing concerns in the end-use of the collected material. Today’s organic markets require less than 1% contamination level, and likewise for the recycling markets. To achieve a sortation of material that is market ready would require extensive (and expensive) technologies and hand-sorting labor. Constructing and operating a MRF specific to the Dry mixed material is similar to a mixed-waste sorting system; with high capital and operational cost and limited markets for the recyclable fraction. Given the contamination sensitive marketplace for secondary materials, the two-bin collection system is not recommended.

⁴ Source: SERA research/case study. Additional information Guelph, Ontario Daily News, Oct. 3, 2011.

E.6 Mixed Waste Processing Facilities

Mixed waste processing involves no generator separation of waste, with all waste processed at what's been called a "dirty" material recovery facility (MRF). Recyclables are then pulled out at the Dirty MRF. There are three primary ways to collect household recycling: source separation, single stream, and no separation from trash (or "all in one"), also known as mixed waste processing (MWP) or using a "dirty MRF."

MWP is a one-bin system where the consumer places all trash and recyclables in one bin with no separation. This material is delivered to a sorting facility to recover recyclables. GreenBlue estimates that MWP facilities make up less than 5% of all MRFs in the US. StopWaste.Org (Alameda County, California) calculated the average recovery rate for MWP facilities in California at 19%, compared to 85% at single-stream MRFs. The technical feasibility of MMWP remains high.

The lack of consumer participation in MWP is a major setback, as there are no educational opportunities to affect waste stream consumption, and consumers are less likely to make the connection to the impacts of their consumption habits. In addition, the potential for contamination of recovered recyclables is very high and the recovery rate is relatively low.

Mixed waste processing facility (MWPF) commodities many times will not meet industry specification and will be sold off-specification. Contamination continues to be an important factor in the recycled commodities market. Contaminated materials require extra processing or are rejected outright and sent to landfills. The export market for these lower quality materials is also shrinking. The problems of residue contamination from film at MWPFs has not been solved. The use of bags to contain garbage, organic animal and human waste, and discarded food, leaves little options other than disposal or thermal disposal.

Most recently, China has begun import restrictions due to contaminated recycling streams. Recycling is not recycling without end markets, which requires quality output; a standard that MWP cannot achieve. All material that smells of garbage when reaching a mill or a port destination will be subject to closer scrutiny and potential rejection or elimination by those that work there. Many of the issues with MWPF commodities are associated with the smell of garbage, even with improved recovery and deeper mining at a MWPF.

Marketing recovered paper from mixed waste processing facilities raises several complex issues. Market perceptions is a key issue. Up to this time, paper produced from MWPF has not been widely marketed because of odor, moisture and embedded organic materials. Most MWPFs in California do not sort for residential paper, though some do sort for OCC. Many mills in the Southeast will not take OCC directly from mixed waste facilities. There are corporate policies (Pratt) based on the mill and the usage for the material being made. Exports will be a bigger issue. OCC from MWPF can be salted in clean shipments (a few bales per clean source separated loads; bales can be broken apart and re-baled with clean material; or can be sold through brokers to reach mills indirectly who have shortages for this material. OCC/Cardboard separates well in MWPFs through screens, and optical sorting of fine pieces of unbleached material returned to the paper line. OCC also does not absorb as much water as other paper because of chemical barriers

to moisture, but it can saturate and become unusable in mixed waste collection and processing, sometimes a great deal of it present.

Mixed/other paper (MWP) recovery is especially an issue for mixed waste processing. Mixed/other paper does not separate well in MWPF from organic material and has a much higher moisture content than MRF-derived paper. MWP paper is currently not marketed as a mill direct commodity from residential MSW MWPFs, though some is re-baled with other paper and sold. This material will be subject to China export material ban. Pratt Industries, the largest consumer in the Southeast, has stated publicly it will not buy MWPF paper for its mills. There are also FDA concerns with contact from food bacteria. Paper towels, food wrapping paper and personal napkins all will be recovered with this grade in MWPF. If higher grades are attempted to get higher prices, specifications are tighter and the cleanliness of the material more important. Since domestic demand is low, and exports will be restricted after the China ban, mixed paper will be a problem grade to sell if quality is less than perfect.

There have been close to 200 facilities built (with approx. 45 operating today) and the output bales have an image problem because of lingering odor issues, regardless of their quality. This physio-psychological barrier to greater acceptance of these materials has not been significantly overcome for paper, though it has been overcome for plastics and metal. The technical feasibility of MMWP remains high. The following outlines the issues with MWP.

- Well over 150 closed sites in North America.
- Well over 50 converted MWPs (running materials or protocols not intended in original mixed waste design).
- Overstatement of recovery potential.
- Overstatement of expected revenue.
- Overstatement of Expected throughput tons.
- Low quality of recyclables (now compost); resultant lessened available revenue.
- Manual Sorting Factor Sorting MSW reduces recovery.
- Attempts to control wastes through flow control and “put or pay”.
- MRF/Landfill/Market watchdogs aligned against full MWPFs.
- Few operating as intended (recovery and revenue)

The National Recycling Coalition published a policy position on MWP on April 10, 2015. The statement in part states:

“Preserving the quality of recyclable materials, from collection through production into new products, will ultimately expand both the supply and the demand for recyclable feedstock for the world’s manufacturing industries. NRC members know that a facility processing waste and recyclables mixed together, known as a Dirty MRF, may harm recycling markets. When

processing recyclables mixed with solid waste, it can result in the recyclable materials being reduced to being reprocessed into lower quality products. Mixing these valuable recyclables with food, diapers, and other contaminants will severely degrade them. Recyclables aren't waste, let's keep it that way."

E.7 Alternative Disposal Technologies

The term alternative disposal technology is all-inclusive of numerous thermal or chemical breakdown processes. Sometimes these processing facility types are called "conversion technology," a term used to describe new and emerging non-combustion thermal, chemical and biological technologies. The major measuring stick for effectiveness and environmental impact is GHG reductions. For a number of years, vendors of alternative technologies have been approaching local communities with new technologies based on pilot-scale system, without proper vetting and full-scale field experience.

Conversion technologies are a group of technologies that convert the organic or carbon-based portion of post-recycling residual solid waste into useful products. These products in turn can be used to produce electricity, green fuels, and/or marketable chemicals and fertilizers. These technologies are intended to be utilized *after* pulling out recyclables and compostables for secondary end-markets. Specific examples of these technologies include thermal conversion processes and biochemical conversion processes.

Thermal Conversion - Direct Combustion

Direct combustion is the complete oxidation of a fuel at high temperatures under controlled conditions yielding substantial net energy release. Temperatures in the combustion zone of the units are generally in the range of 1500° to 3000°F. The direct combustion process results in the production of hot gases, specifically, carbon dioxide, water vapor, heat and a solid residue (ash). The heat energy of the combustion gases is recovered in a steam boiler. Energy in the steam is then used for heating, producing electricity using a turbine generator, or both.

Evaluation and Recommendation: There are full-scale working examples of direct combustion of MSW, all operating at a very high cost per ton (>\$75/ton). In addition, MSW is not a homogenous and consistent fuel supply for energy production, with toxins and explosive material causing significant handling challenges. The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Direct combustion violates the basic principles of Zero Waste, is very low on the Highest and Best Use Hierarchy and offers a large impact on release gases into the atmosphere. Given that this technology is inconsistent with the pursuit of Zero Waste, direct combustion is not recommended.

Thermal Conversion – Gasification

Gasification is thermal decomposition of material in the presence of a limited amount of air or oxygen. Conventional gasification involves the partial oxidation of carbon-based feedstock to generate a syngas, which can be used as a fuel or for the production of chemicals. Feed-stocks appropriate for gasification include coal, wood and organic materials in municipal solid waste (not able to utilize mixed MSW due to its toxicity and inconsistent composition).

Partial oxidation is carried out by using less air than required for complete combustion of the fuel (i.e., sub-stoichiometric air), or by indirectly heating the organic matter. Temperatures range from 1400° to 3000°F. Utilizing that heat, the organic compounds in the feedstock begin to thermally degrade, forming the pyrolysis gases, oils, liquids and char. There is a high level of residual ash at the completion of the process.

The gas that is produced is known as synthesis gas, syngas, or producer gas. Syngas consists primarily of carbon monoxide, hydrogen, methane and other hydrocarbons, as well as carbon dioxide and nitrogen in some gasification processes. Gasification processes may also result in the production of liquids and solids as byproducts.

Evaluation and Recommendation. The gasification process will reduce the BTU heat value of the syngas in addition to producing a considerable amount of carbon dioxide. There are no known working models of municipal solid waste fueled gasification facilities in the United States, and European models offer very high cost per ton (>\$100/ton). The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Gasification violates the basic principles of Zero Waste, is very low on the Highest and Best Use Hierarchy and offers a large impact on released gases into the atmosphere. Given that this technology is inconsistent with the pursuit of Zero Waste, gasification is not recommended.

Thermal Conversion - Pyrolysis

Pyrolysis is a process where organic matter is converted to gaseous, liquid, and solid fuels under high temperatures (700° to 1500°F) in the absence of oxygen. Pyrolysis can use a variety of feedstocks to produce syngas or biofuels. Pyrolysis process is relatively sensitive to its input material and requires homogeneous material flow (not able to utilize mixed MSW). Pyrolysis is similar to the gasification process, but pyrolysis generally occurs at lower temperatures due to absence oxygen. Essentially, the feedstock materials are “cooked” in an oven, with no air or oxygen present. No direct burning takes place. Similar to the case of thermal gasification, the pyrolysis process can be designed to optimize the production of gases or liquids. Pyrolysis produces gases, biofuel and residual solids, including ash, carbon char and activated carbon for absorption of liquid and gaseous emissions. Large quantities of char are produced as a carbon result of pyrolysis requiring further processing to meet specifications for marketable commodities.

Evaluation and Recommendation. There are no known working models of municipal solid waste fueled pyrolysis in the United States, and European models offer very high cost per ton. The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Combustion, including pyrolysis, violates the basic principles of Zero Waste, is very low on the Highest and Best Use Hierarchy, and offers a large impact on release gases into the atmosphere. Given that this technology is inconsistent with the pursuit of Zero Waste, pyrolysis thermal combustion is not recommended.

Thermal Conversion - Plasma Arc Gasification

Plasma arc gasification is new to the field of waste processing as a form of thermal gasification. Plasma is a hot ionized gas resulting from an electrical discharge. Plasma technology uses an electrical discharge to heat a gas, typically air, oxygen, nitrogen, hydrogen or argon, or

combinations of these gases, to temperatures above 7000°F. Plasma gasification typically occurs in a closed, pressurized reactor. The feedstock enters the reactor, where it comes into contact with the hot plasma gas.

Through plasma arc gasification, the organic materials in the waste are broken down into basic compounds, while the inorganic materials form a liquid slag. Generally, a municipal solid waste feedstock is processed *prior* to plasma arc gasification to remove hazardous chemicals, bulky size material, and other undesirable materials. The syngas can be combusted and the heat recovered in a waste heat boiler. After conditioning, the syngas is combusted in an engine or gas turbine producing electricity. The remaining ash material forms a brittle slag that, when cooled, is an inert (non-hazardous) granular material that may have use as a construction aggregate or road base.

Evaluation and Recommendation. There are no known working models of municipal solid waste fueled plasma arc gasification facilities in the United States, and European models offer very high cost per ton (>\$100/ton). The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Plasma arc gasification violates the basic principles of Zero Waste, utilizes a large amount of input electricity, and is very low on the Highest and Best Use Hierarchy. Given that this technology is inconsistent with the pursuit of Zero Waste, plasma arc gasification is not recommended.

Thermal Conversion - Thermal and Catalytic Depolymerization

The depolymerization, or cracking, process theoretically converts polymers in plastic and other synthetic-fiber compounds of the waste stream into products such as diesel and gasoline. Typical feedstocks mentioned for catalytic depolymerization are waste oils, grease and offal (i.e., processed animal soft tissue). Pressure and heat are used to decompose long chain polymers composed of hydrogen, oxygen and carbon into short chains of petroleum hydrocarbons. This process is somewhat similar to that used at an oil refinery to convert crude oil into usable products.

There are two depolymerization methods that can be used to convert organic materials into fuel: thermal and catalytic. In the thermal depolymerization process, high temperatures (temperature ranges from 1000° to 1400°F) and high pressures are used to crack the large hydrocarbon molecules. The catalytic depolymerization process uses lower temperatures (500° to 700°F) and lower pressures than in the case of thermal depolymerization.

Evaluation and Recommendation. There are no known working models of municipal solid waste fueled depolymerization facilities in the United States, and engineered models offer very high cost per ton, although new small-scale models offer competitive pricing of the resultant products. The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Depolymerization is low on the Highest and Best Use Hierarchy and offers a large impact on released gases into the atmosphere. If the generated gases can be fully captured, and the cost per ton reduced, this technology may be useful in the future. Given that this technology is currently cost-prohibitive and inconsistent with the pursuit of Zero Waste, depolymerization is not recommended.

E.8 Biological/Chemical Conversion Technologies

Biological and chemical conversion technologies are focused on the conversion of organics in Materials Recovery Facility (MRF) residues, and food-scrap processing as well. The MRF residue consists of dry matter and moisture. The dry matter further consists of carbon-based organics and minerals. Biological technologies can only convert biodegradables, while chemical processes can potentially convert any organics and inorganics, including plastics. Types of biological and chemical conversion technologies include anaerobic digestion, aerobic digestion and hydrolysis.

Biochemical Conversion - Anaerobic Digestion

Anaerobic digestion can be considered both a biological conversion technology and a composting technology because it makes use of the compostable residue. As a composting technology processing a source-separated municipal solid waste, the anaerobic digestion facility would qualify as a diversion activity.

In anaerobic digestion, biodegradable material is converted by a series of bacteria groups into methane and carbon dioxide. The typical anaerobic digestion process is one in which the organic matter found in the waste stream is converted in an aqueous environment in the absence of oxygen into a combustible gas.

Potential waste-derived organic feedstocks are municipal solid waste-derived organics, wastewater treatment plant biosolids, manure and food waste. Typically, anaerobic digestion is a two-phase process in which the first phase blends into the second one without a noticeable interruption. These two phases are known as the “acid phase” and the “methane producing phase.”

Anaerobic digestion generates a larger percentage of residue, and therefore has a lower diversion rate than direct composting. The end products of anaerobic digestion are biogas, compost, and a solid or liquid residue. The biogas consists primarily of methane (60 to 70 percent by volume), carbon dioxide (29 to 39 percent), and trace amounts of hydrogen, hydrogen sulfide and other gases.

Evaluation. Anaerobic digestion is a diversion technology that can be utilized for processing food scrap and other organics and is equivalent on the Highest and Best Use Hierarchy to composting. Anaerobic digestion of food waste can be explored as a diversion technology, with the caution that there is high cost of construction for a digester. If an existing wastewater treatment facility has spare digester capacity, it may be more cost efficient to convert an existing digester for food-scrap processing. It is recommended to explore anaerobic digestion if direct composting is not selected as a processing option.

Biochemical Conversion - Aerobic Digestion

The aerobic digestion process applies mainly to food waste, agricultural waste and sewage biosolids. The waste material is homogenized into a slurry, which is mixed with air in a bioreactor. Aerobic microorganisms in this reactor oxidize the easily biodegradable material, just like in an aerobic compost pile, producing substantial heat. The heat and retention time are enough to pasteurize the material, which is processed into several liquid and solid fertilizers. Note that this process differs from anaerobic digestion in that no fuel is produced.

Evaluation. Aerobic digestion as a primary means to process food-scrap, is a low end-use of food scrap and other organics and can often cause water run-off contamination in areas where the resulting material is land-applied. Some studies indicate a high release of methane and carbon dioxide in the land-application phase of this technology. Direct composting of food waste should be explored as a higher end-use than aerobic digestion. Given the high cost of construction for a digester and the environmental hazards, aerobic digestion is not recommended.

Chemical Conversion - Hydrolysis

Hydrolysis is a chemical reaction in which organic matter is converted to glucose or other simple sugars that can then be fermented or digested to produce other products or chemicals. Sugar and starch can be easily fermented to ethanol. Some of the products are conventional fuels (e.g., ethanol), which can be burned in energy conversion devices such as heaters and engines. Materials appropriate for chemical hydrolysis include wood and organic materials derived from municipal solid waste (not able to utilize mixed unsorted MSW).

In processes used to chemically hydrolyze municipal solid waste, an acid or enzyme is employed to break down the complex structures of the cellulosic materials contained in municipal solid waste, (e.g., paper, food waste, and yard waste) into simpler compounds (i.e., primarily sugars). Microorganisms can then easily ferment the sugars under appropriately controlled conditions into ethanol or convert them in an anaerobic digestion system into methane-rich biogas.

Evaluation and Recommendation: There are no known working models of municipal solid waste fueled hydrolysis facilities in the United States, and engineered models offer very high cost per ton. The principle goal of Zero Waste is to divert material away from burying (landfilling) and burning (combustion). Hydrolysis is very low on the Highest and Best Use Hierarchy and offers a large impact on released gases into the atmosphere. Hydrolysis is not recommended, as there are higher end-uses of paper, food scraps and yard trimmings at a lower cost per ton.

E.9 Highest and Best Use Hierarchy

While the proposed technologies are newer forms of managing materials planned for disposal, they are also classified at the bottom of the Highest and Best Use Hierarchy, because they create a market for waste rather than attempt to reduce and recycle the material up front. (The Highest and Best Use Hierarchy is described in detail in Section 7.1 of the Plan) The overall goal of Zero Waste is to strive for no waste burned or buried. These technologies may institutionalize waste, by making waste a “commodity” feedstock for the energy production industry. By contrast, waste reduction, traditional recycling and composting are producing known, current, quantifiable net energy savings and reductions in GHGs, at significantly lower cost and with greater local job creation.

While some of these waste-to-energy technologies may appeal to the goals and values of some communities, they also distract communities from instituting Zero Waste systems that are high on the Highest and Best Use Hierarchy. We recommend focusing on technologies that prioritize recycling and composting over combustion and landfilling. The commitment toward Zero Waste requires careful evaluation of new technologies to ensure that the technology can be ranked high on the Highest and Best Use Hierarchy and with lower GHG impacts.

E.10 Economics of Facility Financing and Implications for Retaining Options and Incentives

As a final note about technologies⁵, we note that high-technology disposal and other facilities that require substantial investment also require funding, usually in the form of bonds. Bonding agencies will nearly always require “put or pay agreements” to guarantee a stream of material, and thus, a secure revenue stream.

Put or pay agreements require certain contracted amounts of tonnage to be brought to a facility (at a fee), or if the material is not brought, the payment is still required. The use of a put or pay agreement assures the material stream has a destination. However, if that facility is a disposal facility, it may severely limit the incentive to try to recycle that tonnage if a new recycling program or diversion technology or incentive becomes available.

Similarly, the put or pay agreement may be at a price that can be beat by either an existing technology, or a technology that is yet to be determined. The incentives to recycle are retained if no “put or pay” agreement is required; otherwise, Metro will need to very carefully identify the amount of material that will never (or not within the required contract term) be suitable for recycling or any other destination than the facility that requires the “put or pay” agreement.

⁵ This section from Skumatz, “Funding and Financing Options for Solid Waste Programs and Technologies”, 2008, updated, Skumatz Economic Research Associates.

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Appendix F

Getting to Goal – Step 1: Diversion to 75%

F.1 Introduction/Background

Nashville is developing a Solid Waste Master Plan (Plan) to achieve Zero Waste (ZW). In addition to substantial data collection (waste composition, surveys, tonnages, status quo gaps) and extensive public / stakeholder engagement work, the CDM Smith team is pursuing a three-pronged effort to develop the Plan to reach this goal:

- **Moving to High Performance:** Implementing a set of tailored, targeted, but mostly enhanced traditional strategies in the residential; commercial, industrial, institutional (ICI);¹ construction and demolition (C&D), and government sectors to achieve diversion levels of about 75% of generation. This extensive portfolio of programs, services, incentives, and policies starts with “low-hanging fruit”, or relatively low cost / high impact strategies – to Metro and to the generators. To move beyond 40% takes more concerted efforts and getting to 75% requires designing strategies that change the playing field for residential, commercial, and C&D generators. The next level of strategies move toward options that tend to include more mandates and strategies that may have somewhat lower impacts individually, and, naturally, increasing costs. This work was conducted by Skumatz Economic Research Associates (SERA), and this work is described in this Appendix.
- **Zero Waste Strategies:** These include a set of advanced, cutting-edge strategies that move beyond the “High Performance” options to achieve the ZW goal of 90% diversion. Although this set of strategies moves the needle beyond 75% by only about 15%, this group of strategies is increasingly complex (and sometimes costly) to implement, because they may involve cooperative agreements among multiple parties, efforts on a “bigger stage” (market development and higher-level legislation), or major changes to traditional waste management infrastructure and policy. This work was conducted by Resource Recycling Systems (RRS). This work is described in Appendix G.
- **Build-Up of Supporting Infrastructure:** Both the High Performance and the ZW strategies move materials dramatically from traditional disposal and landfilling toward various processing and materials management facilities, most importantly: composting facilities, recycling processing, and C&D separation / processing facilities. These represent the third element of the Plan. This portion of the work was conducted by Resource Recycling Systems (RRS) and CDM Smith and is discussed in Appendix H.²

¹ We use the shorthand “commercial” to stand in for “non-residential”, and specifically the ICI / Institutional, Commercial, and Industrial sectors and sometimes government, for convenience, because industrial is commonly linked with commercial, and because reliable tonnage information is not available to further disaggregate tonnage beyond residential / non-residential.

² Landfill and transfer station elements and other assignments not related to the strategies were conducted by CDM Smith and other team members.

In this appendix, we discuss multiple topics:

- Appendix F.2: Tonnage Calculations, including information on total tonnages, estimating the splits by sector and waste stream, and computations of the tonnages available to be diverted.
- Appendix F.3: Existing Programs and Gaps, including a review of basic programs in place in Nashville / Davidson County (summarized from Chapter 2), and suggested gaps in opportunities to recycle and compost
- Appendix F.4: Recommended Strategy Inventory and Description, providing a description of the design, targets, and Metro efforts and budgets needed for a list of strategies developed for reaching 75%.
- Appendix F.5: Performance of the Strategies and Scenarios, including tonnage and cost performance of program phasing and scenario packages. This appendix also summarizes the tonnages remaining to be managed at diversion or disposal facilities and available as targets for additional Zero Waste programs.
- Appendix F.6: Summary of the High Performance strategies that are considered core programs required for Metro to reach 75% diversion.

F.2 Estimation of Tonnages Available to Be Diverted

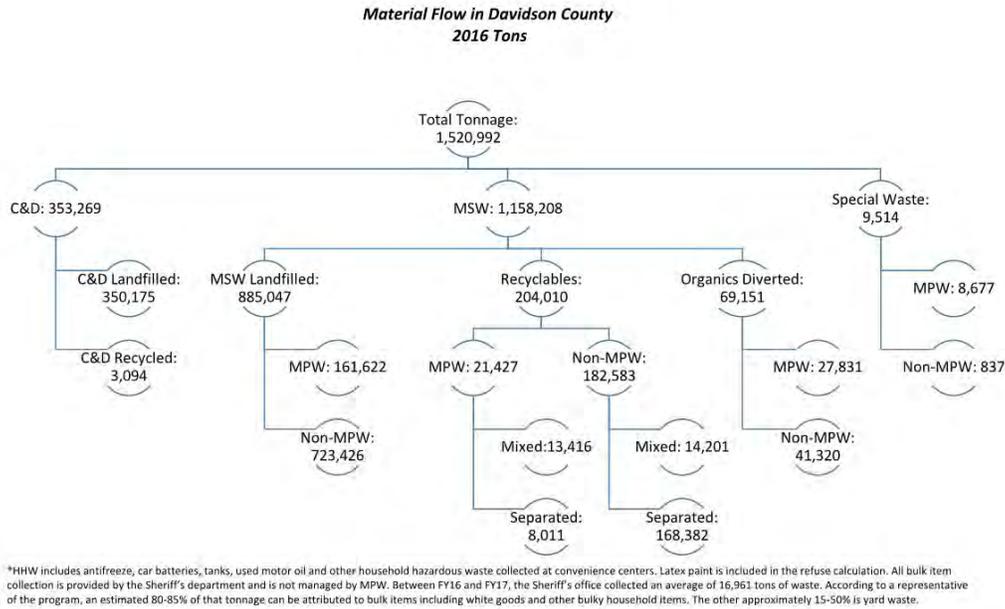
A key step in the modeling work for the Solid Waste Master Plan was to develop estimates of the tonnages that were available to divert for each sector and waste stream. This task was challenging, as tonnage reporting is not mandated, and there are numerous haulers and facilities involved in managing solid waste in the Metro Area. Finally, the boundaries and tonnages associated with the USD and GSD, for which Metro wanted information separately, are not easily associated with census boundaries or service provider boundaries.

Wilmot Inc. was tasked with assembling raw tonnages to the extent possible (**Figure F-1**). CDM Smith conducted waste composition analysis work on the residential and commercial waste streams. SERA conducted work to reallocate the data into tonnages by sector and material to use for the program modeling assignment.

The initial tonnages were only available for the classifications of: Construction and Demolition (C&D); Municipal solid waste (MSW) for Metro Public Works (MPW) tonnages vs. non-MPW tons; and by major material grouping. However, these are not what the generators programs are designed toward. To determine the best integrated plan of strategies required first estimating how much tonnage was being generated and diverted by the various sectors – and how much was being disposed in landfills. The steps outlined below were used to translate very aggregated data into tonnages:

- By sector: residential (single family vs. multi-family) vs. commercial vs. construction and demolition debris.

- By material categories: trash vs. recycling vs. compost vs. C&D.
- By area of the City: USD vs. GSD.



**Figure F-1
Initial Recorded Tonnages**

10

The analytical steps are outlined in **F.7 of this Appendix**, and the flow of steps is described in **Figure F-2** below. The calculations were used to develop the “starting tonnage” values, allocated by sector, material, and area of the city, for 2016.

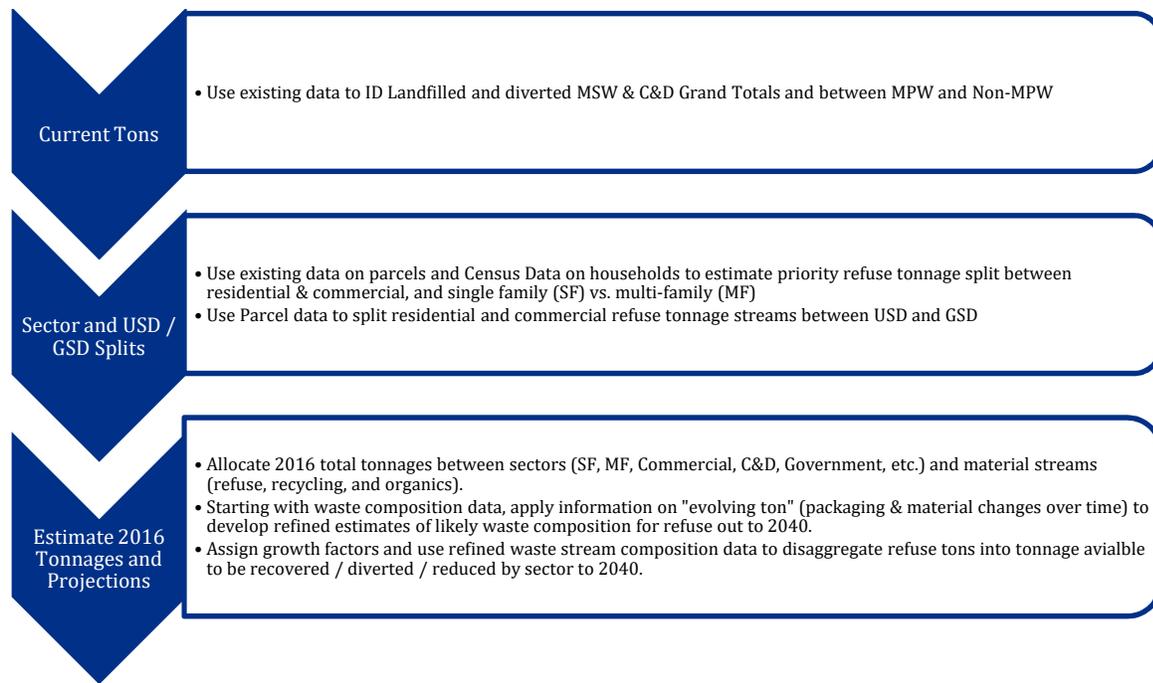


Figure F-2
Steps for Disaggregating Tonnages to Sector, Material, and Area

Several assumptions were necessary in order to allocate the tonnages to sector, material, and region. They are discussed below.

- The assumption was made that 70% of the waste stream is commercial and 30% is residential. This is an unusually high value. Wilmot based this on interviews with the staff conducting the waste sort, based on truck traffic. The most common range is between 60:40 and 40:60. **Table F-1** shows the range from recent research by SERA. The range is from 37% residential to 59% residential (remainder is commercial), and the mean and median are between 51%-52% residential. Metro's 70:30 assumption causes a dependence on success from the strategies in the commercial sector to achieve our desired 75% and zero waste goals – and gives Metro a harder road than many communities that can gain a greater share from easier residential strategies. Note that the previous 10 Year Solid Waste Plan for Metro used percentages of 34% residential and 66% commercial.

Table F-1 Typical Residential/Commercial MSW Disposal Splits

| Disposal | Residential | Commercial |
|------------------|-------------|------------|
| Orange County NC | 37% | 63% |
| CA | 40% | 60% |
| WI | 41% | 59% |
| Santa Fe NM | 45% | 55% |
| Red Deer Canada | 48% | 52% |
| WA | 50% | 50% |
| IL | 51% | 49% |
| San Mateo CA | 53% | 47% |
| IA | 53% | 47% |
| NY | 54% | 46% |
| OR | 62% | 38% |
| CT | 58% | 42% |
| Seattle WA | 59% | 41% |
| Chicago IL | 59% | 41% |
| Simple Average | 51% | 49% |
| Median | 52% | 48% |

Source: USEPA 2013 and SERA web research / database

The data indicate that C&D represents nearly a quarter of the total waste managed. This is a relatively large portion of the waste stream and represents a more challenging sector from which to gain diversion than the traditional residential sector. We assume these figures are fairly certain, however, as this tonnage is tracked directly. Nashville / Davidson County's booming economy is definitely being felt in the waste stream. Comparisons of this percent to a small sample of other communities is provided in **Table F-2**.

Table F-2 Share of C&D as a Percent of Overall Disposed Waste

| Share of C&D of Disposed Waste | |
|--------------------------------|-----|
| Clark County WA | 6% |
| Austin TX | 6% |
| Seattle | 20% |
| Chicago | 44% |

The brush / yard waste diversion is fairly high, and the waste composition discussed in Appendix C of the Plan shows very little additional yard waste available to be captured by programs – even though the existing collection program is periodic and the other option is drop-off. We do understand there is a yard waste ban but are also given to understand that enforcement of bans has typically been underfunded.

These overall tonnages were combined with the waste composition study to provide tonnages by individual materials that would be available for recovery from new solid waste programs, policies, and incentives. **Table F-3** provides a summary of the estimated tonnages used for modeling the recommended programs. The ton computation process is discussed in detail in **Section F.7 of this Appendix**.

Table F-3 Starting Tonnage for Initiating the Modeling Work

| Starting Tons Allocation | 2016 | | | | | | Total Gen | Recycling Rate | Diversion Rate | % of Tot Tons | Percent |
|-----------------------------------|---------|---------|--------|---------|--------|--------|-----------|----------------|----------------|---------------|---------|
| | USD-LF | USD-R | USD-O | GSD-LF | GSD-R | GSD-O | | | | | |
| Estimated Tons | 126,900 | 15,000 | 27,600 | 74,700 | 5,700 | 300 | 250,200 | 8% | 19% | 16% | 21% |
| SF | 80,100 | - | - | 47,100 | - | - | 127,200 | 0% | 0% | 8% | 11% |
| MF | 364,100 | 119,900 | 27,000 | 213,700 | 63,300 | 14,300 | 802,300 | 23% | 28% | 52% | 68% |
| Com'l (all) | 28,500 | 500 | - | - | - | - | 29,000 | 2% | 2% | 2% | |
| CBD (included in Com'l All) | 12,300 | 5,500 | - | 6,800 | 3,000 | - | 27,600 | 31% | 31% | 2% | |
| Conven+Recy Ctr (incl. in Resid) | 14,700 | 500 | - | 12,100 | 200 | - | 27,500 | 3% | 3% | 2% | |
| Gov't (incl. in Com'l) | 225,900 | 2,000 | - | 124,200 | 1,100 | - | 353,200 | 1% | 1% | 23% | |
| C&D | 797,000 | 136,900 | 54,600 | 459,700 | 70,100 | 14,600 | 1,532,900 | 14% | 18% | 100% | |
| Grand Total (excl. Special Waste) | | | | | | | | | | | |
| Percent | 52% | 9% | 4% | 30% | 5% | 1% | 100% | | | | |

USD-O includes brush collection *Totals after distribution among sectors and materials are within about 1% of Tonnage totals for 2016.*

Abbreviations: LF=Landfill; R=Recycling, O=Organics; Gen=Generation

Evolving Ton Computations

Waste composition is not a static thing; what is disposed today reflects today but cannot be counted on to reflect the future “as is”. SERA has been tracking the composition of recycling tonnages for more than 20 years, and we reviewed information available in the literature and from presentations on trends in materials being used in packaging and consumption in the near and longer term.³ We incorporated changes of this type as a refinement in the detailed waste composition work reported in Chapter 3. A description of the directions of the refinements we made follows.

- Plastic has increased more than 55% since the early 1990s, and we assumed it would continue at a similar rate into the future.
- Food has increased 18% since the early 1990s (with recent slowing), but this sector was expected to increase, barring substantial changes in food recovery.⁴
- Metals have been increasing (about 13%), and we estimated a modest upward trend
- Paper has fallen substantially since the early 1990s, decreasing by 21%, and we projected a declining trend into the future.
- Glass use has fallen substantially (decreasing 30%) and we project a continuing decline
- Other materials were assumed not to change, and the changes were re-normalized to waste compositions that added to 100% for each of the outlying years.

Computing Tonnage Available to be Recovered / Reduced

To compute our estimates of the “available tons” in any particular year for any particular segment or waste stream, the following computations were made.

- Waste stream elements from the 2016 starting point.
- Apply growth factors to the individual refuse components based on expected growth in five-year periods to estimate total tonnage disposed for each sector and USD/GSD refuse

³ SERA data and research

⁴ Note that a food recovery program is included in the Zero Waste strategies outlined in Chapter 7.

category (per guidance from the NashvilleNext Plan, we assumed 1% growth individual categories throughout the period to 2040).

- Apply the revised waste composition percentages (after “evolving waste ton” adjustments) for each sector’s refuse tonnage, and aggregate into the target program streams to estimate the available tonnage by program target (e.g. “residential recycling mix”, “single family yard and food waste”, commercial food, etc.). These tons were computed for any modeling year from 2018-2045.

Figure F-3 shows the main components of the disposal stream.

F.3 Review of Existing Metro Programs and Gaps for High Performance

Appendix B of the Plan provided a detailed summary of the status quo collection, program diversion, disposal, and MSW and C&D system in the Metro area. The main diversion opportunities currently in place in Metro include the following.

Residential Sector: Single family households that are served by MPW receive curbside recycling as part of their taxes; individual households serviced by one of multiple private haulers may subscribe to recycling service for an additional fee. Currently only about 20% do so. Households throughout the region may drop-off recyclables and yard waste at a series of drop-off recycling centers (no yard waste) or convenience / recycling centers. Little or no curbside organics collection is available. Bulky item and brush collection, on an appointment basis, is provided by the Sheriff’s office. Household Hazardous Waste and electronics are accepted at two convenience centers. For virtually all households, trash service is provided in large 96-gallon containers (MPW and many haulers) or in other containers (other haulers). Trash service is not required for all households. Price incentives to reduce trash are not available for either single- or multi-family households. There is minimal recycling occurring at multifamily buildings, and apartment dwellers wishing to recycle mostly likely use the recycling drop-offs and convenience centers.

Commercial Sector: Commercial recycling efforts are market-driven, and based on the tonnage data available, are substantial. However, given Metro’s high proportion of commercial tonnage relative to residential tonnage, progress toward 75% will require additional incentives and programs in this sector.

C&D Sector: Some builders are undertaking pilot efforts to divert C&D, and market incentives commonly encourage the diversion of metals in the construction industry. Tracked C&D diversion efforts are small, with just 1% recycled.

Other: Government facilities have recycling available, but there is room to expand, as the recycling rate is currently less than 10% (Table F-3). Public space recycling programs are unavailable in the majority of US communities, and currently, there is not a substantial public space recycling program in Metro’s parks and outdoor venues.

Gaps: There are multiple opportunities for greater access to recycling in the community’s current solid waste management system. The target streams – based on the distribution of tons that are available for capture by key stream – are provided in Figure F-3 below. These are

computed using the disposal tons by sector, and the waste characterization data from Appendix C of the Plan. The tonnage analysis identifies several streams should be especially targeted for recycling, composting, and reduction. These include:

- Commercial (com'l) recycling and food scraps (32% of available materials).
- Construction and Demolition (C&D) Debris (44% overall).
- Residential (single family [SF] and multi-family [MF]) recycling and food scraps (21%).

Note that yard waste (YW) was only a small component of the waste characterization study and is only a small share in Figure F-3. Also note that “C&D” below (33% of the total) denotes C&D waste that was sent to a C&D landfill whereas “C&D from Res/Com'l” (11% of the total) denotes C&D waste that was sent to a MSW landfill.

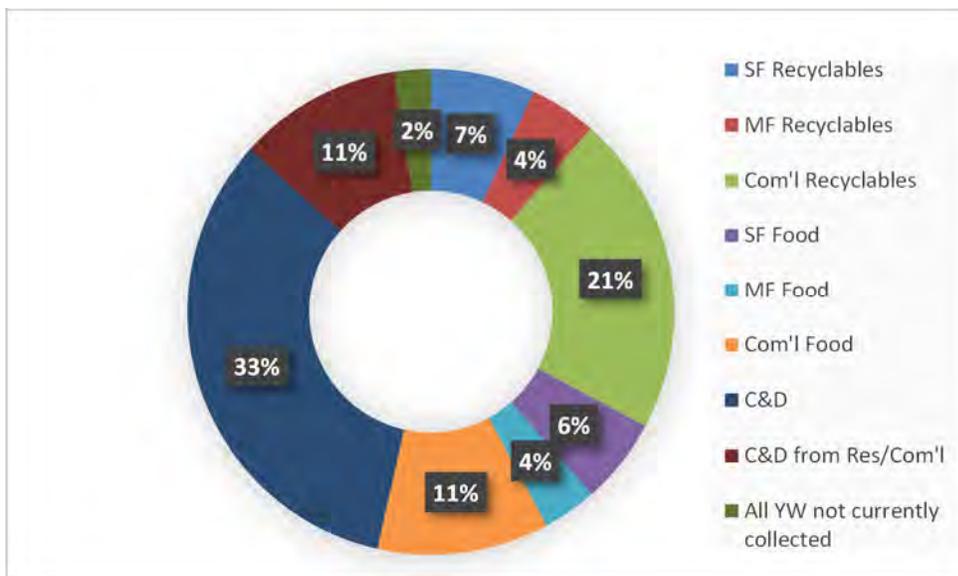


Figure F-3
Share of Key Tonnages Available for Diversion from Landfilling

F.4 Recommended Strategy Descriptions and Inventory – High Performance

This appendix provides an inventory of all the candidate strategies developed to move Metro to diverting 75% of the MSW and C&D. This set of programs focuses on enhanced traditional strategies in the residential, commercial, C&D, and government sectors to achieve diversion.

Portfolios of basic programs, services, incentives, and policies can move communities to about 40%, but this enhanced list brings in a core list of five strategies that are responsible for most of the progress toward 75%.

The philosophy used to develop the list of strategies for Metro included:

- **Providing opportunities to recycle for all types of generators.** In order to achieve high percentages of diversion in Metro, the Plan requires that the residential and commercial sector be addressed to divert MSW. Strategies must also address the high tonnages derived in the C&D sector.
- **Creating strategies that diversify responsibility.** Focusing the responsibility for delivering programs on one sector – like the haulers – is a less robust system than one that diversifies responsibilities. In the package, some rely on haulers (ordinance-based requirements for service), others rely on pricing incentives (surcharges administered at facilities), others rely on Metro (enforcement of bans and mandates), and still others rely on behavior change by generators (education to motivate waste reduction). All are involved, making waste change a universal message, and leveraging changes, rather than becoming a focus of only a small number of actors.

Reflecting industry best practice. The portfolio of strategies for “High Performance” programs reflects those programs, incentives, and policies that have been implemented and performed well in other communities elsewhere in North America. The program portfolio includes innovative and cutting-edge strategies, but also core programs that can be relied on. They represent the best, but also have been explored and can be expected to perform well. Some strategies are “tried and true” programs; for example, Save As You Throw programs are in place in more than 10,000 communities nationwide and cover on the order of 20-25% of the population nationwide.⁵ SAYT has been a core strategy for thousands of strong performing communities across North America for more than 35 years, and has also been adopted by virtually all communities with Zero Waste Goals. Bans and mandates are among the most clear, effective, and cost-effective strategies available; research indicates⁶ these programs deliver 11-30 times more tons for the same cost, and change the mindset and waste “framework”, structure, and expectations in the system. Education can motivate change and is the glue for explaining new programs and motivating changes in behavior. Other programs are clearly designed to provide effective strategies focused on key waste stream, including options designed for food and construction streams. Innovative programs include the introduction of SAYT in the commercial sector – which is the lynchpin in moving recycling forward in this sector because it eliminates the historic barrier that trash plus recycling is no longer more expensive to businesses than trash service alone. This program is in place in some, but relatively few, communities in the US, but is a vital strategy for a community like Nashville that has a 70% / 30% tonnage split for commercial / residential tonnage.⁷

⁵ Skumatz, “Pay as you throw in the US: Implementation, impacts, and experience”, *Waste Management, Elsevier Journals*, 28(12): 2778-85, November 2008; Skumatz, et. al., “PAYT / Variable Rates for Trash Collection: 2014 Update”, *Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO for US EPA Region 9, 2015. Includes Frequently Asked Questions.*

⁶ Skumatz et. al., 2014, “Residential and Commercial Strategies for SWMCB”, Skumatz Economic Research Associates.

⁷ In some cases, we omitted one program in favor of another. A three-bin program has a strong track record for the residential and commercial sector. Wet-dry systems have been tried but have morphed into a system barely distinguishable from three bin – even the Guelph system now uses a third bin. The philosophy may differ, but the delivery of the program is not dramatically different. This and other omitted programs were discussed in Chapter 5.

- **Incorporate previous Metro Nashville Work and Principles.** In addition to consulting our databases of programs, programs in leading communities, and previous research, we also reviewed previous work prepared for Nashville / Davidson County. The recommended strategies reflect and address priorities consistent with Nashville’s Strategic Work including Mayor Barry’s Livable Nashville Committee, NashvilleNext, the Tennessee Department of Environment & Conservation’s 2025 Material Management Plan, the State of Tennessee requirements for 10 Year Solid Waste Plans, and Mayor Dean’s Green Ribbon Committee recommendations. Specifically:
 - **Composting Food- Commercial:** These recommendations correspond to NashvilleNext in NR 3.1 of the Natural Resource Action Plan that address food waste recycling programs for large producers and aligns with TDEC SWMP Objective 4, Increase Diversion of Organics
 - **SAYT:** This program is included in NashvilleNext which suggests a PAYT / weight-based system as a Mid-term goal. Our SAYT program, residential franchise, and expanded convenience center recommendations work towards TDEC SWMP Objective 2, Increase Recycling Access and Participation, and the Livable Nashville strategy to leverage Metro’s administration of solid waste programs by “restructuring incentives to encourage reduction of solid waste and “investigate usage-fee options”.
 - **Bans:** Our recommendations on bans reinforce the recommendation from NashvilleNext to focus on certain materials for diversion.
 - **Education:** Our recommendation for outreach fulfills Objective 6: Expand and Focus Education and Outreach from TDEC SWMP
 - **Landfill Surcharge:** Our landfill surcharge strategy and overall recommendation of sustainable funding addresses Objective 8: Develop Sustainable Funding Sources for Sustainable Materials Management from TDEC SWMP
 - **Increase Residential Recycling:** These recommendations to expand urban and general district services to increase residential and multifamily recycling will help achieve the targets and align with the goals from the Livable Nashville strategies.
 - **C&D:** Our C&D program recommendations are ways Metro can address the goal from The Waste Reduction and Recycling Subcommittee in Livable Nashville to “Reduce Construction and Demolition Waste”.
 - **Food Waste:** Our recommendations align and support the Nashville Food Waste Initiative and the goal set out in Livable Nashville to adopt the FDA national food waste reduction goal.

F.4.1 The Highest Priority and “Big Bang” Strategies, and Modeling of Scenarios and Phasing

To set the stage for moving forward, Metro needs to first implement two essential first-steps. Without this framework, Metro will not have the authority to implement and enforce the new

programs and will not be able to monitor progress or determine if goals have been met. Metro will need the following:

- **Planning and Funding Authority:** The service, oversight, planning, enforcement, and funding authority to move the system forward is critical to the success of nearly all the programs in the High Performing and Zero Waste strategies. Options for this authority are discussed below in Strategy S2.
- **Tracking System:** An effective tonnage and program data collection system is essential for monitoring program performance and the progress toward zero waste. We provide recommended options and describe this recommendation below in Strategy S1 below.

The importance of these two steps cannot be overemphasized. Without that fundamental change, progress toward High Performance and Zero Waste will not be possible. The strategies needed to reach ZW require enforceable authority over services provided by and to a variety of stakeholders and generators. These programs are the first two strategies presented in the inventory in Appendix F.4.1.

The other core “High Performance” strategies that are “Big Bangs” in terms of tonnage diversion are:

- **SAYT and 3-Bin Service for Commercial with associated Food Scraps Ban:** The largest barrier to recycling in the commercial sector is the fact that trash plus recycling costs more than trash alone, harming the business case for recycling. This strategy changes the economics and brings the service and incentives in line with those from SAYT programs on the Residential side. Recycling and, if wanted, food scraps collection service is provided to all businesses, and the cost is not broken out separately, but is embedded into the trash bill. Metro passes an ordinance requiring all haulers providing service to commercial businesses must provide recycling service at a specific ratio of the weekly volume as trash (and a minimum of 96 gallons). To reach 50% recycling in the commercial sector, this container ratio is “equal to” trash volume. To achieve 75% recycling in the commercial sector alone, the volume ratio would need to be more than twice as large for recycling as for trash (twice as large would result in a 66% recycling rate).⁸ An associated food scraps ban further drives participation and diversion. Metro does not currently have a food scraps ban, and legislation would be required to establish one. Further discussion on the implementation of a food scraps ban is included in Appendix L.
- **SAYT and 3-Bin Service for Residents with associated Food Scraps Ban:** Region-wide Trash, Recycling and Yard/Food Waste service with Save As You Throw (SAYT) Incentive Rates and Embedded Program Fees is a core program in the High Performance portfolio.

⁸ Ordinance-mandated ratios for price differentials for trash service pricing may also be needed if program doesn’t achieve goals. For more on Commercial SAYT see Skumatz, et. al., “PAYT / Variable Rates for Trash Collection: 2014 Update”, *Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO for US EPA Region 9, 2015 and Skumatz and D’Souza, “Commercial Recycling, Incentives, and Innovations: Effective and Creative Programs and Collection Changes”, Proceedings of the Global Waste Management Symposium, Phoenix, September 2012.*

Each household receives a large bin for recycling, a large bin for diverting yard waste and food scraps, and a bin for trash, with the selection of size decided by households. Smaller trash bins cost less than larger trash bins, and the price incentive is sufficient to encourage many households to recycle, compost, and source reduce more.⁹ To be most effective and cost effective, the recommended program optimizes stops – providing every other week (EOW) recycling, not weekly, and not monthly service.¹⁰ The recommended optimal medium-to-long-run program includes weekly organics¹¹ (yard and food) collection, accompanied by EOW recycling alternating with EOW trash collection.¹² An associated food scraps ban¹³ further drives participation and diversion. The costs for the recycling and composting programs are recovered through the trash rates, so trash plus recycling is not

⁹ Based on SERA's published statistical work (Skumatz and Freeman, "Pay As You Throw (PAYT) in the US: 2006 Update and Analyses", 12/2006, Prepared for US EPA OSW and SERA, Superior, CO, <https://archive.epa.gov/wastes/conservation/tools/payt/web/pdf/sera06.pdf>), this incentive should be 50%-80% more costly for the 2nd can (twice the service) as the 30 gallon container, and that same dollar differential for each additional 30 gallons. Higher incentives can certainly be provided, but 50% is the minimum that the statistical analysis shows changes behavior, and 80% achieves nearly as strong a recycling amount as programs charging 100% more (double, or "a can is a can"), and results in somewhat less revenue risk than 80% premium levels. Mature programs may elect to charge more as risks are better known. Mini- and micro-cans may make sense as the recycling and organics programs mature. Illegal dumping and other effects are also discussed in Skumatz and Freeman, "Illegal Dumping and Pay As You Throw: Should You Be Worried?", Recycle Florida Newsletter, December 2010.

¹⁰ Detailed statistical research shows that every other week (EOW) recycling delivers only 1-3 percentage points less tonnage but decreases the cost of collection by 40%. This means that these last 1-3 percentage cost almost as much as the first 10-15 percentage points that a curbside program delivers. It would be half the cost (because half the visits and staffing) except the majority of tons is retained, the container is still purchased, and administrative costs remain. These last 1-3 percentage points are very expensive marginal tons. Given that the cost of "getting the truck to the door" – is commonly 80% or more of the cost of service – regardless of what material is collected. Therefore, it is far more effective to use that "stop" to collect an entirely new material stream (organics) that can potentially divert 20% or more, than waste the stop on 1-3 percentage points. Weekly organics collection is effective at removing putrescibles on a weekly basis. Coupled with EOW trash, it tends to help drive the organics out of the less-frequently-collected trash into the more-frequently collected / convenient organics bin. This set of analytical results represent the underpinnings of our recommendation for the residential sector. The source for this statistical research is Skumatz, "Nationwide Diversion Rate Study: Quantitative Effects of Program Choices on Recycling and Green Waste Diversion", prepared for Reason Foundation and others, Los Angeles, CA, 1996 (<https://reason.org/policy-study/nationwide-diversion-rate-stud/>) and additional corroborating SERA statistical analyses through 2015. See also Skumatz, "Every Other Week for Everything", Resource Recycling, 11/2013 and Skumatz "Alternating Weeks: options and opportunities for garbage and recycling. Can every other week provide greater efficiencies and incentives for the future?", Resource Recycling, September 2007.

¹¹ Skumatz, "National Overview: Food Scraps Programs in the United States", Biocycle, July 2011 and "Overcoming Barriers: Accelerating Implementation of Food Scraps Programs", Biocycle, August 2011.

¹² This system optimizes the materials diverted and recovered from two collections per household per week, with a system that works successfully in other communities. In the near term, Metro is expected to phase the program in, maintaining weekly trash until the food scraps collection program and its underlying infrastructure can be fully implemented.

¹³ Augmenting the yard waste ban already on the books.

more expensive than trash alone.¹⁴ Providing convenient opportunities for every household to have recyclables and organics (yard and food scraps) to be collected, along with a supporting price incentive to encourage participation is the most effective and cost-effective strategy for moving toward 75%. with a supporting price incentive to encourage participation is the most effective and cost-effective strategy for moving toward 75%.

- **Contracted Collection in the Residential and Commercial Sectors:** Two additional strategies include introducing contracts for collection in the residential, and later commercial, sectors. These strategies increase diverted tonnages by providing unified collection, outreach, enforcement, and service, at greater economies of scale, and potential cost economies. This strategy reduces the routing of multiple haulers operating on the same streets, reducing inefficiencies and emissions.
- **Enforcement of Existing Bans and Food Scraps Ban:** Access and price incentives (the SAYT options above) provide a strong motivation for diversion. However, those types of programs usually achieve diversion levels of 40-50%. Bans (and/or mandates) can provide the motivation not just to recycle, but to recycle better or more thoroughly, and these strategies are needed to move toward 75%. Most fortunately, Metro already has some bans on the books (specifically yard waste, cardboard, and electronic waste), and getting a ban passed can be the hardest part of the program. For those materials, the program provides budget for an enforcement program for both the residential and commercial sector; Metro Public Works staffing levels are too low to enforce existing bans, and an unenforced ban is not effective.¹⁵ As mentioned above, we also introduce a very important food scraps ban, as this material represents the largest single item remaining in the waste stream. Compliance with this new ban is also enforced using the same staff.
- **Incentive Pricing of Waste Streams at Facilities:** In this program, enhanced surcharges are placed on disposed tonnage at all landfills and transfer stations, and reductions in taxes or fees (or incentive pricing) used for recycling and organics. This changes the apparent economics of recycling, and, when large enough, changes institutional, commercial, and industrial (ICI) sector decision-making regarding diversion, particularly affecting large and small self-haul customers who may not be easily included in the commercial SAYT program.¹⁶
- **C&D Deposit System:** The very high tonnages of C&D generated by Nashville’s booming on-going development represent a priority waste stream – especially since it is either captured during construction / demolition, or the opportunity is lost forever. The most

¹⁴ The program should allow those customers that need more than one recycling bin to have one (recommended collection frequency is every other week). That unlimited service is not expected for yard waste service; one large bin, weekly is the expected service.

¹⁵ Lack of enforcement also leads to an uneven playing field; those who comply with the ban often experience higher costs or inconvenience and are left at a disadvantage relative to non-complying competitors. Enforcement levels the playing field.

¹⁶ See Skumatz et. al., “The Costs and Benefits of Minnesota K-12 School Waste Management Programs”, prepared for MCPA, State of Minnesota, July 2014, <https://www.pca.state.mn.us/sites/default/files/p-p2s6-15.pdf>.

effective programs in place nationally are deposit programs. Developers filing for a construction or demolition permit are required to leave a financial deposit that can be reclaimed if they provide documentation that they recycled or reused a threshold amount of the material generated on-site. Most communities have established a 50% goal; reaching 75% in Nashville/Metro in the combined MSW and C&D sectors is not mathematically possible without a higher goal for C&D because this sector represents 25-30% of the waste stream. However, handling that much C&D material effectively and efficiently requires a special new processing facility. Until that can be developed (and it is among the highest priority facilities), a series of other C&D programs are put in place right away, starting with a requirement for recycling bins with trash service at all sites, and submittal of waste management plans (pre and post project).¹⁷ An associated C&D ban can help support the deposit system. Metro already implements Leadership in Energy and Environmental Design (LEED)-informed guidelines, specifically requiring LEED certification Metro construction projects. When possible, LEED certification includes recycling and reuse of materials.

These core strategies may be a “heavy lift” because they require fundamental change to the existing solid waste management system, and forays into the commercial and C&D sectors. However, without fundamental change in services, incentives, and enforcement, Nashville can expect only minor changes to Metro’s existing 18%-19% diversion rate.

These core High Performance Strategies do not quite achieve the 75% goal on their own, and we developed a number of additional strategies to:

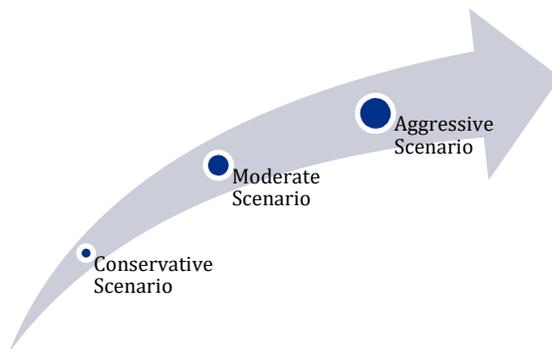
- Provide tailored recycling and diversion opportunities for specific customer subgroups.
- Build on successes in existing programs.
- Provide opportunities that deliver additional tonnage.
- Publicly build expectations that recycling is expected.
- Deliver strategies that are more conservative politically.

As a consequence, this Appendix describes a list of nearly four dozen strategies that were included in SERA’s WDAM (Waste Diversion Assessment Model). In particular, the 75% High Performance goal cannot be met without adding new materials including textiles (representing 5-6% of disposal), glass (representing 4-5% of disposal) and high capture of traditional recyclables (hence the use and enforcement of bans and Metro-wide programs).

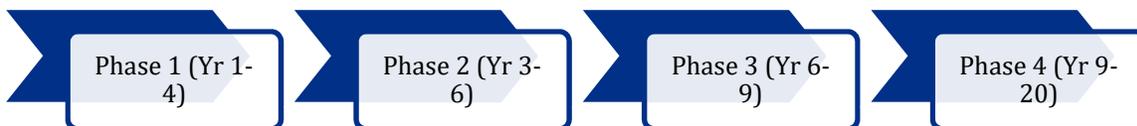
We recognize two factors that affect our modeling – timing of strategy roll-out, and “aggressiveness” of the strategies included in a portfolio. We present results for three portfolios and four phases in our modeling and the results are presented in Appendices F.4 and F.5.

¹⁷ Note that the modeling work captures C&D from three sources: the C&D material currently being landfilled in C&D landfills, and those (smaller) portions from the commercial and residential streams that were identified as C&D in the waste sort.

Scenarios or Portfolios: SERA’s modeling approach also allows the team to recognize that achieving political support, authority, or funding for some strategies may be difficult. We crafted three portfolios or scenarios – an “aggressive” portfolio that can achieve 75% includes nearly all of the strategies described in **Tables F-4 and F-5**. We also crafted two additional portfolios or scenarios for Metro – a “moderate” and “conservative” strategy. Each of these scenarios omits subsets of specific programs that tend to be more difficult to implement, or that encroach on the commercial sector (strategies that can be harder to get passed). However, note that each of these scenarios results in Metro falling far short of 75% from the High Achieving List, and also far short of its Zero Waste goal. The Plan focuses on a discussion of the costs of all strategies, and therefore, the “Aggressive” scenario. Costs for the other scenarios are easily calculated by omitting specific programs.



Phasing: Not all strategies can be implemented overnight; some need facilities that have not yet been developed, others require cooperative agreements among governmental agencies, others may require political will or other groundwork that takes time, and some are better implemented after some basic programs are already in place. SERA’s modeling work assigned a “Phase” (Phase 1-4) to each program, based on our assessment of the most realistic timeline for implementing the strategies. This is noted in Table F-5 and in the descriptions of the programs included in **Section F.8 of this Appendix**. Phase 1 is assumed to run from Year 1-Year 4; Phases 2-4 run from Year 3-6, 6-9, and 9-20 respectively. Overlap between Phases is expected in this system of continual improvement, but each phase brings on a new set of activities to implement.



Conservative Scenario

Conservative / Phase 1: The strategies listed in the Conservative Portfolio / Scenario, Phase 1 are either vital to progress moving forward, or include elements that do not significantly disrupt a sector, or are visible elements signaling a change in the focus on recycling is desired in the Metro area. Those that are vital to progress include the two base programs (S1 and S2) that are needed as underpinnings of all the programs. Strategies that are relatively straightforward to implement

(assuming adequate Metro funding) include enforcement of existing bans, requiring recycling containers at construction sites, and Metro further enhances their contracting scoring procedures to prefer bids with recycling and composting. Those that are visible, not technically difficult, and signal a visible and involving change in the system include new three-bin Residential SAYT system with a food ban, visible small business and schools policies, and an education push (that continues over several phases) for the public and commercial sectors. The SAYT program is not technically difficult (it is, in large part, simply a different way of billing), and is in place in more than 10,000 communities nationwide¹⁸SAYT lays the foundation for other residential programs, as this program provides the bins and collection for both Metro-wide recycling and organics and is the base upon which the other residential strategies depend for collection and incentive foundations.

Conservative / Phase 2: The additional conservative strategies that are not easily introduced in Phase 1 because of funding, facility access, or other timing issues include: greater enforcement of food waste bans (after adequate facilities are built), introducing EOW residential trash collection (as an additional incentive after the basic SAYT system has become familiar), adding a fee or ban for single use bags (visible, and reduces down time at MRFs as recycling picks up)¹⁹, and adding textiles to the residential recycling program to bring additional tons to the program and “energize” additional recycling.

Conservative / Phase 3 or 4: Providing additional incentives to the residential sector will continue diversion progress and keep the SAYT program from becoming stale.

Moderate Scenario

Moderate / Phase 1: No moderate programs are identified for Phase 1; the bulk of the early programs are needed to set the groundwork for all strategies and are included in the conservative bundle.

Moderate / Phase 2: Moderate programs include strategies that need construction beyond those planned under the “facilities” planning that is needed to accommodate the anticipated increase in recycling, organics, and C&D diversion that is expected from the array of strategies recommended. The construction that is needed for one or two additional convenience centers is an example of construction that can wait for Phase 2. In other cases, the programs require greater “set up” either in facilities or administrative set up (specifically, the C&D deposit program) or follow on to other programs as a “next stage”, for example adding bans on top of the opportunity to recycle materials provided in earlier phases (textile and other bans). We anticipate that the C&D deposit program will start in this phase, but will phase in over time, starting with the biggest projects and growing to include the majority of project sizes with higher goals established over time. The contribution of the C&D program is vital to obtaining substantial progress and is a program that is in place in many communities around the nation.

¹⁸ Skumatz, et. al., “PAYT / Variable Rates for Trash Collection: 2014 Update”, Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO for EPA Region 9, 2015

¹⁹ furthermore it is not worth sidelining critical Phase 1 progress for what is sometimes a political battle that adds few tons

With the necessary processing infrastructure, it is a tested and successful program in California, Texas, Florida, and other locations.

No Moderate programs are scheduled for Phases 3 or 4; conservative ones are implemented as planned.

Aggressive Scenario

Aggressive / Phase 1: The aggressive portfolio includes programs that venture into the commercial sector in a more aggressive manner or are more complicated to address. In Phase 1, landscapers are required to bring materials to a certified compost facility – a strategy that can be considered a partner to enforcing the existing yard waste ban (conservative strategy), but possibly with more complexities.

Aggressive / Phase 2: Potentially adding diapers (an increasing waste material) to composting may need additional study and is not a widespread practice at this time. It is included in Phase 2, allowing time for facilities to come up to speed and research to be conducted.

Aggressive / Phase 3 and 4: These are critical programs and are only delayed to Year 6 and beyond because they require planning and set up, depend on political agreements, or because Metro's plate will be fairly full with other programs in earlier phases. However, to the extent that the critical focus program of Commercial SAYT can potentially be moved to earlier years (Phase 2), Metro's diversion will increase dramatically, and the base for progress in the commercial sector is set – recycling and organics collection added for all, and trash plus recycling is not more expensive than trash alone. Both commercial SAYT and enhanced collection, as well as a potential contract system for residential collection (and potentially commercial collection) will require working with multiple haulers of many sizes and requires special "notice" of Metro intervention in the market and other research. These interventions in the commercial sector are less commonly implemented in communities around the country but are in place around the nation with demonstrated positive track records, and the diversion potential is essential to Metro's goal of reaching Zero Waste. Additional programs in the Aggressive portfolio include more aggressive residential incentives (to keep earlier SAYT program incentives from becoming stale) allowing EOW trash collection for the commercial sector (after the organics program is mature), and the broader roll-out of the best from among the MF pilots explored in the Moderate programs in Phase 2. Adding glass is only delayed to this phase because the best capture of significant new materials may require specialized processing or even better, local end users.²⁰ Utilization of the ABC law to drive diversion at businesses that serve liquor would require implementation at the state level; however, on the local level the Metropolitan Beer Permit Board Rules and Regulations could be updated to require businesses with beer permits to have a recSyling program. Incentive surcharges (substantial landfill tip fee surcharges and reductions of taxes or fees on recycling / compost) can provide powerful market incentives to change behaviors and can affect the self-haul

²⁰ Beyond the existing program for glass from honkytonks, and the three others recommended that include glass: convenience center bunkers for glass, ABC law with the Commercial SAYT, requiring certain commercial establishments to have and use a recycling program for all beverage containers or risk revocation of their beer license, and container bans. If the new MRFs built can handle glass well, the curbside programs should immediately incorporate glass; these are significant tons.

commercial businesses that may not be affected by some of the other programs. These may take negotiations or authorities to implement and are placed in Phase 3 or 4 for this reason.

Zero Waste programs: All of the Zero Waste (ZW) strategies except Economic Development and strongly enhanced education are rolled out in Phase 1; these two are Phase 2 recommendations. More information about the ZW programs is provided in **Appendix G**.

Over 40 individual strategies are proposed here, varying in duration and level of effort. These individual strategies have been condensed into 15 High Performance (HP) strategy groups, as discussed in Section 6 of the Executive Summary. Table F-4 shows the correlation between the HP strategies discussed in the Executive Summary and the individual strategies discussed in this Appendix. Note that some of the individual strategies are attributed more than one HP strategy, based on the specific nature of those strategies. For the following analyses in this Appendix, the strategies are considered individually rather than in their HP groups.

Table F-5 illustrates the individual strategies, sorted by phase and scenario. **Table F-6** specifically includes:

- Titles of the strategies, and codes calling out key elements of each High Performing Strategy²¹, including the material / sector streams targeted by the strategy; and
- The estimated tonnage (and percent) diverted for each program recommended for the Solid Waste Management Plan. The tonnages are presented for Year 9 of the Plan implementation, assuming full implementation of the programs implemented in Phases 1, 2, 3, and 4.

Table F-6 includes estimates of the tonnage impacts for all programs included in the Aggressive Scenario (which also includes all strategies in the conservative and moderate scenarios). The totals at the bottom indicate that all strategies, through Phase 4, are necessary to move Metro from its current diversion rate, to a level close to or achieving **High Performance – 75% diversion**.

From the data from Table F-6 we find that the strategies increase diversion by almost 60% to move from about 19% to about 75% diversion. Furthermore, it shows that a subset of the core programs (discussed in more detail in Appendix I) – Strategies #3 (Residential SAYT-“plus”), #7 (Commercial SAYT “plus”), #12 (C&D Deposit Program), and #38 (Contracted commercial collection) – account for about 39% of the additional diversion or 64% of the incremental high-performing diversion.

The impacts of the Three Scenario and the phasing are shown graphically below in **Figures F-4 and F-5**. A detailed inventory of each of the individual Strategies from Table F-5 is provided in **Section F.8 of this Appendix**. The descriptions outline the basic strategy design, materials targeted, Metro’s role in enabling the strategy, budget needs, and funding sources.

²¹ In order to keep the Appendix as succinct as possible, the descriptions include sources for more information on the strategy.

Tables of detailed annual Metro costs for the strategies and the supporting design and implementation assistance are provided in **Section F.9 of this Appendix**.

Table F-4 High Performance Strategy Groups and Individual Strategies

| High Performance Strategy Group | Individual Strategies |
|---|--|
| HP1 Planning and Funding Authority and Tracking System | S1 Tracking, Goals, and Measurement S2 Obtain Needed Planning, Service, Enforcement, and Funding Authorities |
| HP2 SAYT Collection for Residential Sector | S3 Residential SAYT & 3-Stream Package S23 More Aggressive Residential Diversion Strategies |
| HP3 SAYT Collection for Commercial Sector with Supporting Laws and Strategies | S7 Commercial SAYT and ABC Law (adapted), Supporting Bans, and Enforcement S19 Small Business and Schools Policies / Programs and Space for Recycling Ordinance for MF and Commercial S39 EOW Trash Collection Allowed for Commercial |
| HP4 Enforcement of Mandates and Bans | S4-5 Enforce Food Waste Ban – Residential and Commercial S8-9 Enforce Existing Bans – Residential and Commercial S29-30 Containers Ban – Residential and Commercial S31-32 Paper Ban – Residential and Commercial S33-34 Fee for Single Use Bags (or Ban) – Residential and Commercial |
| HP5 Education | S21 Public Education/Outreach (including Businesses) |
| HP6 Support for Compost Made from Yard Waste and Food Scraps | S11 C&D and Compost – Require/Reward Recycling and Reuse of C&D and Use of Local Compost in Metro Contracts and Jobs S41 Landscapers must bring Compostables to Composting Site S42b Change Building Codes to Require Soil Amendment using Local Compost |
| HP7 Enhanced Public Space Recycling | S20 Public Space Recycling |
| HP8 C&D Waste Diversion | S10 Require Recycling Containers with all C&D Trash Service S11 C&D and Compost – Require/Reward Recycling and Reuse of C&D and Use of Local Compost in Metro Contracts and Jobs |
| HP9 Improved Access to Convenience Sites | S15 Convenience Center – Minimum Requirements for Access and Services |
| HP10 Multifamily Strategies | S19 Small Business and Schools Policies / Programs and Space for Recycling Ordinance for MF and Commercial S24 MF Pilots S40 Implement / Roll-out Multifamily Program / Strategy |
| HP11 and HP15 Contracted Franchise Zone Collections | S18 Residential Contracts / Franchises S38 Contracted Commercial Collection |
| HP12 Adding New Materials to the Curbside Program | S25-28, 36-37 Add – then ban – Additional Materials to Residential and Commercial Collection Programs S35 Add Diapers to Organics Program |
| HP13 Incentive Pricing | S6 Allow/Incentivize and Eventually Require Every Other Week Trash Collection at Lower Cost S16-17 Enhanced Incentives for Clean Separated Streams and Diversion at Transfer Stations and Disposal Sites S22 SAYT Higher Incentives and Smaller Service Levels |
| HP14 C&D Waste Recycling Deposit System | S12-14 Require C&D Deposit System |

Table F-5 Programs by Portfolio/Scenario and Phase

| | Conservative Portfolio / Scenario | Add for Moderate Portfolio / Scenario | Add for Aggressive Portfolio / Scenario | ZW Portfolio |
|---------------------|--|---------------------------------------|---|---|
| Phase 1 (Years 1-4) | <p>S1. Tracking, Goals, Measurement PRR</p> <p>S2. Pass Legislation for Authority</p> <p>S3. Residential SAYT with 3-Stream and Food Waste Ban</p> <p>S8. Enforce Existing Bans-Res</p> <p>S9. Enforce Existing Bans-Com'l</p> <p>S10. C&D - Require Recy. Containers and reporting</p> <p>S11. C&D and Compost – Metro Requirements or Preferences</p> <p>S19. Small Business and Schools Policies</p> <p>S20. Public Space Recycling</p> <p>S21. Public Education /Social Mktg</p> | | <p>S41. Landscapers must bring mat'l to compost</p> | <p>ZW1. Metro Procurement Ordinance</p> <p>ZW2. Net Zero Ordinance</p> <p>ZW3. Regional Collaboration Ordinance</p> <p>ZW4. Gov't Construction Ord & Policies</p> <p>ZW5. Deconstruction / Reuse Ordinance</p> <p>ZW6. Special Events Ordinance</p> <p>ZW7. Food Scrap Redistribution Ord</p> <p>ZW8. Recycling / Organics Compliance Ord</p> <p>ZW9. EPR Ord & Policies</p> <p>ZW11. Reduce / Reuse / Repair</p> <p>ZW12. Dep't Name Change</p> <p>ZW13. Color Rebranding</p> <p>ZW15. Support ZW Businesses</p> <p>ZW16. Materials Marketplace</p> <p>ZW17. R&D in Technologies</p> |

| | Conservative Portfolio / Scenario | Add for Moderate Portfolio / Scenario | Add for Aggressive Portfolio / Scenario | ZW Portfolio |
|---------------------|---|---|---|---|
| Phase 2 (Years 3-6) | <p>S4. Enforce FW Ban - Res</p> <p>S27. Add Textiles-Res</p> <p>S28. Add Textiles- Com'l</p> <p>S33. Single Use Bag Ban/Fee - Res</p> <p>S34. Single Use Bag Ban/Fee - MF</p> | <p>S15. Convenience Center – Minimum Requirements for Access</p> <p>S24. MF Pilots</p> <p>S42b. Change Building Codes to Require Use of Local Compost</p> <p>S29. Ban Containers - Res</p> <p>S30. Ban Containers - Com'l</p> <p>S31. Ban Paper - Res</p> <p>S32. Ban Paper - Com'l</p> <p>S36. Ban Textiles - Res</p> <p>S37. Ban Textiles - Com'l</p> | <p>S35. Add Diapers to FW - Res</p> | <p>ZW10. Public Education / Social Media</p> <p>ZW14. Economic Development Tools</p> <p>ZW18. Remanufacturing Hub</p> |
| Phase 3 (Years 6-9) | <p>S5. Enforce FW Ban-Com'l</p> <p>S6. Add EOW Trash</p> <p>S22. SAYT Higher Incentives</p> | <p>S12. C&D Deposit System - Big Jobs; 50% goal</p> <p>S13. C&D Deposit System – Res, with ban</p> <p>S14. C&D Deposit System - Com'l with ban</p> | <p>S7. Com'l SAYT with Targeted 3-Stream, ABC Law, and Food Waste Ban</p> <p>S16. Incentive Surcharges</p> <p>S17. Incentive Surcharges</p> <p>S18. Contracted Residential Collection</p> <p>S25. Add Glass - Res</p> <p>S26. Add Glass - Com'l</p> | <p>No additional ZW programs implemented in Phase 3.</p> |

| | Conservative Portfolio / Scenario | Add for Moderate Portfolio / Scenario | Add for Aggressive Portfolio / Scenario | ZW Portfolio |
|----------------------|-----------------------------------|---------------------------------------|--|---|
| Phase 4 (Years 9-20) | | | S23. More Aggressive Res Diversion Incentives S38. Contracted Com'l Coll'n S39. EOW Trash Allowed Com'l S40. Roll Out Major MF Programs TBD | No additional ZW programs implemented in Phase 4. |

Key:

ZW – zero waste

PRR – percent recoverables remaining

SAYT – save as you throw

C&D – construction and demolition

EPR – extended producer responsibility

Gov't – government

Dep't – department

R&D – research and development

Mktg – marketing

Mat'l – material

FW – food waste

Res – residential

Com'l – commercial

EOW – every other week

MF – multi family

ABC – Alcoholic Beverage Control (Refers to a law where businesses will lose their liquor license if they don't have a recycling program for alcohol containers. In Metro's case, beer permits would be leveraged to encourage recycling- discussed further in Attachment I)

Coll'n - collection

TBD – to be determined

Table F-6 List of “High Performing Strategies” – Phases 1-4

| Sector | Scenario | Timing Phase | Strategy Number | Year Shown ==> 2027 Scenario=>Aggressive - All, Soon GSD Authority In Place?=>Yes Source: SERA WDAM/ZW Model | Tons Generated==> | | 1,710,208 |
|---|----------|--------------|-----------------|---|-----------------------------|-----------------------|-----------|
| | | | | | Tons Diverted - Residential | Tons Diverted - Com'l | |
| | | | | Strategy Name | | | |
| A | C | 1 | 1 | Tracking, Goals, Measurement PRR | - | - | - |
| A | C | 1 | 2 | Pass Legislation for Authority | - | - | - |
| R | C | 1 | 3 | Residential SAYT with 3-Stream and Food Waste Ban | 94,900 | - | 94,900 |
| R | C | 2 | 4 | Enforce FW Ban - Res | 13,400 | - | 13,400 |
| C | C | 2 | 5 | Enforce FW Ban - Com'l | - | 26,900 | 26,900 |
| R | C | 2 | 6 | Add EOW Trash (to improve FW diversion) | 21,200 | - | 21,200 |
| C | A | 3 | 7 | Com'l SAYT with Targeted 3-Stream, ABC Law, and Food Waste Ban | - | 260,000 | 260,000 |
| R | C | 1 | 8 | Enforce Existing Bans-Res | 3,900 | - | 3,900 |
| C | C | 1 | 9 | Enforce Existing Bans-Com'l | - | 25,800 | 25,800 |
| CD | C | 1 | 10 | C&D - Require Recy. Containers | 2,300 | 36,800 | 39,100 |
| CD | C | 1 | 11 | C&D and Compost - City Requirements or Preferences | - | 19,500 | 19,500 |
| CD | M | 3 | 12 | C&D Deposit System - Big Jobs; 50%+ goal | - | 195,300 | 195,300 |
| R | M | 3 | 13 | C&D Deposit System - Res | 4,100 | - | 4,100 |
| C | M | 3 | 14 | C&D Deposit System - Com'l | - | 40,500 | 40,500 |
| R | M | 2 | 15 | Convenience Center – Min Requirements for Access | 4,400 | - | 4,400 |
| R | A | 3 | 16 | Incentive Surcharges | 4,800 | - | 4,800 |
| C | A | 3 | 17 | Incentive Surcharges | - | 38,700 | 38,700 |
| R | A | 3 | 18 | Contracted Residential Collection | 14,200 | - | 14,200 |
| C | C | 1 | 19 | Small Business Policies | - | 13,500 | 13,500 |
| R | C | 1 | 20 | Public Space Recycling | 500 | - | 500 |
| R | C | 1 | 21 | Public Education/Social Mktg | 5,400 | - | 5,400 |
| R | C | 3 | 22 | SAYT Higher Incentives | 7,800 | - | 7,800 |
| R | A | 4 | 23 | More Aggressive Res Diversion Incentives | 7,800 | - | 7,800 |
| M | M | 2 | 24 | MF Pilots | 2,900 | - | 2,900 |
| R | A | 3 | 25 | Add Glass - Res | 2,400 | - | 2,400 |
| C | A | 3 | 26 | Add Glass - Com'l | - | 8,900 | 8,900 |
| R | C | 2 | 27 | Add Textiles-Res | 2,400 | - | 2,400 |
| C | C | 2 | 28 | Add Textiles- Com'l | - | 7,600 | 7,600 |
| R | M | 3 | 29 | Ban Containers - Res | 1,900 | - | 1,900 |
| C | M | 3 | 30 | Ban Containers - Com'l | - | 4,000 | 4,000 |
| R | M | 3 | 31 | Ban Paper - Res | 1,600 | - | 1,600 |
| C | M | 3 | 32 | Ban Paper - Com'l | - | 6,300 | 6,300 |
| R | C | 2 | 33 | Ban Single Use Bags (or fee) - Res | 700 | - | 700 |
| M | C | 2 | 34 | Ban Single Use Bags (or fee) - MF | 500 | - | 500 |
| R | A | 2 | 35 | Add Diapers to Organics - Res | 1,900 | - | 1,900 |
| R | M | 3 | 36 | Ban Textiles - Res | 1,300 | - | 1,300 |
| C | M | 3 | 37 | Ban Textiles - Com'l | - | 3,800 | 3,800 |
| C | A | 4 | 38 | Contracted Com'l Coll'n | - | 61,800 | 61,800 |
| C | A | 4 | 39 | EOW Trash Allowed Com'l | - | 5,400 | 5,400 |
| M | A | 4 | 40 | Roll Out Major MF Programs TBD | 13,100 | - | 13,100 |
| R | A | 1 | 41 | Landscapers must bring mat'l to compost | 700 | - | 700 |
| C | A | 3 | 42 | Bag-based Coll'n in CBD | - | - | - |
| R | M | 2 | 42b | Change Building Codes to Require Use of Local Compost | 400 | - | 400 |
| Total New (All High-Performing Strategies Included) | | | | | 214,500 | 754,800 | 969,300 |

Table Notes: Sectors and Strategy Labels - R=Res=Residential; C=Com'l=Commercial; M=MF=Multifamily; C=C&D=CDL=Construction and Demolition
 Scenario or Portfolio Key: A=Aggressive; M=Moderate; C=Conservative
 Timing Phase: 1=Early (Yr 1-4); 2=Second Phase (Yr 3-6); 3=Third Phase (Yr 6-9); 4=Fourth Phase (Yr 9-20)
 Each phase starts about 3-4 years after the previous phase.

Results based on Tonnages for 2027, if Aggressive Strategy programs (all programs) were implemented.
 Source: Skumatz Economic Research Associates WDAM Model, 2018. Strategy 42 is omitted intentionally (a version is already being tested / implemented in Metro's CBD).

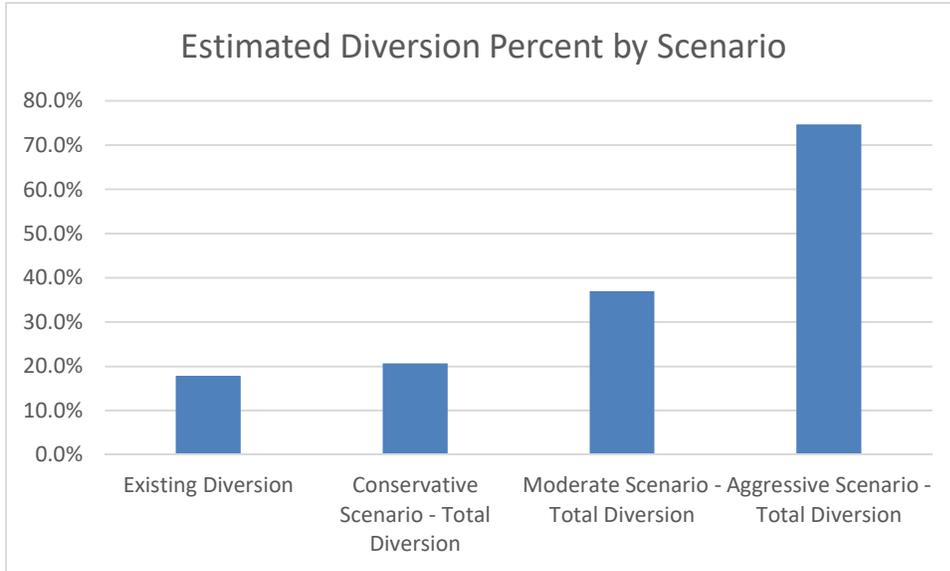


Figure F-4
Diversion from Conservative, Moderate, and Aggressive Strategies for High Achieving Strategies

Note that the diversion tonnages for the three scenarios and the three phases of the Aggressive Scenario in Figures F-4 and F-5 include the diversion percent of the scenario or phase before it (for example, the moderate scenario includes the diversion of the conservative scenario).

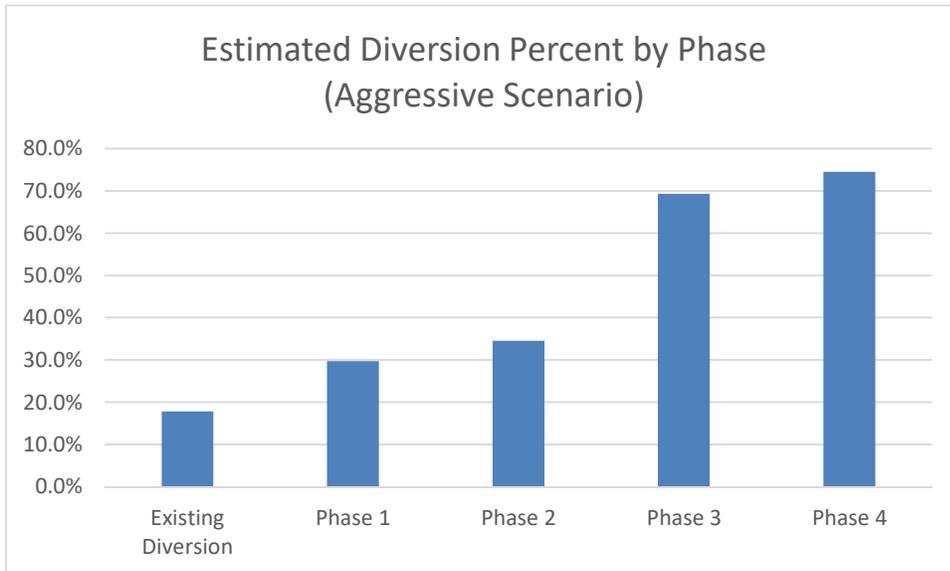


Figure F-5
Diversion from Implementation Phases for High Achieving Strategies

F.5 Analysis of Portfolios, Recommendations, and Tonnage Remaining to be Managed and Diverted

This Appendix includes a detailed analysis of the tonnages diverted and the costs associated with each of the strategies in the “High Performance” portfolio.

Tonnages: To estimate the tonnages associated with each program, we used a two-direction approach. We identified the tonnage “available” to be targeted by each Program. The tonnage model described earlier allowed SERA to estimate tonnages for each specific waste streams and sector combination from now until 2040. For example, we specifically calculate the tons of food scraps available from the multifamily sector, or C&D from the commercial sector, etc. For each strategy, we defined the sector targeted by the strategy (residential, commercial,²² C&D, multifamily, or “overall”), and the material or material group (food, “curbside recycling mix”, C&D, etc.).²³ We used information from past experience, other programs, and the design we built into the programs to estimate the percentage of the material available from the target waste stream that would be diverted by the program. From a second angle, we built up the tonnage expected from an average household or business based on programs in other locations and compared the two estimates to identify the tonnage we expected to be diverted from any program. Of course, the figures can only be estimates, and that is one of the reasons we include a larger number of programs so we can be more certain to achieve Metro’s diversion goals.

Costs: The estimation of costs for each program was complicated and depended on the type and which actors are involved; our work on this project for Metro estimated costs for both Metro and for the Generators (households or businesses). Thus, there were multiple costs estimation efforts for each program. The estimation work depended on program type but were also cumulative. For example, some programs were largely policy or regulatory. The costs for direct implementation of the program in this case accrue mostly to Metro, and we assumed staff time to refine the policy option and develop language, and to implement the strategy. However, the policy (for example, a ban) would have a cost impact on the businesses and households covered by the ban. The extra cost for complying with a ban is difficult to estimate, and that’s where the sequencing plays a role. We assumed that once containers are in place, the cost to place more material in a container that already exists is essentially zero. We also broke costs for households and businesses into two pieces: the “non-tonnage portion” and the “tonnage portion”. We reflect the “non-tonnage” portion in the tables under the cost element. This includes the cost of new collection service stops and containers and billing and the like. The tonnage portion is reflected separately – varying with the tip fees and tonnage delivered in a direct way, and providing greater clarity about the role of facilities, facility costs, and others on the cost of the programs. The cost for development of new supporting infrastructure is reflected in the tipping fees

²² As mentioned earlier, the data for most of the non-residential sector – including institutional, commercial, and industrial, are combined under the sector “commercial” for simplicity.

²³ This sector / material computation in the model is why some programs are split into two – for instance, food waste ban residential, and food wastes ban commercial. This is needed to be able to track program progress by sector, but also an artifact of the complexity of projecting tonnages in the model.

assumed for the tonnages diverted, and their design and development is presented in another chapter.

Some of the largest generator costs are associated with the SAYT programs in the residential and commercial sector. This is because these are the relatively-early programs that deliver the core access to programs – businesses and households receive (and pay for the) bins and the extra stops necessary to deliver access to both universal recycling and organics service curbside. Thus, bans and access programs do not have extra costs associated on the generator side (they do have passage and enforcement costs on Metro side). We used information from case studies from other cities, information in SERA’s database on program costs, and previous project work to develop cost estimates for each program.

In a few cases, costs are negative. For example, a switch to every other week trash service reduces stops, diverts tonnage, and reduces cost. Moving to unified contracted collection in the residential and commercial sectors are expected to reduce costs because they reduce multiple trucks driving by the same homes in areas that are currently serviced by open private hauler competition.

One other special case arises. Metro delivers trash collection service to a number of households and businesses. When residential SAYT is passed, new trucks, containers, and costs arise. This cost will be reflected in Metro’s budget, of course. However, in our calculations, we assign these costs to the “generator” – the household – as they will be incurring the cost and paying Metro (or private haulers in the remainder of the area) for the new services. Metro’s costs are viewed as a pass-through for modeling and cost assignment purposes. Some costs are assigned to Metro (billing systems, administration and other costs), but the service delivery elements are assigned to the residents, and the tonnage / tip fee portions are assigned to that cost element.

Tonnage Diversion Results for the Strategies

Table F-7 shows the estimated tonnages diverted for each program, specifying the tonnages by sector and for the USD vs. GSD areas. In total, the set of programs divert more than 900,000 tons in the template year of 2025, which represents just more than 60% new diversion from the total tonnage generated for the year. Combined with the existing recycling rate of about 18-19% for Metro, the set of strategies achieves and slightly exceeds 75% diversion. The Zero Waste strategies described in the next Chapter include programs and fundamental system changes that bridge the diversion gap between the 75% achieved from this portfolio to the 90-plus percent that represent Zero Waste. The portfolios are not “sequential”; that is, the Zero Waste strategies do not wait until the 75% programs are in place. They are implemented on parallel tracks. However, the “75% programs” are more workhorse-type programs, and the Zero Waste programs represent fundamental changes in the underlying system and are described separately.

Table F-7 Estimated Tonnage Diversion from High Performance Strategies by USD / GSD

| Sector | Scenario | Timing Phase | Strategy Number | Year Shown => 2027 Scenario=>Aggressive - All, Soon GSD Authority In Place?=>Yes Source: SERA WDOM/ZW Model | Tons Generated=> | | Tons Diverted - USD | | | | Tons Diverted - GSD | | | | Total USD & GSD Tons Diverted | |
|---|----------|--------------|-----------------|--|-----------------------------|-----------------------|---------------------|---------|---------|---------|---------------------|---------|--------|---------|-------------------------------|---------|
| | | | | | Tons Diverted - Residential | Tons Diverted - Com'l | Res | Com'l | C&D | All | Res | Com'l | C&D | All | | |
| | | | | | | | | | | | | | | | | |
| A | C | 1 | 1 | Tracking, Goals, Measurement PRR | - | - | - | - | - | - | - | - | - | - | - | - |
| A | C | 1 | 2 | Pass Legislation for Authority | - | - | - | - | - | - | - | - | - | - | - | - |
| R | C | 1 | 3 | Residential S&YT with 3-Stream and Food Waste Ban | 94,900 | - | 59,600 | - | - | 59,600 | 35,300 | - | - | 35,300 | 94,900 | 94,900 |
| R | C | 2 | 4 | Enforce FW Ban - Res | 13,400 | - | 8,100 | - | - | 8,100 | 5,300 | - | - | 5,300 | 13,400 | 13,400 |
| C | C | 2 | 5 | Enforce FW Ban - Com'l | - | 26,900 | - | 17,500 | - | 17,500 | - | 9,400 | - | 9,400 | 26,900 | 26,900 |
| R | C | 2 | 6 | Add EOW Trash (to improve FW diversion) | 21,200 | - | 12,900 | - | - | 12,900 | 8,300 | - | - | 8,300 | 21,200 | 21,200 |
| C | A | 3 | 7 | Com'l S&YT with Targeted 3-Stream, ABC Law, and Food Waste Ban | - | 260,000 | - | 164,300 | - | 164,300 | - | 95,700 | - | 95,700 | 260,000 | 260,000 |
| R | C | 1 | 8 | Enforce Existing Bans - Res | 3,900 | - | 2,100 | - | - | 2,100 | 1,800 | - | - | 1,800 | 3,900 | 3,900 |
| R | C | 1 | 9 | Enforce Existing Bans - Com'l | - | 25,800 | - | 18,600 | - | 18,600 | - | 7,200 | - | 7,200 | 25,800 | 25,800 |
| CD | C | 1 | 10 | C&D - Require Recy, Containers | 2,300 | 36,800 | - | - | 25,200 | 25,200 | - | - | 13,900 | 13,900 | 39,100 | 39,100 |
| CD | C | 1 | 11 | C&D and Compost - City Requirements or Preferences | - | 19,500 | - | - | 12,600 | 12,600 | - | 6,900 | 6,900 | 19,500 | 19,500 | 19,500 |
| CD | M | 3 | 12 | C&D Deposit System - Big Jobs; 50%+ goal | - | 195,300 | - | - | 126,000 | 126,000 | - | - | 69,300 | 69,300 | 195,300 | 195,300 |
| R | M | 3 | 13 | C&D Deposit System - Res | 4,100 | - | 3,000 | - | - | 3,000 | 1,100 | - | - | 1,100 | 4,100 | 4,100 |
| C | M | 3 | 14 | C&D Deposit System - Com'l | - | 40,500 | - | 22,700 | - | 22,700 | - | 17,800 | - | 17,800 | 40,500 | 40,500 |
| R | M | 2 | 15 | Convenience Center - Min Requirements for Access | 4,400 | - | 2,800 | - | - | 2,800 | 1,600 | - | - | 1,600 | 4,400 | 4,400 |
| R | A | 3 | 16 | Incentive Surcharges | 4,800 | - | 3,100 | - | - | 3,100 | 1,700 | - | - | 1,700 | 4,800 | 4,800 |
| C | A | 3 | 17 | Incentive Surcharges | - | 38,700 | - | 24,700 | - | 24,700 | - | 14,000 | - | 14,000 | 38,700 | 38,700 |
| R | A | 3 | 18 | Contracted Residential Collection | 14,200 | - | 8,900 | - | - | 8,900 | 5,300 | - | - | 5,300 | 14,200 | 14,200 |
| C | C | 1 | 19 | Small Business Policies | - | 13,500 | - | 8,400 | - | 8,400 | - | 5,100 | - | 5,100 | 13,500 | 13,500 |
| R | C | 1 | 20 | Public Space Recycling | 500 | - | 300 | - | - | 300 | 200 | - | - | 200 | 500 | 500 |
| R | C | 1 | 21 | Public Education/Social Mktg | 5,400 | - | 3,400 | - | - | 3,400 | 2,000 | - | - | 2,000 | 5,400 | 5,400 |
| R | C | 3 | 22 | S&YT Higher Incentives | 7,800 | - | 4,900 | - | - | 4,900 | 2,900 | - | - | 2,900 | 7,800 | 7,800 |
| R | A | 4 | 23 | More Aggressive Res Diversion Incentives | 7,800 | - | 4,900 | - | - | 4,900 | 2,900 | - | - | 2,900 | 7,800 | 7,800 |
| M | M | 2 | 24 | MF Pilots | 2,900 | - | 1,800 | - | - | 1,800 | 1,100 | - | - | 1,100 | 2,900 | 2,900 |
| R | A | 3 | 25 | Add Glass - Res | 2,400 | - | 1,500 | - | - | 1,500 | 900 | - | - | 900 | 2,400 | 2,400 |
| C | A | 3 | 26 | Add Glass - Com'l | - | 8,900 | - | 5,600 | - | 5,600 | - | 3,300 | - | 3,300 | 8,900 | 8,900 |
| R | C | 2 | 27 | Add Textiles - Res | 2,400 | - | 1,500 | - | - | 1,500 | 900 | - | - | 900 | 2,400 | 2,400 |
| C | C | 2 | 28 | Add Textiles - Com'l | - | 7,600 | - | 4,800 | - | 4,800 | - | 2,800 | - | 2,800 | 7,600 | 7,600 |
| R | M | 3 | 29 | Ban Containers - Res | 1,900 | - | 1,200 | - | - | 1,200 | 700 | - | - | 700 | 1,900 | 1,900 |
| C | M | 3 | 30 | Ban Containers - Com'l | - | 4,000 | - | 2,500 | - | 2,500 | - | 1,500 | - | 1,500 | 4,000 | 4,000 |
| R | M | 3 | 31 | Ban Paper - Res | 1,600 | - | 1,000 | - | - | 1,000 | 600 | - | - | 600 | 1,600 | 1,600 |
| C | M | 3 | 32 | Ban Paper - Com'l | - | 6,300 | - | 4,000 | - | 4,000 | - | 2,300 | - | 2,300 | 6,300 | 6,300 |
| R | C | 2 | 33 | Ban Single Use Bags (or fee) - Res | 700 | - | 400 | - | - | 400 | 300 | - | - | 300 | 700 | 700 |
| M | C | 2 | 34 | Ban Single Use Bags (or fee) - MF | 500 | - | 300 | - | - | 300 | 200 | - | - | 200 | 500 | 500 |
| R | A | 2 | 35 | Add Diapers to Organics - Res | 1,900 | - | 1,200 | - | - | 1,200 | 700 | - | - | 700 | 1,900 | 1,900 |
| R | M | 3 | 36 | Ban Textiles - Res | 1,300 | - | 800 | - | - | 800 | 500 | - | - | 500 | 1,300 | 1,300 |
| C | M | 3 | 37 | Ban Textiles - Com'l | - | 3,800 | - | 2,400 | - | 2,400 | - | 1,400 | - | 1,400 | 3,800 | 3,800 |
| C | A | 4 | 38 | Contracted Com'l Coll'n | - | 61,800 | - | 38,900 | - | 38,900 | - | 22,900 | - | 22,900 | 61,800 | 61,800 |
| C | A | 4 | 39 | EOW Trash Allowed Com'l | - | 5,400 | - | 3,500 | - | 3,500 | - | 1,900 | - | 1,900 | 5,400 | 5,400 |
| M | A | 4 | 40 | Roll Out Major MF Programs TBD | 13,100 | - | 8,100 | - | - | 8,100 | 5,000 | - | - | 5,000 | 13,100 | 13,100 |
| R | A | 1 | 41 | Landscapers must bring mat'l to compost | 700 | - | 500 | - | - | 500 | 200 | - | - | 200 | 700 | 700 |
| C | A | 3 | 42 | Bag-based Coll'n in CBD | - | - | - | - | - | - | - | - | - | - | - | - |
| R | M | 2 | 42b | Change Building Codes to Require Use of Local Compost | 400 | - | 400 | - | - | 400 | - | - | - | - | 400 | 400 |
| Total New (All High-Performing Strategies Included) | | | | | 214,500 | 754,800 | 132,700 | 317,900 | 163,800 | 614,400 | 79,500 | 185,300 | 90,100 | 354,900 | 969,300 | 969,300 |

Table Notes: Sectors and Strategy Labels - R=Residential; C=Commercial; M=MF=Multifamily; C&D=CD=Construction and Demolition
 Scenario or Portfolio Key: A=Aggressive; M=Moderate; C=Conservative
 Timing Phase: 1=Early (Yr 1-4); 2=Second Phase (Yr 3-6); 3=Third Phase (Yr 6-9); 4=Fourth Phase (Yr 9-20)
 Each phase starts about 3-4 years after the previous phase.

The diversion rates for each strategy are presented in **Table F-8**. The relevant diversion from each associated sector, as well as the percent from the overall MSW and C&D generation is shown at the right. The estimated tonnages of waste generated and diverted by sector, for the aggressive scenario, are presented in **Figure F-6**. Projected diversion potential for each scenario and percentage of new diversion per sector are shown in **Figures F-7 and F-8**, respectively.

Table F-8 Diversion Rates Achieved by the High Performing (Getting to 75%) Strategies

| Sector | Scenario | Timing Phase | Strategy Number | Year Shown ==> 2027 Scenario=>Aggressive - All, Soon GSD Authority In Place?=>Yes Source: SERA WDAM/ZW Model Strategy Name | % of Total Generation | Est. Diversion=> 75% | | | |
|---|----------|--------------|-----------------|--|-----------------------|------------------------------|---------|----------|-------|
| | | | | | | Percent of Sector Generation | | | |
| | | | | | % of Res | % of Com'l | % of MF | % of C&D | |
| A | C | 1 | 1 | Tracking, Goals, Measurement PRR | 0.0% | | | | |
| A | C | 1 | 2 | Pass Legislation for Authority | 0.0% | | | | |
| R | C | 1 | 3 | Residential SAYT with 3-Stream and Food Waste Ban | 5.5% | 34.0% | | | |
| R | C | 2 | 4 | Enforce FW Ban - Res | 0.8% | 4.8% | | | |
| C | C | 2 | 5 | Enforce FW Ban - Com'l | 1.6% | | 3.0% | | |
| R | C | 2 | 6 | Add EOW Trash (to improve FW diversion) | 1.2% | 7.6% | | | |
| C | A | 3 | 7 | Com'l SAYT with Targeted 3-Stream, ABC Law, and Food Waste Ban | 15.2% | | 29.0% | | |
| R | C | 1 | 8 | Enforce Existing Bans-Res | 0.2% | 1.4% | | | |
| C | C | 1 | 9 | Enforce Existing Bans-Com'l | 1.5% | | 2.9% | | |
| CD | C | 1 | 10 | C&D - Require Recy. Containers | 2.3% | | | | 9.9% |
| CD | C | 1 | 11 | C&D and Compost - City Requirements or Preferences | 1.1% | | | | 4.9% |
| CD | M | 3 | 12 | C&D Deposit System - Big Jobs; 50%+ goal | 11.4% | | | | 49.6% |
| R | M | 3 | 13 | C&D Deposit System - Res | 0.2% | 1.5% | | | |
| C | M | 3 | 14 | C&D Deposit System - Com'l | 2.4% | | 4.5% | | |
| R | M | 2 | 15 | Convenience Center – Min Requirements for Access | 0.3% | 1.6% | | | |
| R | A | 3 | 16 | Incentive Surcharges | 0.3% | 1.7% | | | |
| C | A | 3 | 17 | Incentive Surcharges | 2.3% | | 4.3% | | |
| R | A | 3 | 18 | Contracted Residential Collection | 0.8% | 5.1% | | | |
| C | C | 1 | 19 | Small Business Policies | 0.8% | | 1.5% | | |
| R | C | 1 | 20 | Public Space Recycling | 0.0% | 0.2% | | | |
| R | C | 1 | 21 | Public Education/Social Mktg | 0.3% | 1.9% | | | |
| R | C | 3 | 22 | SAYT Higher Incentives | 0.5% | 2.8% | | | |
| R | A | 4 | 23 | More Aggressive Res Diversion Incentives | 0.5% | 2.8% | | | |
| M | M | 2 | 24 | MF Pilots | 0.2% | | | 2.0% | |
| R | A | 3 | 25 | Add Glass - Res | 0.1% | 0.9% | | | |
| C | A | 3 | 26 | Add Glass - Com'l | 0.5% | | 1.0% | | |
| R | C | 2 | 27 | Add Textiles-Res | 0.1% | 0.9% | | | |
| C | C | 2 | 28 | Add Textiles- Com'l | 0.4% | | 0.8% | | |
| R | M | 3 | 29 | Ban Containers - Res | 0.1% | 0.7% | | | |
| C | M | 3 | 30 | Ban Containers - Com'l | 0.2% | | 0.4% | | |
| R | M | 3 | 31 | Ban Paper - Res | 0.1% | 0.6% | | | |
| C | M | 3 | 32 | Ban Paper - Com'l | 0.4% | | 0.7% | | |
| R | C | 2 | 33 | Ban Single Use Bags (or fee) - Res | 0.0% | 0.3% | | | |
| M | C | 2 | 34 | Ban Single Use Bags (or fee) - MF | 0.0% | | | 0.4% | |
| R | A | 2 | 35 | Add Diapers to Organics - Res | 0.1% | 0.7% | | | |
| R | M | 3 | 36 | Ban Textiles - Res | 0.1% | 0.5% | | | |
| C | M | 3 | 37 | Ban Textiles - Com'l | 0.2% | | 0.4% | | |
| C | A | 4 | 38 | Contracted Com'l Coll'n | 3.6% | | 6.9% | | |
| C | A | 4 | 39 | EOW Trash Allowed Com'l | 0.3% | | 0.6% | | |
| M | A | 4 | 40 | Roll Out Major MF Programs TBD | 0.8% | | | 9.2% | |
| R | A | 1 | 41 | Landscapers must bring mat'l to compost | 0.0% | 0.3% | | | |
| C | A | 3 | 42 | Bag-based Coll'n in CBD | 0.0% | | 0.0% | | |
| R | M | 2 | 42b | Change Building Codes to Require Use of Local Compost | 0.0% | 0.1% | | | |
| Total New (All High-Performing Strategies Included) | | | | | 57% | 70% | 56% | 12% | 64% |

Table Notes: Sectors and Strategy Labels - R=Residential; C=Com'l=Commercial; M=MF=Multifamily;

C=C&D=CDL=Construction and Demolition

Scenario or Portfolio Key: A=Aggressive; M=Moderate; C=Conservative

Timing Phase: 1=Early (Yr 1-4); 2=Second Phase (Yr 3-6); 3=Third Phase (Yr 6-9); 4=Fourth Phase (Yr 9-20)

Each phase starts about 3-4 years after the previous phase.

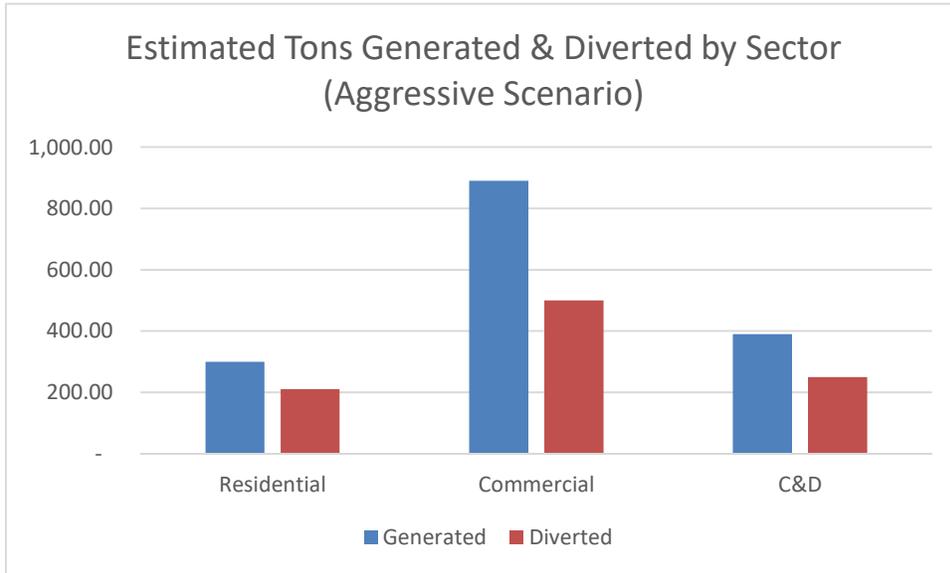


Figure F-6
Tonnes Generated and Diverted by Sector

The expected diversion associated with each of the three “Scenarios” or portfolios – conservative, moderate, and aggressive – is shown in **Table F-9**. Note that the goals cannot be met by halfway or non-aggressive approaches in Metro. To meet 75% and zero waste goals takes real and aggressive change.

Table F-9 Estimated Diversion from the 3 Scenarios – Conservative, Moderate, and Aggressive

| Diversion - 3 Scenarios / Portfolios | % of Total Generation |
|---|-----------------------|
| All Phases - Year Shown ==> 2027 | |
| Existing Diversion | 17.8% |
| Existing C&D Diversion | 0.2% |
| Aggressive Scenario - New Diversion | 56.7% |
| Aggressive Scenario - Total Diversion | 74.7% |
| Moderate Scenario - New Diversion | 18.9% |
| Moderate Scenario - Total Diversion | 37.0% |
| Conservative Scenario - New Diversion | 2.7% |
| Conservative Scenario - Total Diversion | 20.7% |

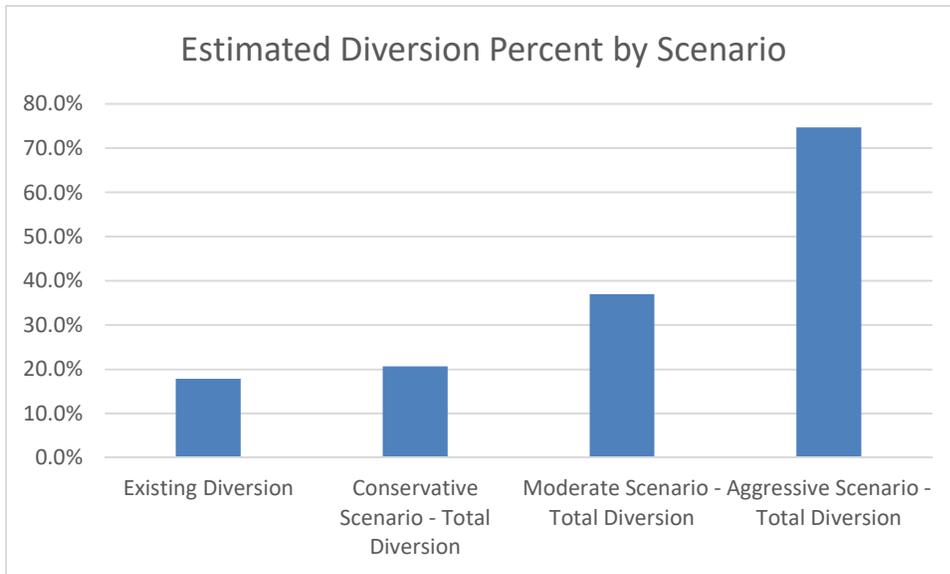


Figure F-7
Diversion by Scenario

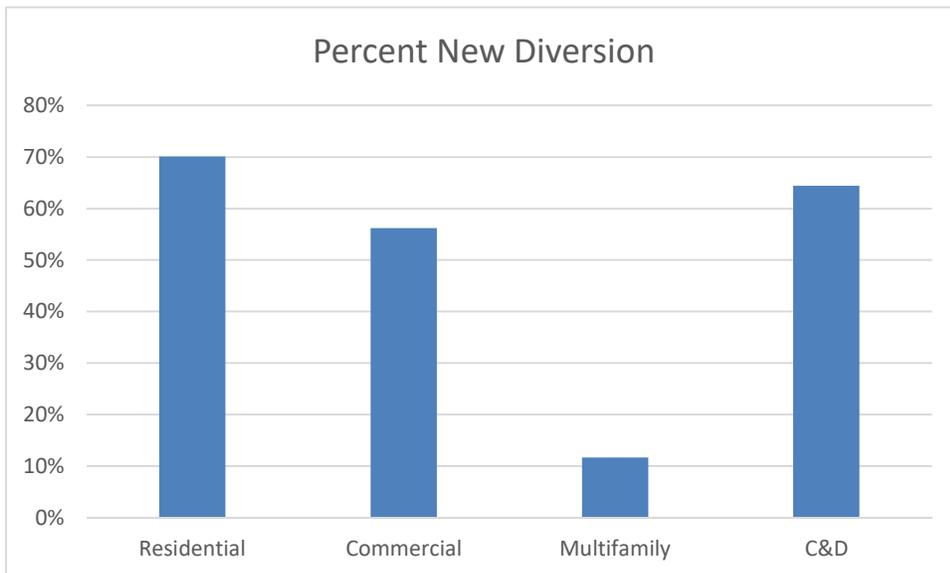


Figure F-8
New Diversion Percentage by Sector

The diverted tonnage goes to new destinations. These destinations are presented in **Table F-10**. Note the implementation of this set of high-performing strategies requires considerable investment in new supporting infrastructure and means dramatic changes in material flows compared to the current reliance on MSW and C&D Landfills. These results are used in the facility development chapter to make sure sufficient investment is made to allow diverted tonnages to be managed safely and effectively.

Table F-10 New Tonnage Destinations for the High Performing Strategies for 3 Scenarios

| Destinations - New Tons, All Phases - Year Shown ==> 2027 | New to MRF | New to Std Compost | New to Food Compost | New to C&D Recy | | From C&D LF | From Trad'l LF | To Trad'l LF | | Source Reduction - No Facility Destination |
|---|------------|--------------------|---------------------|-----------------|--|-------------|----------------|--------------|--|--|
| Aggressive Scenario- New Tonnage Destinations | 368,000 | 22,900 | 207,100 | 298,600 | | 253,900 | 716,000 | 436,208 | | 73,300 |
| Moderate Scenario - New Tonnage Destinations | 132,500 | 7,500 | 89,000 | 298,600 | | 253,900 | 295,300 | 1,081,508 | | 21,600 |
| Conservative Scenario - New Tonnage Destinations | 109,600 | 7,100 | 89,000 | 58,600 | | 58,600 | 227,300 | 1,359,308 | | 21,600 |

Core Strategies

The strategies list in Tables F-4 and F-5 is fairly extensive, but the strategies are designed to keep progress moving forward throughout the 20-year plan. However, a core set of perhaps 15 strategies represent most of the progress. They are illustrated in **Figure F-9**. The Figure also identifies the Scenario associated with each of the strategies. Note the figure is tonnage, not percentage-based. Clearly, the commercial and C&D strategies deliver the greatest tons; recall the tonnage split for Metro has been estimated as 70% commercial, and 30% residential, and a quarter of all tons are C&D.

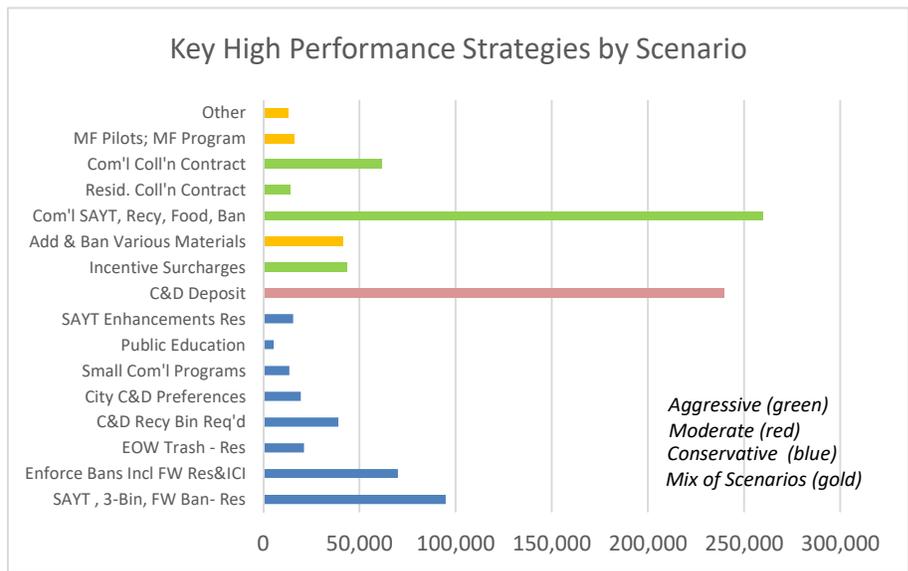


Figure F-9 Tonnage Diversion for Key High-Performance Strategies

The figure helps illustrate that several core strategies are critical to strong performance – specifically the following:

Commercial SAYT. The commercial SAYT incentives and the availability of recycling and organics diversion service embedded with basic trash service -- with no extra fees – are crucial to dramatic change in diversion behavior in the commercial sector. The program removes the barrier of recycling adding cost to the solid waste bill by embedding the cost of recycling in the trash bill (making it parallel to the successful system used fairly widely in the residential sector).

Construction and demolition deposit program. This strategy, implemented in the moderate strategy (and therefore, also in the aggressive scenario) because the infrastructure to sort the material needs must be financed and built, is by far the most successful strategy for diverting C&D

waste in place around the country. Builders leave a substantial financial deposit when apply for a permit and can reclaim the funds if they meet the 50% goal for diversion or reuse of materials from their project. If needed, a ban may also be added to solidify diversion efforts.

Residential SAYT. The residential SAYT program, with recycling and organics (yard waste and food scraps) service provided to all in a combined bill is a critical program. It appears small in the list because the split of tonnages for Metro are estimated to be 70% commercial and 30% residential. If this split were closer to 60:40 or 50:50 the relative size of the commercial and residential SAYT bars would be closer.

The other core strategies include:

- Contracts for commercial and residential service, to provide more integrated service, achieve economies of scale and efficiencies in service delivery.
- Additions of new materials to the recycling programs, and associated bans to encourage their diversion. New materials include textiles, glass, and other materials.
- Incentive surcharges, increasing the trash tipping fee (and reducing costs for recycling and organics) to modify the economics of recycling versus disposal and encourage uptake of diversion by all actors, including self-haul.
- Enhancements to the residential SAYT program later on, to revitalize participation in the program (including stronger rate incentives, smaller containers, etc.)
- Public education using social marketing and enhanced techniques to better motivate recycling and remove barriers to recycling.
- A portfolio of small commercial and schools strategies – including business recognition programs, technical assistance, and other elements – to help small businesses achieve higher diversion. The schools element includes technical assistance and best practices information, small grants, challenges and recognition.
- Metro preferences and requirements in municipal building projects and contracts, to assure Metro “walks the talk” and also to help incubate better and practical C&D practices related to recycling, reduction, and reuse.
- Recycling bins required at all construction job sites – a very early requirement that is only enhanced by the later introduction of the C&D deposit system.
- Introduction of Every Other Week trash collection as an option or potentially as the basic delivery system (as it is in some cities in the US), which provides savings for those who take efforts to recycle more and create less waste and provides a strong incentive to push households to reduce food disposal, and compost.
- Enforce the bans that currently exist in Metro, including bans on yard waste, cardboard, and electronics. The waste sort indicates there is considerable potential for additional diversion in the non-yard waste streams.

- Multifamily approaches are critical, but we are realistic in not assuming tremendous efficacy from these programs. We take an innovative approach, learning from the pilot grant incubation program in Austin, and use two phases. First, funding is set aside for grants from haulers, non-profits, buildings, and others to try new designs for programs in the sector. After these are monitored and evaluated, Metro implements policies, regulations, programs, or the approaches that build off the successes from the pilots so progress can be achieved in multifamily recycling.

These programs are the core of the system; however, they are not enough to guarantee Metro will reach 75% and zero waste. For this reason, a number of other programs are listed in the tables throughout this Appendix. Many are “two-percenters” or less, but diversify the progress, and help assure we reach goal. Both the core programs and these “two percenters” are listed in the figures in the remainder of this Appendix.

Strategy Cost Results

The costs for Metro to plan, implement, and enforce the various strategies are described below and in Appendix I. The costs to Metro are not the only costs associated with the Plan; it is also appropriate to consider the costs of the Plan and its strategies to the residential and commercial generators. The strategy for estimating the costs follows.

- We consider incremental costs – that is, *changes* to existing costs. We do not (and cannot) estimate the costs of the current system to all players.
- We break the estimation of costs into two pieces; tonnage management costs are considered in a separate “tipping fee” total cost. This is the multiple of the tons diverted times the (C&D or MSW) landfill fee (savings) plus the tons time the new tipping fees from the appropriate processing facilities. The collection and container costs and other costs associated with a strategy are calculated and assigned to the individual generator by type – households and businesses. We estimate these using SERA’s residential and commercial collection cost models, estimates of percent of households or businesses reporting they already receive service (from Metro information or the Survey discussed elsewhere), and other sources. Total costs to households and businesses are then the sum of collection and tonnage management-related costs.
- Finally, to avoid double-counting, and for clarity, the largest generator costs are associated with the core programs that require providing new containers and collection (labor, trucks, etc.). Additional generator costs are not assessed for programs that encourage, mandate, or incentivize those businesses to use those containers and service more. Hence, the costs for “SAYT-Plus” strategies are very high because the implementation of those programs incur all the costs for delivery of new recycling and composting service and containers Metro-wide, plus delivery of varied trash container sizes.²⁴ Then, for many programs, the business

²⁴ We do assume containers are re-used to the extent reasonable; for a share of households recycling or organics containers can be “created” by using new lids on large trash containers traded out for smaller containers, etc. New costs take account of the share of households and businesses already signed up for recycling or organics service.

or household costs in the total column are only the marginal changes in tipping fees associated with the tons diverted – the collection and container costs were covered under another program.

The program strategies that are assigned the container and new collection costs are: S3 – Residential SAYT with Three-stream collection; S7 – Commercial SAYT with Three-stream collection; and S10 – Requiring containers and collection for all C&D jobs receiving trash service. Those with zero additional collection and container costs as a consequence include: Bans and enforcement (elements of S3, S4, S5, S8, S9, most of S25-S37), new materials added (S25-28), C&D deposit (S12-14),²⁵ C&D and compost requirements built into new Metro contracts²⁶, incentive surcharges, small business and schools policies, more aggressive incentives for SAYT, MF pilots (paid by Metro program), and the additions, bans, and mandates for a variety of individual materials. Contracting is assumed to save costs by reducing hauler overlap and improving efficiencies / economies of scale. We assume the main cost to landscapers for Strategy 41 is the difference in tipping fees. Programs with nearly only Metro costs are Tracking (S1), Authority (S2), enforcement of bans (S4, S5, much of S29-S37), C&D deposit system administration and C&D ban (S13-S15), incentive surcharges (S16-17), development of additional convenience stations and incentives (S15), public space recycling (S20), small business and schools programs (S19), multifamily pilots (S24), and contracting projects (S38 and S18).

Table F-11 shows the costs associated with the strategies. **Table F-12** summarizes the costs for each of the three scenarios (conservative, moderate, and aggressive). Table F-12 includes a summary of cost per ton for each of the scenarios.

²⁵ The evaluations of these programs from other locations indicate the reuse of materials on-site, and the integration of reuse and recycling at the beginning of project planning – in conditions where processing facilities exist in the area - can significantly moderate the overall C&D project cost increases. A few programs note a share of deposits are not reclaimed, and others only allow the reclaiming of a percent (e.g. 75%) of the deposit. The main costs of this program under our cost modeling assumptions are assumed to be the addition of a collection program (costs accounted for in Strategy 10) plus the change in tipping fee between disposal and processing for the diverted tons. We assume the smallest projects are exempted.

²⁶ We assume any excess costs are reimbursed in the contract price.

Table F-11 Estimated Costs for High Performing Strategies

| Sector | Scenario | Timing Phase | Strategy Number | Year Shown ==> 2027 Scenario=>Aggressive - All, Soon GSD Authority In Place?=>Yes Source: SERA WDAM/ZW Model Strategy Name | 1,710,208 Total USD & GSD Tons Diverted | Annual Avg Costs by Sector (Thous\$) | | |
|--|----------|--------------|-----------------|--|--|--------------------------------------|------------------------------|---------------------------------|
| | | | | | | Metro Cost: Avg Annual Cost | Residential Costs (thous) | Commerci al Costs (thous) |
| A | C | 1 | 1 | Tracking, Goals, Measurement PRR | - | \$340 | \$0 | \$0 |
| A | C | 1 | 2 | Pass Legislation for Authority | - | \$20 | \$0 | \$0 |
| R | C | 1 | 3 | Residential SAYT with 3-Stream and Food Waste Ban | 94,900 | \$70 | \$24,050 | \$0 |
| R | C | 2 | 4 | Enforce FW Ban - Res | 13,400 | \$0 | \$0 | \$0 |
| C | C | 2 | 5 | Enforce FW Ban - Com'l | 26,900 | \$0 | \$0 | \$0 |
| R | C | 2 | 6 | Add EOW Trash (to improve FW diversion) | 21,200 | \$10 | (\$1,840) | \$0 |
| C | A | 3 | 7 | Com'l SAYT with Targeted 3-Stream, ABC Law, and Food Waste Ban | 260,000 | \$990 | \$0 | \$15,120 |
| R | C | 1 | 8 | Enforce Existing Bans-Res | 3,900 | \$440 | \$0 | \$0 |
| C | C | 1 | 9 | Enforce Existing Bans-Com'l | 25,800 | \$440 | \$0 | \$0 |
| CD | C | 1 | 10 | C&D - Require Recy. Containers | 39,100 | \$0 | \$0 | \$2,980 |
| CD | C | 1 | 11 | C&D and Compost - City Requirements or Preferences | 19,500 | \$10 | \$0 | \$0 |
| CD | M | 3 | 12 | C&D Deposit System - Big Jobs; 50%+ goal | 195,300 | \$10 | \$0 | \$0 |
| R | M | 3 | 13 | C&D Deposit System - Res | 4,100 | \$0 | \$0 | \$0 |
| C | M | 3 | 14 | C&D Deposit System - Com'l | 40,500 | \$0 | \$0 | \$0 |
| R | M | 2 | 15 | Convenience Center – Min Requirements for Access | 4,400 | \$1,380 | \$0 | \$0 |
| R | A | 3 | 16 | Incentive Surcharges | 4,800 | \$10 | \$0 | \$0 |
| C | A | 3 | 17 | Incentive Surcharges | 38,700 | \$10 | \$0 | \$0 |
| R | A | 3 | 18 | Contracted Residential Collection | 14,200 | \$160 | (\$7,060) | \$0 |
| C | C | 1 | 19 | Small Business Policies | 13,500 | \$920 | \$0 | \$0 |
| R | C | 1 | 20 | Public Space Recycling | 500 | \$510 | \$0 | \$0 |
| R | C | 1 | 21 | Public Education/Social Mktg | 5,400 | \$310 | \$0 | \$0 |
| R | C | 3 | 22 | SAYT Higher Incentives | 7,800 | \$0 | \$0 | \$0 |
| R | A | 4 | 23 | More Aggressive Res Diversion Incentives | 7,800 | \$10 | \$0 | \$0 |
| M | M | 2 | 24 | MF Pilots | 2,900 | \$240 | \$0 | \$0 |
| R | A | 3 | 25 | Add Glass - Res | 2,400 | \$0 | \$0 | \$0 |
| C | A | 3 | 26 | Add Glass - Com'l | 8,900 | \$0 | \$0 | \$0 |
| R | C | 2 | 27 | Add Textiles-Res | 2,400 | \$0 | \$0 | \$0 |
| C | C | 2 | 28 | Add Textiles- Com'l | 7,600 | \$0 | \$0 | \$0 |
| R | M | 3 | 29 | Ban Containers - Res | 1,900 | \$0 | \$0 | \$0 |
| C | M | 3 | 30 | Ban Containers - Com'l | 4,000 | \$0 | \$0 | \$0 |
| R | M | 3 | 31 | Ban Paper - Res | 1,600 | \$0 | \$0 | \$0 |
| C | M | 3 | 32 | Ban Paper - Com'l | 6,300 | \$0 | \$0 | \$0 |
| R | C | 2 | 33 | Ban Single Use Bags (or fee) - Res | 700 | \$10 | \$0 | \$0 |
| M | C | 2 | 34 | Ban Single Use Bags (or fee) - MF | 500 | \$10 | \$0 | \$0 |
| R | A | 2 | 35 | Add Diapers to Organics - Res | 1,900 | \$10 | \$0 | \$0 |
| R | M | 3 | 36 | Ban Textiles - Res | 1,300 | \$0 | \$0 | \$0 |
| C | M | 3 | 37 | Ban Textiles - Com'l | 3,800 | \$0 | \$0 | \$0 |
| C | A | 4 | 38 | Contracted Com'l Coll'n | 61,800 | \$170 | \$0 | \$840 |
| C | A | 4 | 39 | EOW Trash Allowed Com'l | 5,400 | \$0 | \$0 | (\$770) |
| M | A | 4 | 40 | Roll Out Major MF Programs TBD | 13,100 | \$0 | \$16,960 | \$0 |
| R | A | 1 | 41 | Landscapers must bring mat'l to compost | 700 | \$10 | \$0 | \$0 |
| C | A | 3 | 42 | Bag-based Coll'n in CBD | - | \$0 | \$0 | \$0 |
| R | M | 2 | 42b | Change Building Codes to Require Use of Local Compost | 400 | \$10 | \$0 | \$0 |
| Total New (All High-Performing Strategies Included) | | | | | 969,300 | \$6,100 | \$32,110 | \$18,170 |

Table Notes: Sectors and Strategy Labels - R=Res=Residential; C=Com'l=Commercial; M=MF=Multifamily;
 C=C&D=CDL=Construction and Demolition
 Scenario or Portfolio Key: A=Aggressive; M=Moderate; C=Conservative
 Timing Phase: 1=Early (Yr 1-4); 2=Second Phase (Yr 3-6); 3=Third Phase (Yr 6-9); 4=Fourth Phase (Yr 9-20)
 Each phase starts about 3-4 years after the previous phase.

Table F-12 Costs for High Performing Strategies for the Three Scenarios

| Program Costs, All Phases -Year Shown => 2021 | Total Percent Diverted (Incl. Existing from Landfill) | Total New Tons Diverted from Landfill | Metro Cost: Avg Annual Cost (thous) | Residential Costs (thous) | Commercial Costs (thous) | Marginal Tip Fee Cost (thous)(LF savings minus new tip) | Total Costs (thous) | Metro \$/Ton (new) | HH \$/Ton, All Tons | Bus \$/Ton, All Tons | Marginal Tip Fee \$/Ton | Total Cost per ton |
|---|---|---------------------------------------|-------------------------------------|---------------------------|--------------------------|---|---------------------|--------------------|---------------------|----------------------|-------------------------|--------------------|
| High-Performing / Aggressive Scenario | 74.7% | 969,300 | \$6,100 | \$32,110 | \$18,170 | \$26,150 | \$82,530 | \$6 | \$33 | \$19 | \$10 | \$85 |
| High Performing / Moderate Scenario | 50.1% | 549,600 | \$4,720 | \$22,210 | \$2,980 | \$17,100 | \$47,010 | \$9 | \$40 | \$5 | \$12 | \$86 |
| High Performing / Conservative Scenario | 34.6% | 283,100 | \$3,330 | \$22,210 | \$2,980 | \$7,110 | \$35,630 | \$12 | \$78 | \$10 | \$8 | \$125 |

Table F-12 shows that higher diversion does not necessarily cost more, on a per-ton basis anyway. Bigger programs, and fundamental changes, lead to higher efficiency and effectiveness from the programs. Timid programs can be costly on a per-ton basis (conservative). The marginal tip fee column computes the difference in costs between the cost of landfilling the wastes and delivering the waste (per Table F-10) to a series of other destinations. We use a blended cost for these facilities - a blend of current costs and costs of future facilities. Hauling costs are assumed to be relatively small per ton, and because future facility sites are not known, these costs have been excluded for planning purposes.

The tipping fees used for these facilities follows; materials “reduced” or waste prevention from the SAYT innovative and other programs saves all management cost and were assigned a zero tip fee.

- Landfill and transfer fee avoided: \$37/ton
- Recycling Processing / MRF Tip Fee: \$75/ton
- Yard Waste composting processing facility tip fee: \$28/ton
- Food scraps processing facility tip fee: \$55.00/ton
- C&D Landfill Tip Fee: \$20/ton
- C&D Processing Facility Tip Fee: \$75.00/ton
- Waste reduction / Waste prevention / Source reduction saves landfill fees and does not incur additional processing costs at another facility.

Basic Cost Analysis of the High Performance Strategies and Breakeven Analysis

The calculations in Table F-12 can be simplified to show that the total marginal cost per ton are shown in **Table F-13**.

Table F-13 Metro and Generator Marginals Costs for High Performing Strategies for the Three Scenarios

| Program Costs, All Phases -Year Shown ==> 2027 | Metro Costs Per Ton | Generator & Tip Fee per Ton |
|--|---------------------|-----------------------------|
| Aggressive Portfolio | \$6 | \$52 |
| Moderate Portfolio | \$9 | \$46 |
| Conservative Portfolio | \$12 | \$88 |

Metro’s costs per ton for getting to 75% diversion are quite low. The generator costs are also relatively low but are not zero. **Table F-14** shows the cost per month for the new collection services for the average business and household in Metro. For these costs, all households receiving recycling and organics collection curb-side, and all businesses receive recycling and those with food materials receive organics collection. It is not unexpected that the new program is an incremental cost and costs more than the current system; if an alternate system of 75% diversion was cheaper out-of-pocket, it would probably be happening already.

Table F-14 Metro and Generator Costs for High Performing Strategies for the Three Scenarios

| Program Costs, All Phases -Year Shown ==> 2027 | Metro Costs Per Ton | Generator & Tip Fee per Ton | Total Cost per Ton | Benefits - Metro Area Value Added including Labor - per | Value for "Other" benefits needed to Break Even |
|--|---------------------|-----------------------------|--------------------|---|---|
| Aggressive Portfolio | \$6 | \$52 | \$58 | \$34 | \$24 |
| Moderate Portfolio | \$9 | \$46 | \$54 | \$18 | \$36 |
| Conservative Portfolio | \$12 | \$88 | \$100 | \$31 | \$68 |

Although **Table F-15** shows the costs are higher than the current system, there are direct and measurable benefits from the new programs. The Metro area experiences direct economic benefits from these recycling changes in the form of job creation from new collection, management of materials in more job-intensive ways (recycling and composting over landfilling) and the induced and multiplier benefits from the income and production spent around the Metro economy. The last column in Table F-15 shows the amount of benefit per ton that would still be needed for the Metro area to “break even”, calculated as the total new costs per ton for the programs minus the economic / job benefits in the area.

These additional benefits may be environmental benefits or social benefits, and these concepts are explored in the “Triple Bottom Line” Appendix covered elsewhere in this report. However, the environmental literature shows a lower-bound dollar value of about \$37/ton for the simple environmental externalities²⁷ associated with the emissions. Including only the jobs and this lower-limit externality benefit, Metro is better off with the new aggressive scenario and 75% High

²⁷ EPA 2015 https://19january2017snapshot.epa.gov/climatechange_.html; discussed in more detail in Triple Bottom Line chapter.

Performing portfolio / scenario. These enhanced valuations are discussed in more detail in Chapter 8.

Table F-15 Breakeven Benefits Calculation and Per Month Costs for High Performing Strategies for the Three Scenarios

| Program Costs, All Phases -Year Shown ==> 2027 | Avg Cost per Household per Month | Avg Cost per Business per Month - excl tip fee | Avg Cost per Household per Month Incl Tip Fee. | Avg Cost per Business per Month, incl. Tip fee |
|--|----------------------------------|--|--|--|
| High-Performing / Aggressive Scenario | \$13 | \$47 | \$17 | \$50 |
| High Performing / Moderate Scenario | \$9 | \$8 | \$12 | \$9 |
| High Performing / Conservative Scenario | \$9 | \$8 | \$10 | \$8 |

F.6 Summary – High Performance Strategies

There are several main outcomes from this analysis. The set of programs we developed can deliver 75% diversion for Metro but can only do so if the aggressive strategies are undertaken. The positive side of working with the more aggressive program mix is that the cost per ton is relatively low - including the cost to all generators. The progress comes from all sectors – residential, commercial and schools / institutional sector, government sector, construction, multifamily, and public spaces. The core performers include:

- Enforcement of existing bans (followed by enforcement of new bans).
- SAYT incentive-based rates for both residential and commercial sectors, including universal access to three-bin systems (trash, recycling, and organics) at no separate fee, and a system of supporting food scraps bans
- Introduction of collection of new materials in the relying programs, turning into bans of those materials, and associated enforcement. New materials include glass, textiles, and others.
- Enhancements over time to make the SAYT programs perform better – including introduction of enhanced incentives, and introduction of every-other-week collection of trash to provide greater cost savings opportunities and to drive diversion into the food scraps bin and recycling container.
- In the near-term, construction and demolition sites must receive recycling bins in addition to trash service. Metro’s contracting for projects involving C&D should introduce requirements for a threshold percentage of C&D recycling and reuse.
- Construction and Debris deposit program, using a recoverable financial deposit to incentivize builders to Small commercial programs and technical assistance to provide greater opportunities for these generators. An associated ban will help solidify the incentive to divert and encourage construction of needed facilities.

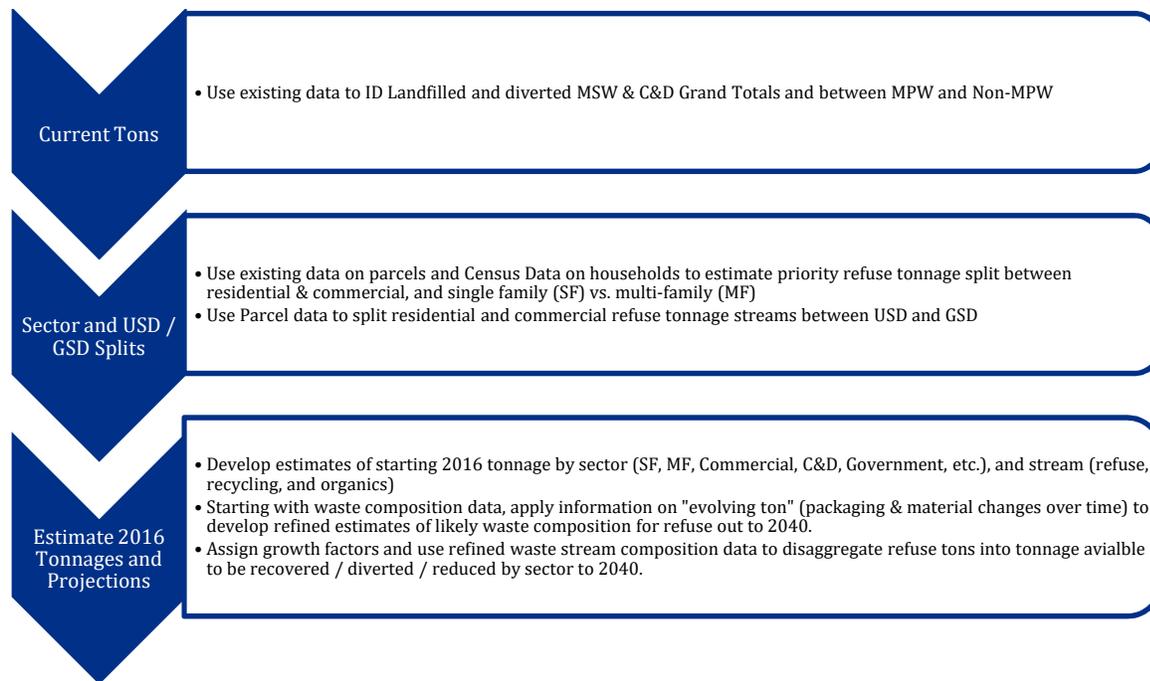
- Incentives / surcharges, increasing the cost of trash disposal relative to recycling streams, to provide greater incentives for uptake of recycling initiatives, and to provide incentives to self-haulers.
- A multifamily innovations grant program to identify programs that are Metro-centric and designed to work here, and then roll-out of the most successful strategies to the wider multifamily sector.
- Contracts for collection in the residential and commercial sector, to gain program uniformity, collection efficiencies, and potentially lower cost.
- Public education designed to focus on incentives, barriers, and motivation.

The strategies recognize and embrace the goals, recommendations, and directions from previous task forces and work conducted in Metro. Finally, based on the “readily calculated” Benefits and Costs for the programs, these programs provide an array of benefits to Metro and its residents, and, when considered in total, are beneficial to Metro.

F.7 Derivation of Starting Tonnages for Metro

To determine the best integrated plan of strategies required first estimating how much tonnage was being generated and diverted by the various sectors – and how much was being disposed in landfills. The steps outlined below were used to translate very aggregated data into tonnages:

- By sector: residential (single family vs. multi-family) vs. commercial vs. construction and demolition debris,
- By material categories: trash vs. recycling vs. compost vs. C&D, and
- By area of the City: USD vs. GSD.



Step 1: Current Tons

Data were assembled by Wilmot from Metro Public Works (MPW), Tennessee Department of Environment and Conservation (TDEC), and other sources to develop estimates of tonnages managed in the region as presented in **Table F-16**.

Table F-16 Management of Total Waste (MSW, and C&D) in the Region

| Management of Waste in the Region | | <i>(Source: Wilmot Memo, page 10)</i> | | | |
|-----------------------------------|----------------|---------------------------------------|------------------|--------------|-----------------|
| 2016 Tons | MPW | Non-MPW | Total | Pct of Total | % MPW (VS. Non) |
| MSW Landfilled | 161,622 | 723,426 | 885,048 | 58% | 18% |
| Recyclables - Mixed | 13,416 | 14,201 | 27,617 | 2% | 49% |
| Recyclables - Separated | 8,011 | 168,382 | 176,393 | 12% | 5% |
| Organics Diverted incl. Brush | 27,831 | 41,320 | 69,151 | 5% | 40% |
| Special Waste | 8,677 | 837 | 9,514 | 1% | 91% |
| CDL Landfilled | | | 350,175 | 23% | |
| CDL Recycled | | | 3,094 | 0% | |
| TOTAL | 219,557 | 948,166 | 1,520,992 | | |
| Percent of Total (excl CDL) | 19% | 81% | | | |

Special wastes (e.g. mostly tires that are recycled, but also toxics, asbestos, drilling and remediation materials, etc.) are not the target of the programs and are largely omitted from the discussion.

Step 2: Sector and USD / GSD Splits

Wilmot gathered parcel data from Metro, which was useful in estimating the share of tons that could be classified as “residential” vs. “commercial”, and the share of tonnage in the USD vs. GSD. The information forwarded by Wilmot is presented in **Tables F-17 through F-19**.

Definitions and Abbreviations Used in the Tables follow:

Bldgs is buildings

CBD is Central Business District;

C&D is Construction and Demolition

CDL is Construction, Demolition and Landclearing (used interchangeably with C&D)

Com'l is commercial

Conv. Ctr is convenience centers.

GSD is General Service District,

ICI is institutional, commercial, and industrial; used interchangeably with Commercial

MF is Multi-family

NMPW is Nashville Metro Public Works,

Res is residential

SF is Single Family

USD is Urban Service District,

Table F-17 Number of Parcels by Type in USD / GSD

| Number of Parcels | <i>(Source: Wilmot/McArdle email, 12/1/17)</i> | | | | | |
|--|--|--------|---------|-----------------|----------------|------------------|
| | USD | GSD | Total | % USD (vs. GSD) | % of Res Total | % of Com'l Total |
| SF HHs | 90,461 | 56,190 | 146,651 | 62% | 54% | |
| MF Bldgs (Parcels) | 15,884 | 10,413 | 26,297 | 60% | | |
| MF HHs (est. SERA from Census) | 76,087 | 47,262 | 123,349 | 62% | 46% | |
| Sm. Commercial | 3,992 | 1,126 | 5,118 | 78% | | 56% |
| Lg. Commercial | 3,212 | 749 | 3,961 | 81% | | 44% |
| Government | 274 | 102 | 376 | 73% | | |
| Agricultural | 32 | 416 | 448 | 7% | | |
| <i>Note: Census reports approximately 270,000 hhs</i> | | | | | | |
| <i>Note: SERA Computations from Census on MF imply average units per MF building or parcel = 4.7</i> | | | | | | |

Table F-18 Deriving Initial Residential vs. Commercial Tonnage Splits

| Deriving Splits Resid. vs. Com'l <i>(Wilmot/McArdle 12/1/17)</i> | |
|---|------------------|
| Deriving Res. Vs ICI Split | 2016 Refuse Tons |
| Totals from MPW | |
| CBD (ICI) | 31,521 |
| USD (Res) | 110,988 |
| Conv Ctr (Res)* | 119,113 |
| Totals from NMPW / TDEC | |
| GSD (Res) | 135,413 |
| USD (ICI) | 373,310 |
| GSD (ICI) | 213,702 |
| Total ICI NMPW** | 619,533 |

Notes: (*) Incl. in USD; (**) 65% assumed USD

These tonnage splits were provided by Wilmot / McArdle email dated 12/1/17.

Table F-19 Assigning Tonnage to USD vs. GSD

| Number of Tons -Split <i>(Source: interpreted from Wilmot/McArdle email 12/1/17)</i> | | | | | |
|--|---------|---------|----------------|-------------|-----------------|
| Starting Wilmot Assumption: % MSW Tons Com'l: | | 70% | Com'l tons | 619,533 | |
| Refuse Tons | USD | GSD | Total | % of Total | % USD (vs. GSD) |
| Residential Refuse | 230,101 | 135,413 | 365,514 | 37% | 63% |
| ICI Refuse | 404,831 | 213,702 | 618,533 | 63% | 65% |
| Total Refuse | 634,932 | 349,115 | 984,047 | | 65% |
| Percent of Total | 65% | 35% | | | |
| CDL | | | 350,175 | 26% | |
| Grand Total Res+ICI+CDL Refuse, this Table | | | 1,334,222 | | |
| Total Non-CDL Refuse from previous figure | | | 885,048 | | |
| Percent & tonnage discrepancy in Res & ICI Refuse | | | 10% | Difference= | 98,999 |
| Reproportioning Calculations to First Table's Totals | | | | | |
| | USD | GSD | Total | % of Total | % USD (vs. GSD) |
| Residential Refuse | 206,952 | 121,790 | 328,742 | 37% | 63% |
| ICI Refuse | 364,103 | 192,203 | 556,306 | 63% | 65% |
| Total Refuse | 571,055 | 313,993 | 885,048 | | 65% |
| Percent of Total | 65% | 35% | | | |
| CDL | | | 350,175 | 28% | |
| Grand Total Refuse (Totals Match Table from Page 10, Wilmot Memo) | | | 1,235,223 | | |

SERA combined information from the Census and the Parcel data to estimate the share of refuse tons that could be attributed to the single family (SF) vs. multi-family (MF) sectors in the USD and GSD. The Census indicated about 270,000 households were in the City / County in 2016. The parcel information indicated the number of SF and MF parcels in the USD and GSD. We assume

each SF parcel is a household; the remainder of households were assumed to be MF and shared evenly across parcels. This computation resulted in an average of 4.7 multifamily units per MF building or parcel (not an un-reasonable assumption). SERA then used information from past projects that suggested that MF households may generate about 75% of the waste of a SF household (smaller footprint, fewer occupants, usually lower income and other factors). We created a number of SF-Equivalent households by multiplying the number of MF units times 0.75, and apportioned the residential trash between SF and MF using this “SF-Equivalent” factor. The result is shown in **Table F-20**.

Table F-20 Assigning Tonnages to Single vs. Multifamily Sectors

| Calculating SF Vs. MF Refuse Ton Split | | (Source: SERA computations) | | | | |
|---|--|-----------------------------|---------|----------------|------------|--------------------|
| Assume MF TPH compared to SF= | | 75% | | | | |
| | | USD | GSD | Total | | |
| SF HH | | 90,461 | 56,190 | 146,651 | | |
| MF HH | | 76,087 | 47,262 | 123,349 | | |
| MF HH in SF Equiv | | 57,065 | 35,446 | 92,512 | | |
| Total SF Equiv HHS | | 147,526 | 91,636 | 239,163 | | |
| Share SF of Equiv HHS | | 61% | 61% | | | |
| Total Residential Tons (Total from Above) | | 206,952 | 121,790 | 328,742 | % of Total | % in USD (vs. GSD) |
| Refuse Tons - SF (SERA computations) | | 126,900 | 74,680 | 201,580 | 61% | 63% |
| Refuse Tons - MF (SERA computations) | | 80,052 | 47,110 | 127,162 | 39% | 63% |

Step 3: Estimate Starting 2016 Tonnages by Sector and Material

We used the information from the previous calculations to come up with justifiable estimates of the tonnages disposed and recycled in 2016 by the array of key actors in Nashville / Davidson County. Assumptions needed to be made regarding the splits between residential and commercial, USD vs. GSD, and single family vs. multi-family. Some were derived from number of trucks to the landfill, some from shares of parcels in the county, and the single-family vs. multi-family split required making assumptions about number of units in the average multi-family parcel or building and comparing with census data for “reasonableness”. For example, we assumed MF households were not doing much recycling. They are likely the source of a portion of the recycling occurring at convenience and recycling centers (and a few buildings may be recycling, and some may recycle with friends or at work), but any apportionment to SF vs. MF would be arbitrary and not important to the overall estimation work. The government sector disposal tonnage was derived using a comparison to the number of parcels assigned to the commercial sector.

The most important caveats or concerns associated with the numbers are the following:

- The assumption that 70% of the waste stream is commercial and 30% is residential is a highly unusual assumption. Wilmot based this on interviews with the staff conducting the waste sort, based on truck traffic. The most common range is between 60:40 and 40:60. **Table F-21** shows the range from recent research by SERA. The range is from 37% residential to 59% residential (remainder is commercial), and the mean and median are between 51%-52% residential. Metro’s 70:30 assumption causes a dependence on success

from the strategies in the commercial sector to achieve our desired 75% and zero waste goals – and gives Metro a harder road than many communities that can gain a greater share from easier residential strategies. Note that the previous 10 Year Solid Waste Plan for Metro used percentages of 34% residential and 66% commercial.

Table F-21 Typical Residential / Commercial MSW Disposal Splits

| Disposal | Residential | Commercial |
|------------------|-------------|------------|
| Orange County NC | 37% | 63% |
| CA | 40% | 60% |
| WI | 41% | 59% |
| Santa Fe NM | 45% | 55% |
| Red Deer Canada | 48% | 52% |
| WA | 50% | 50% |
| IL | 51% | 49% |
| San Mateo CA | 53% | 47% |
| IA | 53% | 47% |
| NY | 54% | 46% |
| OR | 62% | 38% |
| CT | 58% | 42% |
| Seattle WA | 59% | 41% |
| Chicago IL | 59% | 41% |
| Simple Average | 51% | 49% |
| Median | 52% | 48% |

Source: USEPA 2013 and SERA web research / database

- The C&D sector represents nearly a quarter of the total waste managed. This is another very large portion and represents a more challenging sector from which to gain diversion than the traditional residential sector. We assume these figures are fairly certain, however, as we understand this tonnage is tracked relatively directly. Nashville / Davidson County’s booming economy is definitely being felt in the waste stream. Comparisons of this percent to a small sample of other communities is provided in **Table F-22**.

Table F-22 Share of C&D as a Percent of Overall Disposed Waste

| Share of C&D of Disposed Waste | |
|--------------------------------|-----|
| Clark County WA | 6% |
| Austin TX | 6% |
| Seattle | 20% |
| Chicago | 44% |

The brush / yard waste diversion is fairly high, and the waste composition shows very little additional yard waste available to be captured by programs – even though the existing collection program is periodic and the other option is drop-off. We do understand there is a yard waste ban, but are also given to understand that enforcement of bans has typically been underfunded.

Table F-23 2016 Allocated Tonnage for Initiating the Modeling Work

| Starting Tons Allocation | 2016 | | | | | | | | | | |
|--|---------|---------|--------|---------|--------|--------|-----------|----------------|----------------|---------------|---------|
| Estimated Tons | USD-LF | USD-R | USD-O | GSD-LF | GSD-R | GSD-O | Total Gen | Recycling Rate | Diversion Rate | % of Tot Tons | Percent |
| SF | 126,900 | 15,000 | 27,600 | 74,700 | 5,700 | 300 | 250,200 | 8% | 19% | 16% | 21% |
| MF | 80,100 | - | - | 47,100 | - | - | 127,200 | 0% | 0% | 8% | 11% |
| Com'l (all) | 364,100 | 119,900 | 27,000 | 213,700 | 63,300 | 14,300 | 802,300 | 23% | 28% | 52% | 68% |
| CBD (included in Com'l All) | 28,500 | 500 | - | - | - | - | 29,000 | 2% | 2% | 2% | |
| Conven+Recy Ctr (incl. in Resid) | 12,300 | 5,500 | - | 6,800 | 3,000 | - | 27,600 | 31% | 31% | 2% | |
| Gov't (incl. in Com'l) | 14,700 | 500 | - | 12,100 | 200 | - | 27,500 | 3% | 3% | 2% | |
| C&D | 225,900 | 2,000 | - | 124,200 | 1,100 | - | 353,200 | 1% | 1% | 23% | |
| Grand Total (excl. Special Waste) | 797,000 | 136,900 | 54,600 | 459,700 | 70,100 | 14,600 | 1,532,900 | 14% | 18% | 100% | |
| Percent | 52% | 9% | 4% | 30% | 5% | 1% | 100% | | | | |
| <i>USD-O includes brush collection</i> | | | | | | | | | | | |
| <i>Totals after distribution among sectors and materials are within about 1% of Tonnage totals for 2016.</i> | | | | | | | | | | | |
| <i>Abbreviations: LF=Landfill; R=Recycling, O=Organics; Gen=Generation</i> | | | | | | | | | | | |

F.8 Detailed Description of Individual Strategies and Costs

Inventory of High Performing Strategies Developed

Planning level descriptions of each strategy are provided in this Appendix.²⁸ Estimated tons are provided in Table F-3. Strategies are numbered according to their position in Table F-5; each is preceded with an “S” for Strategy.²⁹ Metro Budget needs are described in Section F.5 and derived in Appendix J. The descriptions of the derivation of program costs to generators are also provided in Section F.5. The total for program costs to waste generators and to Metro are summarized and discussed earlier in this Appendix in Table F-11. Zero Waste strategies are described in Appendix G.

S1. Tracking, Goals, and Measurement – Phase 1

Description: Mandatory Reporting (with enforcement) and Measurement / Metrics are Key. Metro will need an ordinance or enhanced hauler / facility licensing requirements or other strategies to be able to compel residential and commercial haulers, private haulers, and facilities to report disposed, recycled, composted, and otherwise diverted tonnages. Metro will also need to develop a robust tracking system that will support the regular, periodic, and monitoring of progress from the status quo diversion levels to the Zero Waste goal. Our team recommends tracking both:

- **Recycling, composting, and diversion rates**, computed as percentage of generation, based on hauler and stakeholder reporting, with the goal of reaching diversion levels of 90% or better for ZW.
- **Percent Recoverables Remaining (PRR)**,³⁰ tracking the recoverables remaining in the disposal stream (using periodic waste composition studies) with a goal to minimize the

²⁸ Information is provided in a later chapter on the quantitative results of the Benefit/Cost Analysis and Economic and Environmental financial assessments for Triple Bottom Line.

²⁹ Note that multiple strategy numbers are included in many cases, because SERA's Waste Diversion Assessment Model (WDAM) models individual combinations of sectors and streams; if more than one stream or more than one sector is targeted in a strategy, the model includes them as separate numbers.

³⁰ For more on Percent Recoverables Remaining (PRR), See Skumatz, “Better Tracking Metrics – Noting what’s not recovered”, Resource Recycling, Aug/Sept 2016; and Burn and McDonnell and Skumatz Economic

percent of materials disposed that are potentially recoverable through Metro’s series of programs and services. This metric indicates the total percent of recoverables left, the most prevalent materials, the impact on emissions, and the potential value. Goals from other city clients for this metric are PRR less than 10% or similar.

Metro should require monthly or every-other-month hauler tonnage reporting for the first six months (to work out the kinks), and twice annual reporting going forward. Enforcement for failing to report tonnages should include warning letter, increasing fines, and potential revocation of license. The PRR metric will require Metro to implement periodic waste composition studies, either at the container, disposal sites, or trucks.

Diversion Modeling Targets: The modeling did not assign tonnage directly to this strategy.

Metro Role:

- Metro / consultant reviews data reporting currently implemented; identifies strategies for better reporting from haulers / develops reporting form(s) and rules for haulers (residential and commercial), stakeholders (facilities, etc.) and associated calculation worksheets for Metro to use going forward.
- Metro / consultant develops monitoring protocol for PRR metric; where measured, how often, precision level needed, etc. Estimates costs.
- Metro / consultant drafts language for ordinance or licensing changes to require reporting
- Metro passes ordinance / licensing changes, posts and advertises to relevant stakeholders
- Metro implements measurement protocol, hiring consultant for periodic waste composition work.
- Metro tracks / monitors progress against the two goals – percent diverted, and the percent and types of materials remaining in the disposal stream.

Metro Budget Needs:

- Staff time: 10% FTE (2 weeks) to identify gaps and reporting to date; 5-10% Metro staff on-going time for tracking / nudging / calculating performance for percent diversion. 10% FTE (2-3 weeks) of consultant or statistical person’s time FTE to identify preferred measurement approach for PRR metric and identify monitoring protocols.
- Direct costs: Estimate for annual 2-season waste composition study, Metro-wide, residential and commercial, is approximately \$75-150K; other options include random

Research Associates, “State of Colorado Integrated Materials Management Plan”, 2015, prepared for Colorado CDPHE, and other publications /research.

collection truck sorts and other strategies. The estimates for conducting this work on an on-going basis is \$250-300K/year.³¹

- **Funding Source:** No dedicated funding source. Recommended as part of an “environmental” or generator fee or enterprise Fund, or rate increases.

S2. Obtain Needed Planning, Service, Enforcement and Funding Authorities - Phase 1

Description: Revised Authorities are an Essential First Step. Waste management in Metro is currently conducted in a fairly complex arrangement of responsibilities and authorities. In order to reach High Performance and Zero Waste, it is essential that a first set of efforts are undertaken to **provide the (integrated) platform of responsibilities and authorities, enabling both service / enforcement powers, and funding authorities.** Metro needs to be able to:

- Implement enforceable and area-wide ordinances, services, mandates, regulatory authority, and other policies regarding solid wastes management, that cover all generator sectors
- Be able to regulate the variety of service providers in the region
- Be able to recover funds to provide services and be able to charge for any and all services provided.
- Be able to issue RFPs and undertake contracting arrangements for services covering the variety of generator sectors;
- Be able to work cooperatively to develop facilities that serve the region in order to assure sufficient capacity and reach cost-effectiveness.
- Establish Enterprise Fund or utilize the existing fund.

Diversion Modeling Targets: The modeling did not assign tonnage directly to this Strategy.

Metro Role:

- Metro / Metro attorney / consultants inventory the authorities needed for the Comprehensive Plan programs and compare against authorities currently in place to identify gaps and best approaches to obtaining authorities.
- Metro staff provide leadership and relationship-building
- Metro / attorney / consultants craft new language and start the processes or agreements needed to achieve the authorities.
- Posting, advertising, notice.

³¹ Based on SERA research for other clients, developing consistent, defensible, statistical monitoring plans with reporting.

Metro Budget Needs:

- Staff Time: Assume 1-week (3-5%) FTE for attorney and assistant; 2 weeks (5-10%) Metro staff; 1-week (5%) consultant. Leadership needed from senior PW staff for perhaps 1-2 weeks of time (5%) spread over half a year.
- No direct costs.
- Funding Source: No dedicated funding source; general fund activity; or Enterprise Fund, generator fee, or rates

S3, 29-32. Residential SAYT & 3-Stream Package with Supporting Bans- Phase 1

Description: “Save as you throw / Pay as you Throw” is the most effective and cost-effective strategy in the residential portfolio³². It incentivizes recycling and organics diversion in addition to resulting in a substantial amount of source reduction³³ on a continuing basis and is all user-fee funded under a program that is essentially no more than a new billing system. A “Bundle” of strategies for the residential sector is a key early strategy and is presented as an integrated package on purpose. Integrated decisions and incentives are presented to households to provide key diversion services to all (recycling and organics). Price incentives (SAYT with embedded program fees) are provided to encourage use of the services, and basic bans are put in place to support and further encourage diversion of the material. The integrated system allows households to make wholly new decisions regarding their waste management behavior. This strategy (and associated ordinance / requirement) includes:

- SAYT: Save as you Throw trash rates, including providing trash service in graduated trash can sizes with incentive-based increasing costs for larger trash containers. There must be one trash service level available that is no larger than 32 gallons.
- Embedded Services and Costs: Recycling and organics containers and service are provided for all households. Containers are provided for all services. No extra fee for recycling or organics service. Frequency and accepted materials to be established by Metro ordinance. This includes minimum every other week service, 96-gallon bins default for all diversion programs, materials continually updated and expanded to match (and push) local MRFs, and Metro may change list of materials by Memo from the Mayor or PW Director.

³²Source: SERA research. See Skumatz, et. al., “PAYT / Variable Rates for Trash Collection: 2014 Update”, Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO for EPA Region 9, 2015; Skumatz et. al., “PAYT: 2006 Update” for SERA and EPA, January 2007; and other updates since Skumatz, “Nationwide Diversion Rate Study – Quantitative Effects of Program Choices on Recycling and Green Waste Diversion: Beyond Case Studies”, Skumatz Economic Research Associates, Prepared as Multi-client Study and Reason Foundation Study 214, 1996.

³³ Source: SERA Research. See Skumatz; “Source Reduction can be Measured”, Resource Recycling, 8/2000; Skumatz, “Measuring Source Reduction: Pay As You Throw (PAYT) / Variable Rates as an Example”, SERA Technical report, included on EPA website, 5/2000.

- Food waste ban implemented; for simplicity, include residential and commercial sectors in ban.³⁴
- Containers Ban: Along with addition for food waste ban, ban containers (plastic, metal, and consider other products) and add to enforcement strategy in an ordinance that implements several bans (paper, food, etc.).
- Broad Paper Ban: Along with new food waste ban, ban containers and add to enforcement strategy in an ordinance that implements several bans (containers, food, and possible other key materials).
- Once or twice per year outreach materials explaining the program / incentives (Metro approval required).
- Ability to check Hauler books for compliance³⁵
- Outreach to explain the program and solicit responses regarding desired container sizes
- Modifications to Metro billing system
- Phase-in schedule

Through an area-wide ordinance (or stringent hauler licensing regulations) Metro requires any hauler providing residential trash service in the Metro limits to provide recycling service (minimum 96 gallons every other week, with materials specific by letter/memo from the Mayor to allow updating and consistency with MRFs), plus organics service including yard waste (minimum 96 gallon container with service at least every other week). This service is to be upgraded to include food along with Yard waste as soon as the first composting site that can take food waste is established within (50) miles of Metro limits. The hauler may not charge separately for the recycling or organics service; the cost of the three services must be embedded in the graduated trash bill. There must be a trash option available that is no larger than 32 gallons. The differential costs between service levels will be established by Metro (and periodically revisited) and must be no less than 50% extra for double the service for the first 30-35 gallons,³⁶ the same

³⁴ Integrate into the ban a clause for diaper composting, to be implemented when Metro deems the process is mature and Metro requires area composting facilities used by Metro to allow this material. Do not advertise this portion of the ban, and it is not invoked until a letter / memo by DPW is issued. This is recommended in order to avoid having to pass a separate ban.

³⁵ The key components of Best Practices in PAYT / SAYT include: embedded recycling program / provide service to all households with no separate fees; 50-80% price differentials for trash rates; at least one trash service size no larger than 35 gallons; parallel containerization; and ability to inspect hauler books. Source: "Skumatz, "Variable Rates in Solid Waste: Manual for Local Solid Waste Officials" for EPA Region X (1990), updated periodically in Resource Recycling and State Manuals. Latest, Skumatz, et. al, "PAYT/ Variable Rates for Trash Collection: 2014 Update", Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, 2015.

³⁶ The optimal price differential range calculations from Skumatz Economic Research Associates statistical research on data from 1,300 communities. A 50% differential in cost for twice the service (e.g. 30 gallons to 60 gallons) is sufficient to result in substantially more recycling and organics diversion than smaller financial differences; and a differential of 80% results in the same diversion as differentials of 100% ("doubling" the

price differential is used for additional increments of 30-35 gallons. Containers must be provided for all services. A system for paying for “extra” waste is introduced through pre-paid bags or stickers, or automatic billing (with photo or other documentation) for waste set out beyond subscribed amount. Haulers not complying lose the license to provide any residential collection services in the Metro Area. Metro enforcement is conducted through street inspections and review of hauler records, among other strategies.

Metro implements an ordinance mandating a food waste ban – for the residential and commercial sector -- immediately, with enforcement to be invoked as soon as a facility is available to take the material. Enforcement is at the generator (not hauler) level. If allowable under the powers of a solid waste authority, implement a system of fines to modify behaviors and enforce compliance. The ordinance authorizes inspectors to perform random inspections at home and business containers. First infraction leads to a warning letter (to generator); second infraction involves a fine; third infraction assesses a larger fine. Enforcement of payment may potentially include an extra assessment on utility bills. Heavy enforcement is implemented with Phase 2 or when a food waste facility is on-line. Enforcement of bans is critical to the success of this strategy. The legal and programmatic challenges to enforcement will be assessed during the implementation phase.

Implementation of the SAYT program for Metro Service Area: Metro itself will require considerable out-of-pocket costs and a drain on the near-term budget; however, these costs are directly paid back over time by user fees. Costs include: SAYT multiple-sized container purchase and delivery, truck and labor costs for new services and associated containers, outreach, cart replacement / maintenance costs, changes to billing system, rate study, changes to tipping fees (between trash, recycling, and organics with tonnage shifts) and other costs. If Metro wishes to reduce the environmental impacts of the program, it should consider the integration of CNG trucks. The trucks will have lower emissions, with higher up-front costs, but potentially lower operating costs. However, it will require the development of a CNG refill station, which is quite costly. If other Metro trucks move to adopt CNG, the costs attributable to solid waste will be lower.

Diversion Modeling Targets: The modeling for this Strategy assumed high levels of diversion of residentially-generated single-stream recycling mix, yard waste, food waste, and also assigned waste diversion / source reduction to the strategy, in accordance with extensive statistical analysis documenting these effects from SAYT.³⁷

fees, or “a can is a can” rate). See Skumatz, “PAYT in the US: Implementation, Impacts, and Experience”, Waste Management Journal, Elsevier Publications, 2008. Skumatz, “Pay As You Throw (PAYT) in the US: 2006 Update and Analyses”, prepared for USEPA and SERA, January 2007. Skumatz, “Recycling Incentive Alternatives: Results of an Analysis of Performance, Pros, and Cons of RecycleBank™, Recycling Credits, and PAYT”, Resource Recycling, Feb and March 2011; Skumatz, “Getting to More: Review of Option for an Area with Robust Recycling”, Skumatz Economic Research Associates, Prepared for King County WA, December, 2014; and elsewhere.

³⁷ See Skumatz, et. al., “PAYT / Variable Rates for Trash Collection: 2014 Update”, Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO for EPA Region 9, 2015, and Skumatz; “Source

Metro Role:

- Required Public process
- Ordinance or Updated Hauler Regulations for SAYT / Embedded; Discussions with Haulers; Notice; Enforcement
- Ordinance for Food Waste Ban; Notice; Enforcement
- Encourage expansion of Recycling and Organics facilities; encourage expansion for acceptance of food
- Outreach to explain the program and solicit responses regarding desired container sizes
- Modifications to Metro’s billing system

Metro Budget Needs (in two parts):**Costs for Designing / implementing the ordinance, Public process:**

Staff Time: 25% FTE for public process, ordinance, and outreach development. Enforcement of hauler compliance is significant; assume 50% FTE for 1st year, and rest covered by inspectors checking compliance with bans.

Direct costs: Education materials \$2/hh (outreach is covered by strategy 21).

Funding Source: Combination of General Fund or Enterprise Fund (education) and hauler surcharge (compliance).

Costs for SAYT Rollout in Metro Area:

Staff Time: Updating billing system capabilities may cost up to \$20K (repeated billing of a set fee) to \$100K or more depending on existing system capabilities (specialized consultant or staff time). Metro Staff time for SAYT roll-out: If 25%-40% of Metro’s 55,000 households calls 10 minutes, temp CSR staff needs are 3-4 FTE (will need about twice as many for 6 months, then let go, but for budgeting purposes we show annual figures). Approximately 30 new drivers are needed on an on-going basis.

Direct costs for switch to 3-bin service (adding 2 bins for most households), assume 30 new trucks for Metro area at \$350K each is \$10.5 million (spread over 8 years minimum). Two new containers per household at \$55 each is \$6 million plus 10% for spare carts. Assembly / Cart delivery can add another \$7/cart, but we exclude here assuming Metro may receive discounts for large orders. Ongoing costs \$13-19/hh/month for service, including maintenance, etc.³⁸ Assumed no major new billing costs once system is running.

Reduction can be Measured”, Resource Recycling, 8/2000; Skumatz, “Measuring Source Reduction: Pay As You Throw (PAYT) / Variable Rates as an Example”, SERA Technical report, included on EPA website, 5/2000.

³⁸ *Costs from Skumatz PAYT manuals and SERA PAYT residential collection / cost computation model.*

Funding: Note these funds are generally paid out of / can be embedded into the SAYT user fees (self-funding).

The cost of the residential SAYT (S3 strategy) roll-out is greater than for other programs, however, these fees are directly paid by household rates.

S41. Landscapers must bring Compostables to Composting Site – Phase 1

Description: Landscapers will be required to bring organic materials to Metro-recognized sites that divert the organics for composting. This may include separate streams at transfer stations, or directly to composting facilities. Landscape services may be fined, and ultimately lose their business license for violations (TBD).

Diversion Modeling Targets: The modeling for this strategy assumed moderate levels of diversion of residentially-generated and some commercially-generated yard waste.

Metro Role:

- Metro or consultant researches ordinances language; Metro drafts and pass ordinance, post / advertise to landscaping firms and to the general public (notifying households and businesses that contract for the service)
- Enforcement inspectors to randomly inspect transfer station and landfill truck traffic and take complaints (from a Metro hotline); and to implement / follow-up on fines.

Metro Budget Needs:

- **Staff time:** 5% FTE developing ordinance, passing, notifying. Enforcement plan assumes 10% FTE, due to volume of building in Metro.
- **Direct costs:** No significant direct costs assumed.
- **Funding Source:** No significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates

S8 & 9. Enforce Existing Bans - Phase 1

Description: Bans can be among the most effective and cost-effective solid waste management strategies in the portfolio.³⁹ Metro has done the hard work – getting the bans in place. This Strategy helps these bans realize their potential by adding stronger enforcement. Metro enforces the bans it currently has on the books, including Yard Waste, Cardboard, and Electronic Waste. If penalties do not currently involve substantial fines, Metro (or under the powers of a new solid waste authority) develops ordinances to make generators responsible, and a series of penalties

³⁹ SERA research indicates that portfolios with bans can deliver 11 to 30 times more tonnage than plans that rely on more voluntary strategies including education, incentives, and opt-in programs – at similar City cost. See Burns and McDonnell and Skumatz Economic Research Associates, “CDPHE – Colorado Integrated Solid Waste and Materials Management Plan”, June 2016, and Skumatz, “Some Things that are Cooking in Recycling Research...”, Colorado Association for Recycling (CAFR), spring 2013 newsletter for more information.

should be incorporated into the ordinance.⁴⁰ Inspectors perform random inspections at home and business containers. First infraction leads to a warning letter; second infraction involves a fine; third infraction assesses a larger fine. Enforcement of payment may potentially include extra assessment on utility bills. Enforcement of bans is critical to the success of this strategy. The legal and programmatic challenges to enforcement will be assessed during the implementation phase.

Diversion Modeling Targets: The modeling for this Strategy assumed substantial diversion of residentially-generated and commercially-generated Yard Waste, Cardboard, and Electronic Waste banned from waste containers.

Metro Role:

- Enforcement inspectors to randomly inspect household and business trash containers for the presence of more than trace amounts of the banned materials, take complaints (from a Metro hotline) and to implement / follow-up on fines.

Metro Budget Needs:

- Staff Costs: Conservative estimate for enforcement for ALL bans (including upcoming bans) is 7 FTE, with potential to ramp to that number.
- Direct Costs: Cars assumed to be \$20K each per year in direct costs.
- Funding Source: Enterprise Fund, generator fee, or rates.

S10. C&D – Require Recycling Containers with all C&D Trash Service - Phase 1

Description: By ordinance, haulers providing trash service or containers to a C&D job site must provide a recycling container of at least half the size of the main container. Include the flexibility that the size of the second container may be scaled up over time by Metro as more recovery facilities become available. Inspection / enforcement is to hauler, and inspectors drive to job sites and view. First infraction leads to a warning letter to hauler; second infraction involves a fine; third infraction assesses a larger fine and potential loss of business license.

Optional added inspection (if needed): Enforcement of reasonable degree of diversion by the C&D site. In this case, the haulers inspect the containers, and if reasonable care has not been taken to separate valuable / easily-recycled materials (wire, metal, cardboard, etc.), the construction firm at the job site may be penalized. In this case, enforcement is first infraction receive a warning letter, second infraction results in a fine, and third infraction involves a larger fine. Payment enforcement TBD.

⁴⁰ According to SERA case studies, interviews, and research, these features represent our assessment of best practices in bans / mandates / enforcement. Skumatz, "Mandates and Bans: SERA White Paper", Skumatz Economic Research Associates, 2012, updated.

Diversion Modeling Targets: The modeling for this Strategy assumed low-to-moderate diversion of C&D, largely from the separate C&D sector (less from household-generated C&D).

Metro Role:

- Metro or consultant researches ordinances language, drafts and passes ordinance, and subsequently post / advertise to haulers and builders / C&D / demo firms, etc. on new requirements.
- Enforcement inspectors to randomly inspect job sites (and take complaints on a hotline) and to implement / follow-up on fines.

Metro Budget Needs:

- Staff: Metro staff or consultant time 1-2 weeks (5% FTE), assumed inspectors identified under strategy 8/9 can enforce.
- Direct Costs: None.
- Funding Source: No significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates

S20. Public Space Recycling - Phase 1 (carrying over to Phase 2)

Description: The Public Works Department works with the Parks and Recreation Department to install, or where needed improve, paired trash and recycling bins with appropriate restrictive lids and effective signage at City / County parks. The program starts in Phase 1 and carries over to Phase 2. The recycling bins must have special lids to discourage contamination. Bins must be emptied at such frequency that they are not overflowing or lead to litter. Over time, Metro installs bins at more and more parks / downtown areas.

Diversion Modeling Targets: The modeling for this Strategy assumed relatively low diversion of single-stream-recycling mix materials because case studies and research shows fairly high contamination from these programs; however, they are usually considered an important and visible part of a Metro's recycling program.

Metro Role:

- Metro or consultant research to identify key first parks and downtown areas for implementing the program; bulk purchase of containers suitable for the two different areas;
- Install paired containers and appropriate, instructional signage
- Perform regular, adequate collection (or contract for collection)
- Expand the program / coverage over time.

Metro Budget Needs:

- Staff Time: Metro / consultant time about 3 weeks;

- **Direct and On-going Costs:** Containers, signage, placement, and service for 600-1000 paired containers (300-500 sites around the Metro area) could cost about \$1 million. Capital costs are about \$650K plus, and operations would cost about \$200K-400K per year of staff, trucks, (net) tipping fees, and amortized containers.⁴¹ This program is assumed to ramp up over a series of years; tonnages are quite low. Assume capital costs are spread over 5 years.
- **Funding Source:** Significant costs; will need to fund from grants (for some containers), enterprise fund, generator fee, or rates

S21. Public Education / Outreach (including Businesses) - Phase 1 (all Phases)

Description: Metro assesses its current outreach / education program and prepares enhanced outreach to support the rollout of the variety of Phase 1 strategies. Outreach to Businesses should be an important element, provided by Metro and in partnership with appropriate agencies (e.g. Chamber of Commerce, Metro Business or Licensing departments, Building Permit Division, and elsewhere). The outreach should address the variety of programs; however, residential outreach should focus on explaining the SAYT / 3-bin program, including why Metro is implementing the program, how the program works for the household, and tips for successful use. Social marketing approaches should be part of the outreach work, potentially working with City non-profits and NGOs, or others. Metro may elect to include a contract for production of outreach materials. Outreach should be conducted via a range of media including radio, newspaper, newsletters, web, Facebook and others. The impacts of outreach strategies have been measured⁴² and while they do not deliver the most tonnage, nor are they the most cost-effective, they are an important part of a solid waste management portfolio and should be delivered as cost-effectively and efficiently as possible.⁴³

Diversion Modeling Targets: The modeling for this Strategy assumed relatively low net diversion of residential and commercial single-stream mix, yard waste, food, and source

⁴¹ Information on Best Practices for Public Space Recycling from Skumatz and D'Souza, "Public Space Recycling: Benchmarking Study and Toolkit", Skumatz Economic Research Associates, 2018, prepared for Keep America Beautiful.

⁴² From Skumatz Economic Research Associates research. See "Education / Outreach Programs in Recycling: Impacts and Effects", SWANA Wastecon, 2006; "Optimizing Education and Program Outreach: Measuring the Impacts of Recycling and Resource Conservation Programs", prepared for SWANA WasteCon 2001 proceedings, October 2001; "Evaluating the impact of recycling education", Resource Recycling, August 2001; Skumatz, "Evaluating The Impacts Of Education / Outreach Programs – Lessons On Impacts, Methods, And Optimal Education", Proceedings of the 2000 ACEEE Summer Study, Asilomar, CA, 2000; Skumatz and Green, "Evaluating the Impacts of Recycling / Diversion Education Programs – Effective Methods and Optimizing Expenditures" for Iowa DNR, Econservation Institute, 2002, updated periodically.

⁴³ See Skumatz and Freeman, Spending Your Outreach Dollar Wisely: Increasing Recycling Using Community-Based Social Marketing", Waste Advantage, February 2012; Measuring the Impacts of Social Marketing on Recycling – What is the "Bang for the Buck"? Is it Worth It?", Proceedings of the SWANA WasteCon Conference, 2011; Skumatz, "Does Social Marketing Work: Addressing Measurement Gaps in Impacts and Retention for Behavioral Programs, Proceedings of the IEPEC Conference, 2011, Skumatz, "Social Marketing – How Cost-Effective is it?", Resource Recycling, April 2010.

reduction. Even with strong programs, education itself does not show itself (statistically)⁴⁴ to be a large contributor to diversion; however, we used higher-end numbers because we assumed best practices in the outreach / education approach. Education is an important component of successful programs.

Metro Role:

- Metro or consultant assesses the effectiveness of current outreach methods and identifies the outreach needs for residents and businesses and what are the key programs.
- Working with professionals or Metro’s department, craft outreach strategy, key messaging, test, and deliver messaging to residential and business sectors.

Metro Budget Needs:

- Staff time: High diversion cities can spend considerable funds on outreach, and Metro will need a substantial push in the early years to roll out the new programs. Some staff assumed already assigned; we assign one extra FTE in the first year and increase by 20% FTE (ongoing) because there will be periodic roll-outs of new initiatives.
- Direct Costs: Based on estimated costs of \$1/capita - \$1.50/capita, Metro might see costs of \$600K-\$1 million; assume costs are spread over two years. This will include some business outreach. Social marketing costs, and inclusion of schools programs could increase this by 50-100%. Assume outreach consultant assistance of \$75K periodically. Basic on-going outreach is not a new cost; adding about \$200K for enhancing the quality of outreach in Metro.
- Funding Source: Enterprise fund, generator fee, or rates.

S19. Small Business and Schools Policies / Programs and Space for Recycling Ordinance for MF and Commercial - Phase 1

Description: Metro implements a multi-pronged program to aid small businesses and schools in increasing recycling. The strategies should include, at a minimum:⁴⁵

1. Ordinance requiring “Space for Recycling” in All Commercial and MF Remodeling & New Construction: Metro passes an ordinance requiring that all new construction and substantial remodels in the commercial and larger MF sector (>4 units) must include allocation of space to accommodate space for recycling (meaning recycling and organics combined) that is at least as large as the required space for trash. This is to be included in building codes / permit process, and ideally, no COO is provided unless the condition is met.

⁴⁴ Skumatz, “Social Marketing – How Cost-Effective is it?”, Resource Recycling, April 2010; Skumatz and Green, “Evaluating the Impacts of Recycling / Diversion Education Programs – Effective Methods and Optimizing Expenditures” for Iowa DNR, Econservation Institute, 2002, updated periodically; and other sources.

⁴⁵ These strategies from SERA Research. See Burns and McDonnell and Skumatz Economic Research Associates, “State of Colorado Integrated Materials Management Plan”, prepared for CDPHE, 2015 and other SERA studies.

2. Ordinance requiring that MF buildings must have a dumpster for recycling as well, with effective signage. The size should be no less than half the trash size.
3. Clear Invoicing:⁴⁶ An ordinance should be passed that requires that invoices for commercial collection service from haulers must clearly / transparently label all services, sizes, and frequencies of the services being delivered, the cost for the service, and provide information on where to call for additional information on recycling.
4. Technical Assistance: Technical assistance, using Metro staff / contractors or consultants to work with individual businesses that request the service, can provide tailored in-business advice on strategies to recycle or compost more materials from the business. The service should be provided to small businesses at zero or token cost. Metro may elect to explore savings-sharing relationships for larger businesses. Many cities also conduct targeted outreach to advertise the program, targeting certain business types first (offices, restaurants, etc.).
5. Recycling Plans: Require business recycling plans by businesses. Metro or consultants will design a web-based drop-down form that all businesses must complete; a copy retained on-site for inspection. Less commonly, the plan is “filed” with Metro (or less preferably, with the hauler). The form does not require behavior change, but forces the business to walk through the process of determining if they might save money by recycling or composting more. In addition, it makes it clear where they can look for services.
6. Web Information and Optional Hotline: Metro or consultants should develop a website targeted to small businesses. It includes information on how to recycle or compost /divert, where to look for haulers that recycle, tips and case studies from peer-type businesses, and other information.
7. Small businesses may be put on Residential Recycling Collection Service: Metro may elect to route through areas with small businesses using residential containers and service (up to 1 96-gallon cart). The service should be provided a no charge or low fee. This addresses a critical recycling barrier for small businesses – the fact that trash plus recycling costs more than trash alone.
8. Recognition Programs: Metro develops a program to establish criteria by which businesses can receive a version of a “Green” certification / label that is recognized within Metro. The certification is different with increasing levels (one star, two stars, etc.), and the criteria is usually somewhat tailored to major business categories (e.g. office criteria are different from restaurants, dry cleaners or auto shops). Businesses start with a self-report form on program basics, as part of the request to Metro to be inspected for the program. Certified businesses receive a door / window static sticker large enough to be noticed by customers and may be highlighted in Metro’s newsletter or website.
9. Possible Grants for Bins: To reduce one of the recycling / composting barriers some businesses see in the cost of internal recycling / composting bins, Metro establishes a fund that buys and distributes bins to businesses requesting the containers. A request system is established.
10. Possible First Three Months of Service Free: Metro sets aside a determined pot of funds and businesses that sign up for organics or recycling service (prior to the implementation

⁴⁶ From SERA research, see Skumatz, *Resource Recycling*, “Cracking Commercial Contracts: Commercial recycling can be thwarted by codes and clauses within hauler contracts that leave businesses ignorant of diversion opportunities”. *Resource Recycling*, September 2014.

of Commercial SAYT) for at least a year, can receive the first 3 months of service “for free”.⁴⁷

11. Schools Programs: Technical assistance and information on best practices, schools challenges and recognition, small grants, curriculum and tours, and other programs.
12. Other programs, to be developed.

Diversion Modeling Targets: The modeling for this Strategy assumed low to moderate diversion of commercial single-stream mix (focused on paper / cardboard, and other commercial constituents). Diversion expectations are not high because the programs exclude large firms, and because these strategies exclude significant financial incentives.

Metro Role:

- Metro or consultant researches ordinances language, designs a suite of programs, pre-tests, and advertises
- Set up web sites
- Hire consultants or train in-business technical advisors; develop technical assistance program, business recognition program, and business plan documents / programs.
- Set aside funding for the grant-type programs; identify sourcing for in-house containers
- We assume no significant enforcement for the business plans at this level; enforce clear invoicing through inspection of hauler records conducted through enforcement of other programs like SAYT.

Metro Budget Needs:

- Staff time: 25% FTE staff or consultant to plan the suite of programs. 4-8 FTE Metro or consultant for technical assistance program and business recognition program.
- Metro Service Costs: Adding businesses onto residential service (GSD) \$50K-\$100K.
- Direct costs: Grants for 3 months service \$25K-\$50K grant; bin grant program \$25K-\$50K (flexible based on Metro budget).
- Funding Source: Enterprise fund, generator fee, or rates.

S11. C&D and Compost – Require / Reward Recycling and Reuse of C&D and Use of Local Compost in Metro Contracts and Jobs - Phase 1 or 2

Description: Metro contracts involving any construction and demolition require recycling of materials of a threshold percentage of material generated during the process (the threshold percentage increases over time). Firms not specifying their planned practices are ineligible to receive the contract; firms specifying more aggressive recycling strategies receive higher points.

⁴⁷ For additional description of many of these strategies see City of Denver and Skumatz Economic Research Associates, “USDN: 2013 Roadmap to Commercial Waste Reduction”, 2013.

In addition, Metro requires that any construction, road / transportation, or other jobs that involve soil amendment of any kind must use locally-generated compost. Firms proposing must do so or they are ineligible; again, firms that identify ways to use more material may receive more points. All work done by Metro must also use these materials. Metro “walks the talk” and helps pave the way for firms to hone practices related to reuse and recycling of building / demolition-related materials. This type of strategy would likely require changes to procurement / purchasing requirements since many public construction projects are awarded based on low bid.

Diversion Modeling Targets: The modeling for this Strategy assumed very low diversion of C&D and organics, mainly because government sector construction does not represent the majority of development in Metro.

Metro Role:

- Metro / consultant develops standards and language for ordinance; pass ordinance; post and advertise.
- Metro / consultant identifies appropriate language for RFPs / contracts.
- Metro notifies all departments of changes in rules on C&D, compost, road projects, etc.
- Metro Budget Needs:
 - Staff time: 5% -10% staff time to craft language suitable for legal contracting and purchasing / procurement, and make sure the language is inserted into all relevant contracting.
 - Direct Costs: No direct costs assumed; this may be a simplification if required C&D reuse increases cost of Metro contracts; however, pre-planning can reduce costs.
 - Funding Source: No significant on-going Metro costs beyond potential increases in contracts. Short term, enterprise fund, generator fee, or rates.

S24. MF Pilots - Phase 2

Description: This strategy establishes a proposal-based grant program that allows haulers and potentially non-profits to propose ideas for programs that will increase recycling in larger multi-family buildings (>75 units) that will be an incubator for strategies that might work as a Metro-wide roll-out. The grant program should require significant metrics and tracking and record keeping on costs so the results may be used by Metro to compare options and allow Metro to develop a full-scale program in Phase 3 or 4. The goal is to try to work with as many haulers with different ideas as possible.⁴⁸

Diversion Modeling Targets: The modeling for this Strategy assumed nearly zero diversion of MF-generated single stream recycling mix, because it is only a pilot program. Food waste may

⁴⁸ Design based on helpful discussion with Bob Gedert, RRS, based on programs he developed in Austin and Fresno (January 2018)

also be diverted, depending on the pilot submittals, but significant tonnage does not occur until programs expand beyond the pilot level.

Metro Role:

- Metro or consultant develops RFP, Metro advertises to haulers and potentially Non-profits. Staff / consultant personal outreach to haulers and potential bidders to encourage participation. Accept proposals at least twice a year in the early phases to allow word to grow.
- Score proposals, and award grants to strong-scoring proposals.
- Monitor and check paperwork / reporting, pay as agreed.
- Review results / performance and examine the results for programs with potential on a wider scale.

Metro Budget Needs:

- Staff needs: Assume this is an important preparation project for meeting the needs of this sector. Assume 50% or more staff person.
- Direct costs: Approximately \$25-50K each for 7-12 projects (\$400K).
- Funding Source: May include significant on-going Metro costs; consider enterprise fund, generator fee, or rates

S33-34. Fee for Single Use Bags (or Ban) - Phase 2

Description: Metro develops / passes an ordinance for a fee for single use paper and plastic bags. The small fee (5-10 cents) is shared in some proportion with the retailers. The program will likely result in an 80% or greater reduction in plastic (and paper) bags in the waste stream. Although they do not represent large tonnages, plastic bags in particular are an issue in recycling facilities, litter, and drainage, as well as wildlife safety.⁴⁹ Single use bag fees (or bans) can also be an effective strategy for achieving these other goals, for providing a visible and constant reminder to households to remember that behaviors and choices matter, that there are alternative to the traditional choices, and they are often desired by factions of the local “green” community. S33 covers implementation of this strategy in single family areas and S34 covers implementation of

⁴⁹ SERA Research. For more information on design choices, impacts, and case studies, see Skumatz, Freeman, and Friend, “Of Bags, Bans, and Fees”, *Resource Recycling*, March 2012; Skumatz, et. al., “The Bag Basics”, *Resource Recycling*, November 2016. Research on costs, administration, and options from Skumatz, “Advance Disposal Fee (ADF) Options Research, Skumatz Economic Research Associates, Prepared for Alameda County StopWaste, 2010.

this strategy in multi-family areas. The difference between these two strategies is nominal; there is no difference in implementation.

Metro will need to identify an administration system, identifying all covered retailers through Metro Business License system; in addition, a Nexus study to identify the direct Metro cost (in litter clean-up, etc.) to justify the fee will be needed. Metro may wish to notify useful supporters / interested groups as the legislation comes forward (environmental groups concerned with clean rivers, hunters, school children) and to craft the program. The program represents a revenue source to Metro for certain programs / efforts. Metro may wish to establish a canvas-bag giveaway program, focusing on low income neighborhoods.

Diversion Modeling Targets: The modeling for this Strategy assumed strong diversion of the small (by weight) share of residential and multi-family-generated plastic bags; the case studies upon which this strategy is crafted show fees and bans can reduce this stream by more than 80%.

Metro Role:

- Metro contracts to have Nexus study conducted, Metro / consultant researches and crafts ordinance; Metro passes / posts ordinance, advertises widely to residents and businesses
- Sends information to retailers explaining program and setting up administration system.
- Considers reusable bag giveaway program, focused on low income neighborhoods.

Metro Budget Needs:

- Staff Costs: Metro or Consultant research on design, administration options, funding, and development of ordinance 15% FTE. On-going the program may take up as much as 10% FTE potentially if administration requires significant special outreach to businesses.
- Direct costs: For Nexus study: \$40-75K; Administration notification costs and coordination on taxes with businesses: Zero if already conducting outreach for businesses; otherwise, assume \$50K. Costs for Bag giveaway: \$25K-75K, depending on Metro's perceived need; optional add-on.⁵⁰
- Funding Source: No significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates.

S4&5. Enforce Food Waste Ban in the Residential and Commercial Sectors - Phase 2

Description: Metro adds enforcement of the residential and commercial food waste ban to the responsibilities of the inspectors assigned to enforce the “existing bans”. Inspectors perform

⁵⁰ There may be additional costs, depending on requirements in Metro. An interview with Bob Gedert indicates Austin spent \$50K for legal notification to affected businesses, conducted a 2-year education campaign (\$250K), and enforcement officers (Austin was able to enforce with existing staff). It is unclear whether these costs will apply in Nashville.

random inspections at home and business containers. First infraction leads to a warning letter; second infraction involves a fine; third infraction assesses a larger fine. Enforcement of payment may include extra assessment on the water bill (with threat of water shutoff if not paid). This is especially important to enforce once facilities that can take food waste are on-line.

Diversion Modeling Targets: The modeling for this Strategy assumed moderate-to-fairly strong impacts on the remaining food scraps in the residential and commercial sector. Additional tonnages of this material are diverted later when collection frequency for trash changes.

Metro Role:

- Enforcement inspectors to randomly inspect household and business trash containers for the presence of more than trace amounts of the banned materials, and take complaints (from a Metro hotline); and to implement / follow-up on fines.
- We assume no additional inspectors are needed.

Metro Budget Needs:

- Staff time: No additional staff costs or direct costs beyond those enforcing existing bans (listed above).
- Direct Costs: As listed above.
- Funding Source: No significant on-going Metro costs / covered by another strategy.

S6. Allow / Incentivize and (Eventually) Require Every Other Week Trash Collection at Lower Cost - Phase 2; Phase 4

Description: Metro or consultant conducts research and take steps to eliminate any Metro, city, county, or state health department or other barriers to every other week collection of trash, and/or change existing regulations to modify language from trash to “putrescible”. Once barriers are removed – and once a facility is available to take food waste -- modify the SAYT hauler ordinance to require that haulers offer an every other week trash collection rate at a non-trivially-lower rates (recommended thresholds to be established with more research). In Phase 4 this changes to a mandatory every-other-week (EOW) trash collection regulation. Ordinance requires haulers to advertise the option to all residential customers annually on the bill. The optimal ordinance would include requiring all haulers to move yard waste / food waste service to weekly for all households.

Haulers provide stickers or different lids to clearly mark households on EOW service on the containers to identify households on the service (and to effectively advertise the service to other customers. This program is expected to drive food waste from the trash can to the organics can; a share of households have proven reluctant to move food to the organics container without this added incentive and EOW collection of trash can help modify this behavior.⁵¹

⁵¹ From Skumatz “Every Other Week for Everything”, *Resource Recycling*, November 2013; Skumatz, “Alternating weeks: Options and opportunities for garbage and recycling. Can every other week provide

Diversion Modeling Targets: The modeling for this Strategy assumed fairly strong impacts on the remaining food scraps in the residential sector.

Metro Role:

- Metro or consultant conducts research to find and eliminate Metro / city / county / state health department or other regulations that pose barriers to EOW collection of trash; include research of any barriers on the commercial side to prepare for a later Task 4 strategy.
- Metro/ consultant identifies the appropriate price discount/ incentive threshold for the service. Pass 2-part ordinance, allowing incentivized optional EOW trash collection, and giving the authority to the DPW (via memo) to modify the ordinance to require EOW as an option, unless households elect to pay a premium fee for weekly collection. Metro invokes this strategy if Metro waste sorts indicate significant food waste remains in the trash, or if goals are not being met.
- Metro crafts an ordinance; passes, posts, and specifically notifies haulers. Metro inspectors check routes for reasonable number of customers on EOW service, and inspects hauler records to assure haulers are complying. No new inspectors are needed; assumed the same inspectors enforcing SAYT will add this to the inspection list.

Metro Budget Needs:

- Staff Time: Metro / consultant staff time for research 10%-15% FTE. Assume no new inspection staff.
- Direct Costs: New container costs do not involve full container purchases but do include new lids or decals (assume 10% of containers switch to the service, with a retrofit cost of \$25 each). Some savings in routing.
- Funding Source: Costs reimbursed from user fees.

S15. Convenience Center – Minimum Requirements for Access and Services - Phase 2

Description: Metro draws maps with concentric circles around the existing convenience centers / recycling centers with reasonably complete services and identifies areas without good access. The ideal is that citizens are not more than 5 miles away from convenience centers or 1.5-2 miles from recycling drop-offs (TBD). Metro looks for service deserts (especially around multi-family households) and looks for locations (either new land or partners willing to use part of their lot) to establish additional convenience centers. The centers should accept an enhanced list of recyclables (including, potentially, color separated glass), and possibly compost / brush (TBD, or

greater efficiencies and incentives for the future?” Resource Recycling, September 2007, Burns and McDonnell and Skumatz Economic Research Associates, “State of Colorado Integrated Materials Management Plan”, prepared for CDPHE, 2015 and other updates.

may be phased in). Metro will need to comply with regulations, including steps, potentially lighting / power, specially-designed lids, etc. The site should be staffed when open.

There are currently 4 convenience centers providing service for Nashville’s 680,000 residents (200K:1). This number is not dramatically different than the ratio in Austin (4 sites for 930,000 households), or ratios in other cities like San Jose, San Francisco, or other locations.⁵² However, comparisons are difficult. Inevitably there are also networks of private and non-profit drop-off centers that augment access to some degree.⁵³ Comparisons are also difficult because reliance on drop-offs decreases as enhanced (and mandatory) curbside services become available.

Drop-offs can be an important part of a system. Drop-off / convenience centers can provide access for some multi-family, small commercial, and most importantly, can be set up to allow recycling of materials that may not be collected at the curb – and can be particularly appropriate as a location for recycling glass, as it can allow color sorting and is kept separate from fibers and plastics, and improves cleanliness and market value of recovered materials.

The bottom line is “convenient access” is needed for sites to be used – potentially defined in relation to simple distance, or potentially with an element introduced regarding places people would tend to go anyway (e.g. shopping centers, grocery stores, etc.). Developing guidelines for what constitutes appropriate and convenient “access” can draw on some precedents but it is complicated in a time when Metro envisions implementing a set of strategies that dramatically improve access from residential and commercial curbside programs, mandates, bans, and incentives. Three miles⁵⁴ may be a suitable first-cut for convenience, and no matter what the distance, “similar” access may be a relevant goal.⁵⁵

⁵² The other extreme is Dallas, with hundreds of little drop-offs / dumpsters scattered in areas like downtown and multifamily areas; contamination can be an issue in unstaffed sites like this. (SERA case study)

⁵³ *Some are one-material; others take more, but they are hard to quantify and classify. Furthermore, these facilities, usually suffer from being less well-known / advertised to the public, and less used (unlike sites we’ve analyzed in Anchorage and a few other locations with somewhat unusual recycling situations).*

⁵⁴ *In a bit of an inverse interpretation of the logic for “access” for bottle bill redemptions in California, it could be interpreted that convenient access was generally defined as about a half mile for urban / suburban areas, or else three miles in rural areas. This is for a very mature state and was really defined to assure good distribution (rather than crowding) of redemption centers. We are proposing multiples of these values for minimum access to convenience centers. SERA case study.*

⁵⁵ *ignoring issues of grocery store magnets, and ignoring the presence of a separate network of private facilities)*

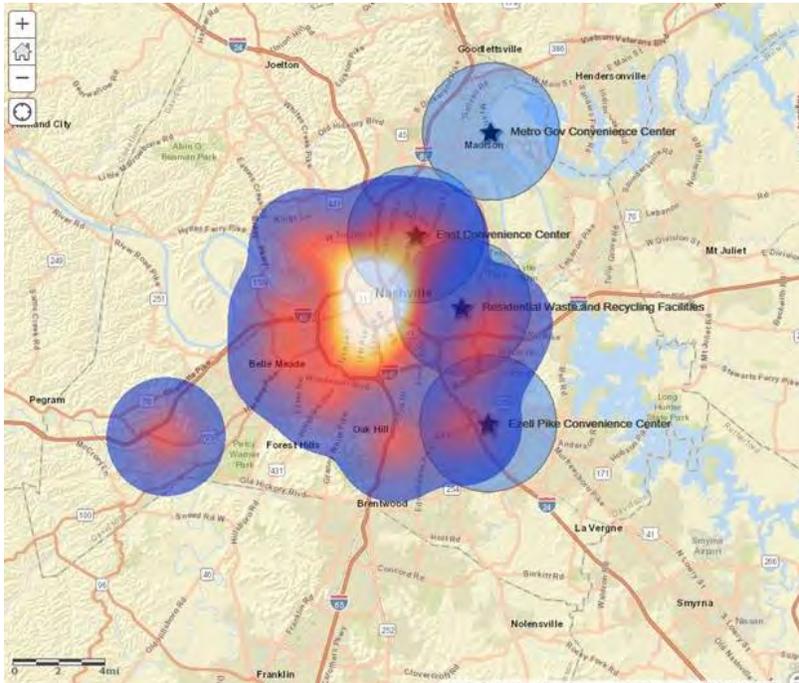


Figure F-10
Davidson County Population Density Map superimposed with Convenience Centers with 3-mile distance radii

Figure F-10 shows a map of the location of population centers in Davidson County, and the locations of the drop-off facilities. With a 3-mile radius around sites, the population in the eastern half of Metro is well served; the western half is not served equally well.⁵⁶ We suggest Metro will need a minimum of two (and possibly 3) additional sites, in the western areas, in order to provide similar convenience of service.

Program Design: For planning purposes, we assume Metro sets a threshold of facilities within three miles of a large percent of the population (90%) and identifies that 2-3 staffed facilities are needed. In addition, these sites should provide full service and enhanced access for materials not currently / near term accepted in the curbside container. They should take separate colored glass (in bunkers or containers), major single stream materials, and potentially brush, textiles, and possibly Styrofoam or other materials for which markets can be identified / developed. This will be a focus of on-going study for Metro. Metro may save money by developing sponsors, or private partners.

Diversion Modeling Targets: The modeling for this Strategy assumed smaller effects on recycling and brush than the existing convenience centers. The materials were assumed to be

⁵⁶ Fortunately examining the income distribution within Davidson County, it appears that the current sites are concentrated in the lower income areas; they are receiving fairly good access from the current sites.

drawn from the single family, multifamily, and (small) commercial sectors; however, the calculations assumed some diversion came from non-curb-side materials.

Metro Role:

- Metro / consultant identifies locations of current facilities, and service deserts and confirms priority / valued materials to be diverted.
- Metro undertakes development of new site(s) over time.

Metro Budget Needs:

- Staff Time: We assume 10% staff / consultant time to conduct the basic analysis of population distribution around existing convenience centers, examine materials and markets, discuss MRF needs, and conduct preliminary discussions around the need for site(s). On-going staffing time is also assumed. The planning for each site will be significant.
- Direct Costs: According to RRS, the cost for each site in capital costs (excluding land and site preparation), and annualized, may be \$310K/year. On-going costs for each site (RRS) is expected to be \$850K/year. If Metro develops a second site, these costs will increase in step. Note there are some differences in the population per site ratio at current sites and the assumptions in the RRS planning numbers.
- Funding Source: Significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates

S42b. Change Building Codes to Require Soil Amendment using Local Compost - Phase 2

Description: Under this strategy, Metro building code is amended to require that with all new residential and commercial construction, soil amendment must use locally-generated compost. On-site building inspectors enforce use of material *and use of the material must be demonstrated for occupancy permit to be provided*. This is a critical step -- a secure demand for product -- that establishes markets for the product and allows local compost facilities to be profitable, and “closes the loop”. Compost is, at its best, a local product and cannot economically be shipped far; without this requirement, diversion (and processing) is required, generating a product with minimal demand, and the economics of the system (and facilities) are weak.

Diversion Modeling Targets: The modeling for this Strategy assumed limited tonnages of organics; the major impacts are the circular economy / economic market development effects, rather than direct tonnage.

Metro Role:

- Change building code to require soil amendment must be locally-generated compost; advertise / publicize
- Change inspection procedures to incorporate this step in order for occupancy permit to be provided.

Metro Budget Needs:

- Staff time: 10% FTE for development of ordinance and working with relevant departments to understand / incorporate into procedures. Assume it is integrated into existing enforcement / inspections of buildings and sites (simplification).
- Direct Costs: None for Metro.
- Funding Source: No significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates.

Description and Funding Needs for High Performing Strategies – Phase 3 and 4 Strategies**S7. Commercial SAYT and ABC Law (adapted), Supporting Bans, and Enforcement - Phase 3**

Description: The commercial sector is responsible for a majority share of waste disposal in Metro, and this strategy focuses on removing barriers from commercial recycling and organics diversion and allowing businesses to see more unambiguous financial incentives to reduce disposal. The main element of this strategy is to require that recycling (*and organics service*) be provided to all businesses with the cost of the program embedded in the trash fee – so that recycling plus trash is no longer more expensive than trash service only.⁵⁷ Significant increases in recycling are attributed to this strategy.

The strategy is implemented through an ordinance including the following key components:

- All haulers and businesses providing trash service in the commercial sector must provide recycling, and for limited business types, organics service. Costs to provide these services may not be separate and must be embedded in the trash bill. Minimum acceptable materials are identified and updated / enhanced periodically by Metro (Memo by DPW) to meet and push local MRFs.
- Recycling service no less than 96 gallons, (and food scraps in containers no smaller than 32 gallons) and the combination of organics and recycling service must be equal to the businesses' trash service volumes, with costs embedded in the trash fee (no separate fee). Recycling service may be provided in multiples of 96-gallon carts if screening, space, or other issues arise. Note that Metro will want to increase the multiple as Metro's goals move forward (e.g. 150%, etc.; equal service levels equate to just a 50% diversion achievement for the Commercial sector).
- Metro may change the ratio of recycling / organics to trash service required with a PW Director memo. The program may phase in, starting with largest businesses first, according to the PW Director; however, it may not take more than 3 years to include all businesses.

⁵⁷ Information on Commercial SAYT / PAYT from SERA Research. See Skumatz, et. al., "PAYT / Variable Rates for Trash Collection: 2014 Update", Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, 2015. For EPA Region 9, and Skumatz et. al., "PAYT: 2006 Update" for SERA and EPA, January 2007 and other research.

- ABC law requires that business with Metro beer licenses must certify / demonstrate they have a program for recycling all beverage containers or their beer license may be revoked.⁵⁸ Utilization of the ABC law to drive diversion at businesses that serve liquor would require implementation at the state level; however, on the local level the Metropolitan Beer Permit Board Rules and Regulations could be updated to require businesses with beer permits to have a recycling program. We also adapt this law to require that organics service (food) will be provided to all customers with food licenses/ targeted food businesses (groceries, cafeterias, schools / universities, restaurants, etc.) in containers from 32 gallons and larger, or their license may be revoked.⁵⁹
- Metro has the right to inspect company records to verify compliance; require clear invoices; require haulers to highlight the program and objectives twice a year on bills or bill inserts
- Violations result in a letter, increasing fines, and ultimately, potential loss of the license to haul commercial waste from businesses in Metro.
- Be sure to add element for every other week (EOW) trash collection, assuming barriers are removed as part of the residential EOW research. Do not push / advertise; this additional strategy / incentive is invoked later.

Diversion Modeling Targets: The modeling for this Strategy assumed high levels of diversion of commercially-generated single-stream recycling mix, food waste, and also additional waste diversion / source reduction. Although statistical results for the commercial sector are scarce, we adapt the residential results and limited commercial case studies.

Metro Role:

- Research to identify specific language for ordinance; meetings with haulers
- Develop ordinance, pass, post / notify
- Enforcement of ordinance through inspectors reviewing business containerization (and potentially, bills), hauler records, and hotlines and issue violations and fines. Enforcement is key to level playing field for haulers.
- PW Director updates the phase in period and ratio of required recycling / organics to trash service.

⁵⁸ Liquor licenses are used elsewhere, but Tennessee's liquor license is state-level.

⁵⁹ For additional description of this ABC law strategy see City of Denver and Skumatz Economic Research Associates, "USDN 2013 Roadmap to Commercial Waste Reduction", 2013, Skumatz, "Cracking Commercial Contracts: Commercial recycling can be thwarted by codes and clauses within hauler contracts that leave businesses ignorant of diversion opportunities". Resource Recycling, September 2014; Skumatz, "Commercial Recycling, Incentives, and Innovations: Effective and Creative Programs and Collection Changes", Paper for Proceedings of the Global Waste Management Symposium (GWMS), Phoenix, September 2012, with Dana D'Souza; and other publications.

Metro Budget Needs:

- Staff time: First year - 10% - 15% FTE for additional research on development of ordinance and working with relevant departments to understand / incorporate into procedures.
- On-going staffing needs: Assume enforcement includes 8 staff, per SF. This may decrease over time, but the program involves multiple elements, including a link with the business license department to carry out the enforcement of the ABC law.
- Direct Costs: 8 cars for commercial hauler and service set out enforcement.
- Funding Source: Significant on-going Metro enforcement costs to enforce level playing field; hauler surcharge to cover oversight. If necessary, enterprise fund, generator fee, rates. Fines may cover some costs but should not be assumed to be a significant revenue source.

S12, 13, 14. C&D – Require C&D Deposit System - Phase 3

Description: One of the most effective C&D programs implemented to date has been the C&D deposit program pioneered by the City of San Jose California (and adapted by other communities since). This program requires that firms taking out building permits for construction or demolition projects for residential, multifamily, or commercial jobs must pay a financial deposit, which may be reclaimed if they demonstrate they recycled or reused a minimum threshold (e.g. 50%) of the materials generated as part of the job. The fee is based on the square feet of the job, and uses different “per square foot multipliers” depending on whether the job is new construction, remodel, or demo, and whether it is single family, multifamily, or commercial. Enforcement is through the building department; funds are not paid back unless the requirements are met. Piggybacking on an existing approval / registration process is an important element. The financial factor must be sufficient to modify behavior. Over time, a refinement to the program evolved; as the mandatory diversion led to a more stable stream of C&D, processing facilities were established. The City conducted a certification program, and certain facilities were determined to “meet” the 50% (or other) threshold. After that point, any builder bringing appropriate (and sufficient) weight slips from these facilities were deemed to have complied and could receive their deposits back. Other refinements included excluding the smallest 25% of jobs (25% of administrative burden, and roughly 10% or less of material generated). Other variations were developed in other cities, based on this pioneering model.⁶⁰

Metro would implement a similar program, using an ordinance, changes to the building permit system, and ultimately, certification of C&D processing infrastructure. In addition, a supporting C&D landfill ban will help reinforce the system.

⁶⁰ For additional description of this strategy see Burns and McDonnell and Skumatz Economic Research Associates, “State of Colorado Integrated Materials Management Plan”, prepared for CDPHE, 2015; and Skumatz Economic Research Associates and City of Denver and Skumatz Economic Research Associates, “USDN 2013 Roadmap to Commercial Waste Reduction”, 2013 and other SERA publications.

Diversion Modeling Targets: The modeling for this Strategy assumed high levels of diversion of the C&D stream, diverting goal-level amounts of material (e.g. 25%, 50%). The program has been demonstrated to be highly effective in other locations.

Metro Role:

- Metro / consultant reaches out to existing C&D processing facilities and existing builders to discuss existing capacities and behaviors, and the potential for facilities to expand in the near and longer term.
- Metro / consultant investigate financial thresholds from other cities and their early implementation strategies, establish potential / feasible recycling thresholds and exemptions, and identifies “acceptable” methods to demonstrate certification with and without certified facilities.
- Metro works with building department to modify forms and implementation/ enforcement processes.
- Metro drafts ordinance, noting that changes to recycling / diversion / reuse threshold may be updated periodically by the PW director. A phase in period should be considered to allow some facilities to begin to be established.
- Metro monitors development of (regional) C&D processing facilities and ultimately establishes a certification protocol. Metro helps address bottlenecks or problems in infrastructure development as appropriate and feasible.

Metro Budget Needs:

- Staff time: 10% FTE for development of ordinance and working with relevant departments to understand / incorporate into procedures. Assume it is integrated into existing enforcement / inspections of buildings and sites (simplification; may require a portion of a person).
- Direct Costs: None for Metro.
- Funding Source: No significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates. Note that this deposit system (unclaimed deposits) has sometimes been a supplemental source of revenues and may cover some portion of the program’s cost.

S16 & 17. Enhanced Incentives (Surcharges / Discounts) for Clean Separated Streams and Diversion at Transfer Stations and Disposal Sites - Phase 3

Description: Financial incentives can change behavior, especially in the commercial sector. In particular, a system of surcharges and tax reductions can help increase the financial incentive for recycling and organics programs over disposal. In this strategy, Metro imposes a substantial surcharge on tons disposed (landfilled or other technologies that may be implemented) for haulers, self-haulers and others bringing waste -generated within Davidson County to disposal facilities. This will include local / regional facilities directly (public and private transfer stations, landfills, etc.) and research will be needed to identify the best strategy for imposing the fee on

waste leaving the region and not stopping at any local facilities (if any). In addition, Metro should identify strategies to reduce the cost for recycling and organics streams. Some cities forgive various sales or other taxes on these streams; others require set percentage or dollar discounts for these streams as part of rate setting, and others focus on larger MSW disposal surcharges to establish this financial differential. If the surcharge is set appropriately (large enough), the program will tend to reinforce the economics of robustly participating in recycling and organics programs.⁶¹

Diversion Modeling Targets: The modeling for this Strategy assumed low to medium levels of diversion of commercially-generated recyclables and food scraps, in accordance with relevant case studies and research.⁶²

Metro Role:

- Metro / consultant researches legality of the option and works with attorney to remove barriers for strategy.
- Metro / consultant researches sufficient financial incentives to change behavior, policy options / sharing for funds, and appropriate administrative (money collection) and enforcement / compliance procedures.
- Metro crafts, passes, posts, and advertises new ordinance to appropriate stakeholders
- Metro works with affected entities to implement the option and administration departments collect / distribute funds as determined.

Metro Budget Needs:

- Staff time: 10%-15% FTE to work with attorneys to confirm / identify authority, and with administrative department to work out on-going fund transfer arrangements, and to develop / pass / post / advertise / implement the ordinance.
- Direct Costs: None for Metro / no special enforcement envisioned as it is a pricing differential. Periodic checks of signage and separate pricing could be conducted by inspectors checking for violations of bans; inspection of books could be conducted by Metro inspectors or administration on an as-needed basis as well.
- Funding Source: On-going Metro costs are covered as part of the surcharges / self-funding.

⁶¹ Quantitative research by SERA has found that participation in organics programs was nearly three times higher for public / commercial entities that faced significant differentials from these two sources. See Skumatz, et. al., "The Costs and Benefits of Minnesota K-12 School Waste Management Programs", Prepared for Minnesota MPCA, July 2014. For additional description of this strategy see City of Denver and Skumatz Economic Research Associates, "USDN 2013 Roadmap to Commercial Waste Reduction", 2013.

⁶² Op.cit.

S18. Residential Service Contracts / Franchises - Phase 3

Description: Research indicates that ordinances can make delivery of programs and services (and incentives) uniformly available within a community with relatively low objections from haulers and affected stakeholders. However, if performance is not as desired, Metro and its residents may gain additional advantages from considering contracting (or districting / franchising – basically specialized contracting arrangements) for residential service.⁶³ Contracting (including its districting / franchising) can gain three primary advantages for Metro and its residents:

- Lower emissions and lower wear and tear on Metro streets because fewer trucks go over the same streets because collection is organized and multiple haulers no longer operate in an overlapping way in neighborhoods (enhancing Triple Bottom Line analysis);
- Lower costs or rates for households because: 1) collection is geographically concentrated and economies of scale exit for the remaining haulers, and 2) service is postage-stamp-priced and achieved through a competitive bid process.
- Metro gains greater control over haulers, including more uniform program design, education materials, service options, pricing, customer service and quality, reporting, and other factors that can enhance diversion and an integrated system.

Metro⁶⁴ issues a notice publicly as well as to all haulers operating in the area / region that it intends to intervene in the sector and issue an RFP for residential collection in Metro (usually a minimum of 6 months before the service is anticipated to be transferred).⁶⁵ Metro hires a consultant familiar with this process. We recommend Metro uses a process involving a request for proposals (RFP), not a request for bids (RFB), for flexibility and ability to consider criteria beyond lowest cost. Metro may also choose to open the entire Metro Area to RFP or focus on the area not currently served by Metro. Although some cities have undertaken the first suggestion and allowed Metro to participate in the Proposal process and compete for one or more areas, we assume this process is set up such that Metro continues to serve its traditional area, and that the remainder of the area (currently served by “other” haulers) is the area competed under an RFP process.

Meetings with Metro Council will be essential to confirm whether the existing system of ordinances is sufficient, or whether a transition to contract / district / franchising, or to

⁶³ For more information on contracting, and comparisons to the ordinance option, see Skumatz, “Taking Control: How do Municipalities Organize Collection? What is the Best Way?” *Resource Recycling*, January 2013, and Skumatz et. al., “PAYT: 2015 Update”, *Econservation Institute / Skumatz Economic Research Associates (SERA)*, Superior, CO, 2015 (For EPA Region 9), See Burns and McDonnell and Skumatz Economic Research Associates, “State of Colorado Integrated Materials Management Plan”, prepared for CDPHE, 2015, and other SERA research in presentations and reports.

⁶⁴ This process reflects process SERA has used with multiple cities, and additional information is available in Skumatz, “Taking Control: How Do Municipalities Organize Collection? What is the Best Way?” *Resource Recycling*, January 2013; and other SERA publications / presentations.

⁶⁵ There are reasons to provide or not to provide this announcement before consideration of the strategy is widely known; note that there is generally no penalty if the Metro changes its mind in the event of a change in Council direction, no favorable bids, or other reasons.

municipal collection is desired. The rest of this design is written assuming a contract / district / franchise arrangement is selected. Consultant researches options for the RFP and brings a discussion of these elements to staff and a work session of the Councils to determine the key elements of the RFP. Since SAYT, embedded recycling, and other elements are already part of the system, the remaining decision items include:⁶⁶ how many districts / contracts will be offered (or general guidelines), whether one or more districts will be set-aside for small haulers or local haulers (and how small and local will be defined), specific rate structure, program requirements, periodic outreach requirements, what additional services may be assigned (e.g. public parks, bulky, metro buildings, etc.), container ownership (and possible financing help for small haulers), whether destination of various materials to facilities will be included (e.g. recycling, landfill, organics facilities, or “certified facilities”, etc.), specifying container requirements, whether Metro will separately contract for disposal or processing service and only issue the RFP for collection services, who will do billing (important), associated data transfer design (high level), and other topics. An extensive public, and/or public hearing process will likely be required at one or more points during this process, depending on Metro’s requirements, and can be beneficial.⁶⁷

After these decisions are made, the Consultant gathers information on the collection areas to identify the “districts” to be bid on⁶⁸, and researches other topics as needed. The consultant gathers information on Metro’s procurement process and requirements, develops an RFP, with criteria and associated scoring and review process, schedule for pre-bid meetings and Q&A procedures, and with appropriate contract penalties for non-performance and sample contract. The RFP is submitted to Metro for review, and consultant revised after discussion with Metro and Council. The Consultant develops a list of a large list of haulers to which the RFP should be distributed; a large list (including local, regional, and national firms) ensures the process is

⁶⁶ There are pros and cons to each of these options; SERA has developed “decision trees” and other tools to help councils and staff wade through the pros and cons of the various options, and maintains examples of RFPs and contracts from many jurisdictions around the nation. E.g. Metro billing can reduce bill collection / bad debts for the haulers, and can result in lower bills; however, the Metro must modify the billing system and develop a strong data transfer system with each of the selected haulers. Metro conducting CSR duties provides more control, but requires developing an information transfer system. Metro will want to construct contracts that provide the containers to Metro after the contract period is over (potentially for a nominal fee); otherwise the second proposal process will provide a distinct advantage to the existing contract-holders because they will not have to purchase and distribute containers – an expensive proposition and new bidders would not realistically be able to compete. Some cities consider pros / cons of carts vs. bags, and many other discussions / choices are also part of this phase.

⁶⁷ However, our experience has shown that sometimes the public process can be more fruitful if it is conducted after a point in which the (range of) savings households are likely to gain from the new system are known and can be advertised. One concern that will be noted is some customers prefer to keep the hauler they already have. Under contracts Metro cannot generally ban another from providing service, but Metro can compel that the households must pay for the Metro-wide service provided. That is, a citizen can keep their hauler, but they would basically be paying twice for the service.

⁶⁸ In addition, best practices should be used in selecting the districts to ensure sensible routing, and competitive proposals – and For instance, SERA case studies indicate that districts should not necessarily be the same size – especially large districts. In the simple case of two districts, and potentially two large firms that would expect to win. Awarding the larger district to the lower-bid proposer will cause both firms to sharpen their pencils and provide a better proposal to Metro. Another option SERA implemented in cities is that the lower cost proposer is awarded an extra area located between two districts.

considered open and competitive, and better allows Metro to “designate” facilities if it wishes. Metro issues the RFP, requests notification of “intent to bid” by a date certain, complies with the schedule, pre-proposal meetings, Q&A (and posts / distributes any resulting revisions to the RFP), and accepts proposals per the specifications listed in the RFP. A public opening is usually arranged, announcing those submitting proposals. Metro and consultant review the proposals to eliminate those not qualified for failing to meet submittal requirements and distributes the qualified documents to the evaluation team. The Independent Consultant may review first and provide an interpretation / translation of the price differences, and possibly summarize key differences between the proposals (this second element may occur after preliminary scoring). Preliminary scoring by all of the evaluation team occurs, and an internal discussion / Q&A meeting is held. Revised scoring occurs, and the leading firms are identified. Follow-up questions may be issued; interviews are usually conducted. Best and final offers may be requested; scheduling is discussed.⁶⁹ The results are discussed with the Council, and negotiations proceed. If negotiations with the leading firm(s) are not successful, the next most qualified proposers are approached for negotiation. After tentative agreements are reached, the results are discussed with Council; Council approves and contracts are announced and signed. Whether multiple districts or franchises (likely with a City this size), or one contractor (unlikely), Metro will have the flexibility to impose fees or add its costs for overarching duties onto the customer rates (within limits).⁷⁰ This is a key funding source.

The implementation phase depends on the contract arrangements and options selected. This will likely involve: container purchase and distribution, truck purchase, methods for data transfer (for billing, or customer service, if Metro has a role), public outreach, and many other elements. Roll-out for a reasonable-sized city rarely takes much under a year after contracts are signed. The transition phase will involve an extensive public process, and considerable temporary work load increases for Metro as it answers questions from customers and facilitates the transfer to new service providers.

Diversion Modeling Targets: The modeling for this Strategy assumed low to medium levels of additional diversion of residentially-generated recyclables and food scraps, given that mandatory programs were already in place. The diversion effects derive from more integrated program (and information) delivery, and cost savings are also assumed.

Metro Role:

- Post intent to consider RFP for Metro contracts for collection.
- Hire consultant with a work scope matching the above responsibilities; hold needed meetings with Staff and council; likely meetings with haulers; public process
- Review and issue RFP, conform to conditions, select / negotiate with winners

⁶⁹ Usually avoiding mid-winter in areas with potential for weather issues, etc.

⁷⁰ Metro can identify the total it needs to pay the contractors and establish its own (postage-stamp) rates (and rate design) to be imposed that will cover the costs of contracts plus an array of related Metro costs / responsibilities, as with several Cities SERA has worked with.

- Staff up to handle transition period.
- On-going contract oversight and any other duties assigned to Metro.
- Re-bid periodically.
- Note that flexibility for invoking other strategies (bans, mandates, every other week trash collection, outreach, pilots, and other strategies must be built in).

Metro Budget Needs:

- Staff Time: Assumes Metro-delivered collection services do not change; assumption is that Metro implements RFP and contract process for the remainder of the County. Metro works with consultant to handle independent contracting process. Metro staffing needs are for RFP contract oversight, administration / attorney / procurement staffing time for review, and staffing / procurement time to participate in evaluation process and to negotiate contracts and briefing council. Assume a total of 75% FTE. On-going staff time is 1 FTE or less, with 50% assistant time to manage contractors, check for violations, etc. Costs can be significantly higher depending on whether Metro vs. haulers handle billing, outreach, customer service, etc. This can be identified in early phases of the consultant work, provided as options in the RFP so cost assessments can be made; full costs to Metro cannot be determined without these decisions, but all costs are paid through rates or contract management fees. Significant public outreach needed; included under direct costs.
- Direct Costs: Consultant to conduct RFP process and for Metro (\$40-100K) depending on amount of public input handled by the contractor.
- Funding Source: Significant on-going Metro costs but funded through surcharges through the rates / add-on to hauler costs.

S22. SAYT Higher Incentives and Smaller Service Levels - Phase 3

Description: To encourage additional residential diversion, Metro introduces mini- and / or micro-cans (smaller trash service levels in the 20 and 10 gallon range,⁷¹ possibly through further extension of the EOW program) and updates the SAYT incentive thresholds to the high end of the 50-80% range⁷² or moves beyond the range.

⁷¹ Mini cans and micro cans have been in use in cities since the early 1990s, starting with communities in the Northwest. Olympia, Seattle, and many other communities in Oregon and Washington and elsewhere.

⁷² Information on SAYT / PAYT incentive levels from SERA research. See Skumatz, Skumatz, "PAYT in the US: Implementation, Impacts, and Experience", *Waste Management Journal*, Elsevier Publications, 2008. Skumatz, "Pay As You Throw (PAYT) in the US: 2006 Update and Analyses", prepared for USEPA and SERA, January 2007; Skumatz, "Recycling Incentive Alternatives: Results of an Analysis of Performance, Pros, and Cons of RecycleBank™, Recycling Credits, and PAYT", *Resource Recycling*, Feb and March 2011; Skumatz, "Getting to More: Review of Option for an Area with Robust Recycling", Prepared for King County WA, December, 2014; and elsewhere.

Diversion Modeling Targets: The modeling for this Strategy assumed low-to-medium levels of additional diversion of residentially-generated recyclables and food scraps, extrapolating from the diversion achieved optimal pricing research on PAYT.⁷³

Metro Role:

- Metro updates DPW memo requiring additional service levels and higher incentives between service levels and haulers must comply or lose license. Require of / modify contractors or franchisees if these strategies are in place.
- Inspectors continue to enforce using street inspection, inspection of company records and subscribed service distributions, and hotline violation reports. Violators receive letters, increasing fines, and potential loss of license.
- Metro will be conducting periodic SAYT rate studies; this element would merely be introducing a more aggressive rate incentive into that periodic calculation, so the attributable cost is minimal. Furthermore, the costs are paid back by the resulting rates.

Metro Budget Needs:

- Staff Time: Zero. Rate studies are conducted already; no additional time. A brief set-out survey and/or survey could be conducted to enhance estimation work, but the costs are minimal (less than \$5-10K) and should be conducted periodically as part of metrics and performance work anyway.
- Direct Costs: Zero. As above, costs would be low. An outside rate study or review by a consultant – which should be considered every few years in any case – should not cost more than \$35-75K, and this element is a tiny incentive design variation. Costs strictly attributable to this study are: a small portion of the rate study, and any investment in container changes that may result, largely planned by attribution / replacement or changes in collection frequency with existing containers. Both are directly paid by the new rates.
- Funding Source: Small on-going Metro costs that are covered as part of inspector staff brought on in Phase 1.

S35. Add Diapers to Organics Program - Phase 3 or 4

Description: Metro’s waste composition study showed diapers were a non-trivial share of the waste stream, and demographic trends indicates this will be an increasing waste constituent. Metro should monitor communities and processes that allow for the inclusion of diapers in composting operations and encourage the adoption of these technologies in local composting facilities when the processes are mature.

Diversion Modeling Targets: The modeling for this Strategy assumed that this is one of the few strategies that will lead to recycling of this specialty material; convenient curbside collection

⁷³ *Op.cit.*

(whether in the traditional containers or a separate system) was targeted on residentially-generated diapers.

Metro Role:

- Metro / consultant periodically monitors the state of diaper composting processes and whether strategies are implementable in the area.
- When the process is deemed ready, Metro (DPW memo/letter) requires that the capability be integrated into regional facilities in order to stay certified or be contracted by Metro.
- Metro checks that any ordinances requiring composting do not exclude diapers so organics bans may be more fully enforced.

Metro Budget Needs:

- Staff Time: Periodic Metro staff time to research the topic is not significant; it is one of multiple programs the staff should keep on top of. Assume that once the technology is to be triggered, it uses the same 5-10% FTE needed to craft procedures or any ordinances / letters that might be needed and keeps in touch with regional facilities on any problems once implemented.
- Direct Costs: None.
- Funding Source: Minimal to no on-going Metro costs

S23. More Aggressive Residential Diversion Strategies - Phase 4

Description: After implementation of SAYT, aggressive incentive levels, and small service levels, Metro should conduct a container audit. If substantial materials remain, Metro may elect to implement one or more of the following strategies that have been implemented in other locations⁷⁴:

- No Bin No Barrel: Trash is not collected if recycling / organics is not set out.
- Higher rates for NOT setting out recycling or organics: Higher trash rates are charged for households not using the recycling or organics programs. This may be monitored by RF tag or other technologies that may become available.
- Other strategies that may be developed over time.

⁷⁴ Information on more aggressive strategies in the residential sector from SERA research. See Skumatz, Skumatz, "Getting to More: Review of Option for an Area with Robust Recycling", Prepared for King County WA, December, 2014; Skumatz et. al., "PAYT: 2015 Update", Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, 2015 (For EPA Region 9), and other SERA research.

Diversion Modeling Targets: The modeling for this Strategy assumed low to medium levels of diversion of residentially-generated recyclables and food scraps, in accordance with relevant case studies and research.⁷⁵

Metro Role:

- Metro / consultant conducts a waste composition study or can audit to determine if substantial divertible materials still remain in household containers. If so, it conducts research on best strategies available to achieve higher diversion.
- Metro / consultant develops ordinance and other associated procedures to implement and enforce the strategy / strategies.

Metro Budget Needs:

- Staff Time: 5-10% staff time to discuss diversion performance, and potential new strategies with the (contracted) hauler(s); implements ordinance or contract changes, as needed, to implement the new strategies. Assume it can be handled using contract oversight or in-house staff.
- Direct Costs: Any container or procedural changes will be implemented into next rates. Several are rate incentives; no direct costs.
- Funding Source: Minimal to no on-going Metro costs.

S25-28, 36-37. Add – then Ban – Additional Materials to Residential and Commercial Collection Programs - Phase 3

Description: Metro should continuously expand the list of materials that must be accepted by haulers in the residential and commercial programs (by DPW memo, integrated with SAYT strategies above), in a way that is designed to match and push those materials accepted by regional MRFs. We expect additional plastics, and other materials to be added periodically. However, in addition to these materials, Metro should work with MRFs and haulers to identify feasible programs for additional materials that represent significant portions of the Waste Composition study. Once programs are available for key materials, bans should follow to help drive materials to higher diversion levels.⁷⁶ These include:

⁷⁵ *Op.cit.*

⁷⁶ *Again, bans are highly effective and cost-effective, and drive much more diversion than voluntary measures. They may be among the most effective strategies in the commercial sector. See Skumatz, "Identifying Best Next Steps" in Diversion Programs, Outreach, and Policies: What do the Real Numbers Tell Us?", Paper for Proceedings of the Global Waste Management Symposium (GWMS), Phoenix, September 2012; McDonnell and Skumatz Economic Research Associates, "State of Colorado Integrated Materials Management Plan", prepared for CDPHE, 2015; City of Denver and Skumatz Economic Research Associates, "USDN 2013 Roadmap to Commercial Waste Reduction", 2013; Skumatz, et. al., "The Costs and Benefits of Minnesota K-12 School Waste Management Programs", Prepared for Minnesota MPCA, July 2014; Skumatz Economic Research Associates, "Options for Increasing Diversion in Salt Lake City, Utah: Impacts and Analysis", 2012.*

- Glass – Program and then Ban: Tradeoffs exist with glass in a recycling program. The materials are heavy and help reach goal and are linked with recycling in households’ minds; however, the material breaks and is not easily separated from paper and some other materials, hurting the quality of these other materials. Strategies other communities have used include: establishing aggressive drop-off programs for glass with strong supporting education⁷⁷; using glass “inserts” or separate containers for glass, encouraging early separation of glass as a first step in MRFs, or other strategies. Note that technology is improving for separation of glass at MRFs; at the same time, glass is a decreasing part of the waste stream as plastics and other containers are growing in share.
- Textiles – Program and then Ban: Working with the haulers or with non-profits, identify a feasible collection program for this constituent that has a market, and is a non-trivial share of Metro’s waste stream. Options include: once-monthly truck route collecting the materials (by haulers or non-profit), allowing it in the stream if the MRF can separate; provide easily pulled colored bags and collection via the traditional.
- Consider other materials as processing improves and waste stream percentages change, e.g. Styrofoam packaging, film packaging, pallets, wood, C&D, etc.

Diversion Modeling Targets: The modeling for this Strategy assumed medium to strong impacts on the remaining levels of these targeted materials in the residential and commercial sector from traditional / moderate levels of enforcement of bans on these materials (recognizing that additional diversion is achieved when the bans are more strongly enforced in the ZW strategy section).⁷⁸

Metro Role:

- Metro / consultant reviews options for programs for glass and textiles, and other products that are significant in waste stream, or for which feasible programs have been developed elsewhere. For example, textiles may be a periodic set out in logoed bags for once monthly pick up by a non-profit, etc. Minimal costs assumed.⁷⁹
- Metro works with haulers and / or MRFs to integrate into programs / processing
- Metro crafts and passes a ban; posted and advertised
- Enforced with other residential and commercial bans.

⁷⁷ See a variant of this in Skumatz and Gordon, “Beyond Success: Taking the Next Steps Toward 50% (Glass in Fort Collins)”, Resource Recycling, November 2011. In this program, the City elected to allow glass in the curbside program but strongly discourage it with education, letting customers know that far less of that material makes it to market – and strongly encouraging they bring the material to the drop-off centers instead. The program was deemed quite successful.

⁷⁸ Op.cit.

⁷⁹ Note that adding materials may impact MRF contract dollars and there is public education involved every time a program changes.

Metro Budget Needs:

- **Staff Time:** Assign 5-10% staff FTE to research the option(s) and meet with regional processors and stakeholders (e.g. Goodwill, etc.) when Metro diversion performance lags and/or MRF or other expansions are planned or become possible.
- **Direct Costs:** No new containers assumed; costs assumed included in rates. Changes in market prices and MRF rates are not possible to predict in advance. Our research indicates adding each of these materials (textiles excluded) can be profitable after retrofits, but there are associated pros and cons.
- **Funding Source:** Minimal extra on-going Metro costs; covered by inspectors included in Phase 1.

S38. Contracted Commercial Collection - Phase 4

Description: It can be difficult to assure that commercial haulers are following the programs and services that Metro wishes (and enforcement can be complicated), or that collection is efficient, cost-effective, and integrated. Multiple haulers can cause duplication of services and Metro may determine that Metro’s commercial sector could realize advantages from more organized collection. Some cities have taken on this challenge, and have contracted for service, either Metro-wide with one or more haulers, in districts, or in some cases, municipalization has occurred for part of all of Metro. Many elements of his process are parallel to the discussion in S18; we concentrate on those elements that differ.

The prospect of contracting in the commercial sector is considerably more complicated and less common, but there are examples. The consultant or Metro must work with Metro’s attorney to identify any special conditions that must be met. It may be necessary to form a kind of a “business improvement district” or other arrangement to allow the intervention into this traditionally-private market. Sub-areas may be easier (and more important) to address, than Metro-wide (or city-wide or county-wide) contracts. All these options should be considered before embarking on this path. However, the control it provides is a substantial improvement over the operation of myriad large and small haulers collecting on intersecting and overlapping routes with rampant inefficiencies. Pricing becomes more transparent and less “negotiated”, eliminating some of the deal making that can be harmful, especially to small businesses. Uniform programs, and well-advertised access to programs can result. Good rate incentives, balancing efficient collection (frequency and size) and incentives for behavior change from disposal to diversion can be mandated.⁸⁰ Clarity, postage-stamp pricing⁸¹, and better compliance with program requirements can be a result.

⁸⁰ SERA research and rate studies we have conducted on the commercial side have highlighted the degree to which very dramatic improvements can be made in the area of rate incentives for collection efficiencies and for diversion.

⁸¹ Uniform prices across Metro or the contracted area.

If the Council elects to move forward with this process, the steps beyond the initial analysis to identify a legal “mechanism” would be fairly similar to the steps for S18.⁸²

Diversion Modeling Targets: The modeling for this Strategy assumed medium levels of additional diversion of commercially-generated recyclables and food scraps, given that mandatory programs were already in place. The diversion effects derive from much more integrated program (and information) delivery, given Metro will be managing the system. Cost savings are also assumed.

Metro Role:

- Post intent to consider RFP for Metro contracts for collection.
- Hire consultant with a work scope matching the above responsibilities; hold needed meetings with Staff and council; likely meetings with haulers; public process
- Review and issue RFP, conform to conditions, select / negotiate with winners
- Staff up in order to handle transition period.
- On-going contract oversight and any other duties assigned to Metro
- Re-bid periodically.
- Note that flexibility for invoking other strategies (bans, mandates, every other week trash collection, outreach, pilots, and other strategies) must be built in.

Metro Budget Needs:

- Staff Time: Metro hires consultant to handle independent contracting process. Metro staffing needs are for RFP contract oversight, administration / attorney / procurement staffing time for review, and staffing / procurement time to participate in evaluation process and to negotiate contracts and briefing council. Assume a total of 75% FTE. On-going staff time for overseeing the contract(s) is 1 FTE or less, with 50% assistant time. Costs can be significantly higher depending on whether Metro vs. haulers handle billing, outreach, customer service, etc. This can be identified in early phases of the consultant work, provided as options in the RFP so cost assessments can be made; full costs to Metro cannot be determined without these decisions, but all costs are paid through rates or

⁸² From SERA Research. See sources including Skumatz, “PAYT: 2015 Update”, Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, 2015; Skumatz, “Taking Control: How Do Municipalities Organize Collection? What is the Best Way?” Resource Recycling, January 2013; Skumatz and D’Souza, “Commercial Recycling, Incentives, and Innovations: Effective and Creative Programs and Collection Changes”, Paper for Proceedings of the Global Waste Management Symposium (GWMS), Phoenix, September 2012; City / County of Denver and Skumatz Economic Research Associates, “USDN 2013 Roadmap to Commercial Waste Reduction”, 2013.

contract management fees. Significant public outreach needed; included under direct costs. This is in addition to the residential contract.

- **Direct Costs:** Consultant to conduct RFP process and for Metro (\$60-100K) depending on amount of public input handled by the contractor.
- **Funding Source:** Significant on-going Metro costs but funded through surcharges through the rates / add-on to hauler costs.

S39. Every Other Week (EOW) Trash Collection Allowed for Commercial - Phase 4

Description: Moving to less frequent trash collection can help drive use of food / organics programs.⁸³ In this strategy, Metro follows-on to the residential EOW program and expands the flexibility in trash collection to the commercial sector – once putrescible are largely moved to the organics stream. This program would likely be targeted to food-rich businesses.

Diversion Modeling Targets: The modeling for this Strategy assumed fairly strong impacts on the remaining food scraps in the commercial sector.

Metro Role:

- Research is conducted when fortnightly collection of residential trash is explored. Once made legal (if possible), our preference is that this option is included in the original language for the commercial SAYT ordinance, but not emphasized until this strategy is triggered.
- We assume Metro monitors progress in the commercial sector. When additional incentives are needed for diversion (food diversion in particular), outreach can highlight this strategy, require lower costs for this service, and the enforcement staff can begin to look for sufficient uptake in this strategy.
- No special costs are assigned to this strategy.

Metro Budget Needs:

- **Staff Time:** Researched as part of the residential strategy, and early ordinances incorporate – but do not emphasize / invoke -- the strategy. When Metro needs additional incentive, it starts an outreach campaign and requires the service be available at a lower cost than weekly collection. No staff time; integrated into periodic outreach and existing enforcement.

⁸³ Research on commercial every-other-week food collection has not been conducted. This strategy is adapted from residential research by Skumatz. See Skumatz “Every Other Week for Everything”, *Resource Recycling*, November 2013; Skumatz, “Alternating weeks: Options and opportunities for garbage and recycling. Can every other week provide greater efficiencies and incentives for the future?” *Resource Recycling*, September 2007, Burns and McDonnell and Skumatz Economic Research Associates, “State of Colorado Integrated Materials Management Plan”, prepared for CDPHE, 2015; City / County of Denver and Skumatz Economic Research Associates, “USDN 2013 Roadmap to Commercial Waste Reduction”, 2013, and other updates.

- **Direct Costs:** None; integrated into periodic outreach and existing enforcement.
- **Funding Source:** Minimal extra on-going Metro costs; covered by staff included in commercial contracting and ban-enforcement efforts.

S40. Implement / Roll-out Multifamily Program / Strategy - Phase 4

Description: The larger MF sector is a large sector within Nashville / Davidson County; however, successful MF strategies in this sector are rare, even in leading cities. It has proven difficult to reach sustained recycling levels much beyond 20% in this sector without outside-the-box strategies.⁸⁴ Fundamental problems are related to split incentives (different generators vs. bill-payers), unit turnover, space, anonymity and the associated inability to enforce individual violations, and other factors. Strategies that have been tried have included hauler bounties (rewards for diversion in buildings in the sector), recycling champions in buildings, bag-based SAYT with bag sales by managers,⁸⁵ and reports of technical solutions like multiple trash chutes, etc. This Strategy anticipates that several solutions will be needed for the sector, including some tailored to new buildings, different strategies for medium vs. very large buildings, etc. We will assume that the MF pilots program will generate solutions that are 1) effective, 2) practical / implementable, and 3) well-suited to the Metro situation.

Diversion Modeling Targets: The modeling for this Strategy depends on the program designed, which is unlikely to be known until after the MF pilot programs / grants are conducted and evaluated.

Metro Role:

- Staff or consultant reviews the results of the pilot studies, conducts literature review and researches strategies employed by leading communities nationwide.
- Metro introduces ordinances, programs, policies, incentives or other strategies designed to result in improved recycling and food scraps⁸⁶ reduction from the section.

⁸⁴ The most-cited example of non-traditional options are San Jose cycling this sector's material through a "dirty MRF" (or Mixed Waste Facility / processing center) to achieve substantially higher diversion from the sector (SERA research, multiple sources including Skumatz, et. al., "Pay As You Throw / Variable Rates for Trash Collection: 2014 Update. US EPA Region 9 Grant Report", Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, February 2015, http://paytnow.org/PAYT_EI_R9_v25_Vol1.)

⁸⁵ PAYT / SAYT in small MF buildings is not an issue; those that have collection similar to SF are treated as SF. However, the same is not true of larger buildings. According to research by SERA, multiple options to develop PAYT / SAYT in the multi-family sector have been tried and are described in several sources: Skumatz, Resource Recycling, 1996, through Skumatz, et. al., "Pay As You Throw / Variable Rates for Trash Collection: 2014 Update. US EPA Region 9 Grant Report", Econservation Institute / Skumatz Economic Research Associates (SERA), Superior, CO, February 2015, http://paytnow.org/PAYT_EI_R9_v25_Vol1.)

⁸⁶ For example, Metro may explore in-sink food disposals. See Skumatz and Freeman, "Philadelphia's Clean Kitchen / Green Community Project Evaluation Report", Skumatz Economic Research Associates, May 2013. Metro may even elect to provide contracts or franchising as part of the commercial franchising option described above.

- Metro implements, enforces, and/or funds the various strategies, conducting tracking and monitoring for performance, cost, and cost-effectiveness.

Metro Budget Needs:

TBD based on design / research.

- Staff Time: TBD.
- Direct Costs: TBD.

Funding Source: Possible significant on-going Metro costs; if necessary, enterprise fund, generator fee, or rates.

F.9 Summary of Annual Metro Staffing and Budget Needs

The Plan includes an array of strategies; not all of which can be implemented in any one year. Instead, the plan relies on sensible “Phasing” of the strategies. The phasing assigned is based on an array of factors:

- Programs that must precede other programs.
- Taking advantage of cost-effective strategies first.
- Moving forward strategies for which groundwork has been set (enforcing bans).
- Moving forward in residential before commercial.
- Delaying some programs until sufficient recycling infrastructure can be ready (e.g. SAYT, C&D deposit).
- Other considerations.

The annual pattern of cost needs is directly dependent on these assignments and phasing, and can be changed based on discussions with Metro and their considerations regarding feasible ramp-up, negotiations that might be needed, etc.

Design and Implementation Assistance

S99. Implementation Consultant Assistance for “High Performing Strategies” – Phases 1-4

Description: A Comprehensive Plan provides the multi-year set of strategies needed to allow Metro to reach goals. However, while Plans provide robust information and analysis of the strategies, these plans do not develop strategy-by-strategy design and implementation plans; that would be a very expensive and lengthy plan and would not be a guidance / vision document.

On-going assistance on the strategy implementation is an element of the Plan, and **Table F-24** below provides an assessment of the relative level of effort associated with various strategies – from Very High (VH) to Low (L). The Figure presents the strategies in “implementation year” order. It lists the strategy’s phase, implementation year, strategy number and name, and the associated consultant effort level. Naturally, there will be some shift as some strategies implement smoothly and according to plan, but others are held up for infrastructure, funding, political, or other reasons.⁸⁷ However, **Table F-24** serves as a guide.

Table F-24 Implementation Consultant - Relative Level of Effort by Strategy for “High Performing Strategies”

| Impl. | | | | | Impl. | | | | | Impl. | | | | |
|---------|------|------|--|----------------|--------|------|------|---|----------------|--------|------|-------|---|----------------|
| Phase | Yr | S# | Strategy | Consult Effort | Phase | Yr | S# | Strategy | Consult Effort | Phase | Yr | S# | Strategy | Consult Effort |
| 1 | 2018 | S1 | Tracking, Goals, & Measurement | H | 1 or 2 | 2020 | S11 | C&D and Compost - Require / Reward Recycling and Reuse of C&D and Use of Local Compost in City Contracts and Jobs | M | 2 | 2023 | S15 | Convenience Center - Minimum Requirements for Access & Services | ML |
| 1 | 2018 | S2 | Obtain Needed Planning, Service, Enforcement, and Funding Authorities | M | 1-2 | 2021 | S20 | Public Space Recycling | M | 3 | 2023 | S22 | SAYT Higher Incentives and Smaller Service Levels | L |
| 1 | 2018 | S41 | Landscapers must bring Compostables to Composting Site | ML | 2-Jan | 2021 | 42b | Change Building Codes to Require Soil Amendment using Local Compost | MH | 3 | 2024 | 3, 14 | Require C&D Deposit System | VH |
| 1 | 2018 | S10 | C&D - Require Recycling Containers with al C&D Trash Service | M | 3-Jan | 2021 | 5-37 | Add - then Ban - Additional Materials to Residential and Commercial Collection Programs | H | 3 | 2025 | & 17 | Incentives (Surcharges / Discounts) for Clean Separated Streams and Diversion at Transfer Stations & Disposal Sites | H |
| 1 | 2019 | S3,2 | Ordinance - Residential SAYT & 3-Stream Package with Supporting Bans | H | 2-Jan | 2022 | S24 | MF Pilots | VH | 3 | 2025 | S18 | Residential Service Contracts / Franchises | VH |
| 1 | 2019 | S8 & | Enforce Existing Bans | MH | 2-Jan | 2022 | 3-34 | Fee (or Ban) for Single Use Bags | MH | 4 | 2026 | S38 | Contracted Commercial Collection | VH |
| 1 & all | 2019 | S21 | Public Education / Outreach (including Businesses) | M | 2-Jan | 2022 | 4&5 | Enforce Food Waste Ban in the Residential and Commercial Sectors | M | 4 | 2026 | S39 | Every Other Week (EOW) Trash Collection Allowed for Commercial | L |
| 1 | 2020 | S3,2 | Metro Service - Residential SAYT & 3-Stream Package with Supporting Bans | VH | and 4 | 2022 | S6 | EOW Trash - Allow / Incentivize and (Eventually) Require at lower cost. | H | 4 | 2026 | S40 | Implement / Roll-out Multifamily Program / Strategy | VH |
| 1 | 2020 | S19 | Small Business Policies / Programs and Space for Recycling Ordinance for MF and Commercial | VH | 3-Jan | 2022 | S7 | Commercial SAYT & ABC Law (adapted), Supporting Bans, and Enforcement | VH | 3 or 4 | 2028 | S35 | Add Diapers to Organics Program | L |
| | | | | | | | | | ML | 4 | 2028 | S23 | More Aggressive Residential Diversion Strategies | M |

Aggregated level of effort by year is provided in the Figure below, assigning greater levels of effort to those strategies needing “VH” assistance, and low effort to those with “L”. Implementation assistance. The figure at the left is an approximate amount of effort, translated into approximate thousands of dollars (150= \$150K). These figures, somewhat smoothed (and

⁸⁷ For this reason, we smoothed the dollars for later stages in Table F-17.

rounded after applying inflation), are included as the last strategy/row in the annual budget shown in **Figure F-11**.

Thousands of dollars

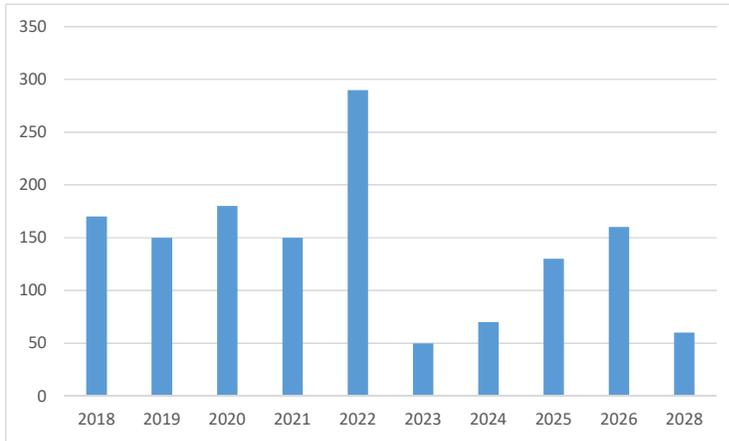


Figure F-11
Estimated Level of Consultant Assistance Budget by Year for “High Performing Strategies”

Detailed Cost Tables

Two sets of tables are provided below:

- **Tables F-25 – F-27** repeat the cost explanations by program and translates the explanations into cost elements. Tables F-25 – F-27 includes columns, in turn, for:
 - ID information, including row, Strategy number (or groups corresponding to Figure 1 at the beginning of this appendix), strategy name,
 - Summary Description of the cost elements and assumptions
 - Whether program is included / excluded from the computation
 - Start, and where relevant stop, year for the strategy
 - First year and on-going staffing needs, presented as a portion of FTE
 - Staffing needs (first year and on-going), translated into dollars, using approximate Metro staff costs (fully loaded) of \$86K/year.
 - First year and on-going direct costs, and the years the first-year costs are spread over when calculating annual costs for the model.

Tables F-28 – F-29 compute and aggregate these costs into annual buckets. We include the following.

- The strategy identification information, whether the strategy is included or not in the total, and what year the strategy is implemented.

- The total costs, per year, including first year costs (in one year or more), plus the on-going costs (at the top).
- The aggregated Metro staff needs, by year (at the top)
- These costs include an **inflation rate** over time.
- The data are presented by program and by year.
- Notice that, because the cost of the residential SAYT (S3 strategy) roll-out is so much greater than for other programs, and because these fees are directly paid by household rates, the Totals in Figure 4 are presented including and excluding this part of the costs.
- Note Metro may elect for similar “separate” treatment of the cost of convenience centers or some other strategies.

Finally, Tables F-25 – F-27 include a summary of our estimate of the consultant budget for refining and implementing this set of “High Performing” strategies. The description of efforts needed, by several-year-batches, is presented at the bottom of Table F-24 and is described as Strategy 99 above.

Table F-25 Metro Budget Assumptions by Year and Strategy; Phasing Reflected in Start Year

Dollars in Thousands. Source: Skumatz Economic Research Associates WDM Model, 2018

| Row | Phase | Strategy Number | Strategy | Cost Description | Pgm In/Out | Start Year | Stop Year | \$86.0 <==FTE Cost \$K/Yr | | | | | Direct cost Ongoing (thous) | Yrs to Spread |
|-----|-------|-----------------|--|--|------------|------------|-----------|---------------------------|-------------|--------------------|-----------------------|-------------------------|-----------------------------|---------------|
| | | | | | | | | FTE Yr 1 | FTE Ongoing | Labor Yr 1 (thous) | Labor Ongoing (thous) | Direct Cost Yr1 (thous) | | |
| 1 | | | | TOTAL INCLUDING ROLL-OUT OF RESIDENTIAL SAYT IN METRO AREA | | | | | | | | | | |
| 2 | | | | TOTAL EXCLUDING ROLL-OUT OF RESIDENTIAL SAYT IN METRO AREA | | | | | | | | | | |
| 3 | | 1 S1 | Tracking, Goals, & Measurement | Staff time: 10% FTE (2 weeks) to identify gaps and reporting to date; 5-10% city staff on-going time for tracking / nudging / calculating performance for percent diversion. 10% FTE (2-3 weeks) of consultant or statistical person's time FTE to identify preferred measurement approach for PRR metric, and identify monitoring protocols. Direct costs: Estimate for annual 2-season waste composition study, county-wide, residential and commercial, is approximately \$75-150K; other options include random collection truck sorts and other strategies. The estimates for conducting this work on an on-going basis is \$250-300K/year. Funding Source: No dedicated funding source. Recommended as part of an "environmental" or generator fee or enterprise fund, or rates | 1 | 2018 | | 0.27 | 0.1 | \$23.2 | \$8.6 | \$350.0 | \$275.0 | 1 |
| 4 | | 1 S2 | Obtain Needed Planning, Service, Enforcement, and Funding Authorities | Staff Time: Assume 1 week (3-5%) FTE for attorney and assistant; 2 weeks (5-10%) City staff; 1 week (5%) consultant. Leadership needed from senior PW staff for perhaps 1-2 weeks of time (5%) spread over half a year. No direct costs. Funding Source: No dedicated funding source; general fund activity; or Enterprise Fund, generator fee, or rates | 1 | 2018 | 2020 | 0.22 | 0 | \$18.9 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 5 | | 1 S3,29-32 | Ordinance - Residential SAYT & 3-Stream Package with Supporting Bans | Staff Time: 25% FTE for public process, ordinance, and outreach development. Enforcement of hauler compliance is significant; assume 50% FTE for 1 st year, and rest covered by inspectors checking compliance with bans. Direct costs: Education materials \$2/hh (outreach is covered by strategy 21). Funding Source: Combination of General Fund or Enterprise Fund (education) and hauler surcharge (compliance). | 1 | 2019 | | 0.75 | 0 | \$64.5 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 6 | | 1 S3,29-32 | Metro Service - Residential SAYT & 3-Stream Package with Supporting Bans | Staff Time: Updating billing system capabilities may cost up to \$20K (repeated billing of a set fee) to \$100K or more depending on existing system capabilities (specialized consultant or staff time). City Staff time for SAYT roll-out: If 25%-40% of the City's 55,000 households calls 10 minutes, temp CSR staff needs are 3-4 FTE (will need about twice as many for 6 months, then let go, but for budgeting purposes we show annual figures). Approximately 30 new drivers are needed on an on-going basis. Direct costs for switch to 3-bin service (adding 2 bins for most households), assume 30 new trucks for Metro area at \$350K each is \$10.5 million (spread over 8 years minimum). 2 new containers per household at \$55 each is \$6 million plus 10% for spare carts. Cart delivery excluded. Ongoing costs \$13-19/hh/month for service, including maintenance, etc. Assumed no major new billing costs once system is running. Funding: Note these funds are generally paid out of / can be embedded into the SAYT user fees (self-funding). | 1 | 2020 | | 3.5 | 30 | \$301.0 | \$2,580.0 | \$17,200.0 | \$7,140.0 | 8 |
| 7 | | 1 S41 | Landscapers must bring Compostables to Composting Site | Staff time: 5% FTE developing ordinance, passing, notifying. Enforcement plan assumes 10% FTE, due to volume of building in the city. Direct costs: No significant direct costs assumed. Funding Source: No significant on-going City costs; if necessary, enterprise fund, generator fee, or rates | 1 | 2018 | | 0.15 | 0 | \$12.9 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 8 | | 1 S8 & S9 | Enforce Existing Bans | Staff Costs: Conservative estimate for enforcement for ALL bans (including upcoming bans) is 7 FTE, with potential to ramp to that number. Direct Costs: Cars assumed to be \$20K each per year in direct costs. Funding Source: Enterprise Fund, generator fee, or rates | 1 | 2019 | | 7 | 7 | \$602.0 | \$602.0 | \$140.0 | \$140.0 | 1 |
| 9 | | 1 S10 | C&D - Require Recycling Containers with al C&D Trash Service | Staff: City staff or consultant time 1-2 weeks (5% FTE), assumed inspectors identified under strategy 8/9 can enforce. Direct Costs: None. Funding Source: No significant on-going City costs; if necessary, enterprise fund, generator fee, or rates | 1 | 2018 | | 0.05 | 0 | \$4.3 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 10 | | 1-2 S20 | Public Space Recycling | Staff Time: City / consultant time about 3 weeks; Direct and On-going Costs: Containers, signage, placement, and service for 600-1000 paired containers (300-500 sites around the City) could cost about \$1 million. Capital costs are about \$650K plus, and operations would cost about \$200K-400K per year of staff, trucks, (net) tipping fees, and amortized containers. This program should ramp up over a series of years; tonnages are quite low. Assume capital costs are spread over 5 years. Funding Source: Significant costs; will need to fund from grants (for some containers), enterprise fund, generator fee, or rates | 1 | 2021 | | 0.06 | 0 | \$5.2 | \$0.0 | \$650.0 | \$400.0 | 5 |
| 11 | | 1 & all S21 | Public Education / Outreach (Including Businesses) | Staff time: High diversion cities can spend considerable funds on outreach, and the City will need a substantial push in the early years to roll out the new programs. Some staff assumed already assigned; increase by 20% FTE because periodic new roll-outs. Direct Costs: Based on estimated costs of \$1/capita - \$1.50/capita, Nashville might see costs of \$600K-\$1 million; assume costs are spread over two years. This will include some business outreach. Social marketing costs, and inclusion of schools programs could increase this by 50-100%. Assume outreach consultant assistance of \$75K periodically. Basic on-going outreach is not a new cost; adding about \$200K for enhancing the quality of outreach in the City. Funding Source: Enterprise fund, generator fee, or rates | 1 | 2019 | | 0 | 0.2 | \$0.0 | \$17.2 | \$1,000.0 | \$200.0 | 2 |

Table F-26 Metro Budget Assumptions by Year and Strategy; Phasing Reflected in Start Year

Dollars in Thousands. Source: Skumatz Economic Research Associates WDAM Model, 2018

| Row | Phase | Strategy Number | Strategy | Cost Description | Pgm In/Out | Start Year | Stop Year | FTE Yr 1 | FTE On-going | Labor Yr 1 (thous) | Labor Ongoing (thous) | Direct Cost Yr1 (thous) | Direct cost Ongoing (thous) | Yrs to Spread |
|-----|---------|-----------------|---|---|------------|------------|-----------|----------|--------------|--------------------|-----------------------|-------------------------|-----------------------------|---------------|
| 12 | 1 | S19 | Small Business Policies / Programs and Space for Recycling Ordinance for MF and Commercial | <u>Staff time:</u> 25% FTE staff or consultant to plan the suite of programs. 4-8 FTE city or consultant for technical assistance program and business recognition program. <u>City Service Costs:</u> Adding businesses onto residential service (GSD) \$50K-\$100K. <u>Direct costs:</u> Grants for 3 months service \$25K-\$50K grant; bin grant program \$25K-\$50K (flexible based on City budget). <u>Funding Source:</u> Enterprise fund, generator fee, or rates | 1 | 2020 | | 3.25 | 7.25 | \$279.5 | \$623.5 | \$150.0 | \$150.0 | 1 |
| 13 | 1 or 2 | S11 | C&D and Compost - Require / Reward Recycling and Reuse of C&D and Use of Local Compost in City Contracts and Jobs | <u>Staff time:</u> 5% -10% staff time to craft language suitable for legal contracting and purchasing / procurement, and make sure the language is inserted into all relevant contracting. <u>Direct Costs:</u> No direct costs assumed; this may be a simplification if required C&D reuse increases cost of city contracts; however, pre-planning can reduce costs. <u>Funding Source:</u> No significant on-going City costs beyond potential increases in contracts. Short term, enterprise fund, generator fee, or rates | 1 | 2020 | | 0.1 | 0 | \$8.6 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 14 | 2 | S24 | MF Pilots | <u>Staff needs:</u> Assume this is an important preparation project for meeting the needs of this sector. Assume 50% or more staff person. <u>Direct costs:</u> Approximately \$25-50K each for 7-12 projects (\$400K). <u>Funding Source:</u> May include significant on-going City costs; consider enterprise fund, generator fee, or rates | 1 | 2022 | | 0.5 | | \$43.0 | \$0.0 | \$400.0 | \$0.0 | 2 |
| 15 | 2 | S33-34 | Fee (or Ban) for Single Use Bags | <u>Staff Costs:</u> City or Consultant research on design, administration options, funding, and development of ordinance 15% FTE. <u>Direct costs:</u> For Nexus study: \$40-75K; Administration notification costs and coordination on taxes with businesses: Zero if already conducting outreach for businesses; otherwise, assume \$50K. Costs for Bag giveaway: \$25K-75K, depending on City's perceived need; optional add-on. <u>Funding Source:</u> No significant on-going City costs; if necessary, enterprise fund, generator fee, or rates | 1 | 2022 | | 0.25 | 0.1 | \$21.5 | \$8.6 | \$125.0 | \$0.0 | 2 |
| 16 | 2 | S4&5 | Enforce Food Waste Ban in the Residential and Commercial Sectors | <u>Staff time:</u> No additional staff costs or direct costs beyond those enforcing existing bans (listed above). <u>Direct Costs:</u> As listed above. <u>Funding Source:</u> No significant on-going City costs / covered by another strategy | 1 | 2022 | | 0 | 0 | \$0.0 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 17 | 2 and 4 | S6 | EOW Trash - Allow / Incentivize and (Eventually) Require at lower cost. | <u>Staff Time:</u> City / consultant staff time for research 10%-15% FTE. Assume no new inspection staff. <u>Direct Costs:</u> New container costs do not involve full container purchases, but do include new lids or decals (assume 10% of containers switch to the service, with a retrofit cost of \$25 each). Some savings in routing. <u>Funding Source:</u> Costs reimbursed from user fees | 1 | 2022 | | 0.15 | 0 | \$12.9 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 18 | 2 | S15 | Convenience Center - Minimum Requirements for Access & Services | <u>Staff Time:</u> We assume 15% staff / consultant time to conduct the basic analysis of population distribution around existing convenience centers, examine materials and markets, discuss MRF needs, and conduct preliminary discussions around the need for site(s). On-going staffing time is assumed. The planning for each site will be significant. <u>Direct Costs:</u> According to RRS, the cost for each site in capital costs (excluding land and site preparation), and annualized, may be \$310/year. On-going costs for each site (RRS) is expected to be \$850K/year. If the City develops a second site, these costs will increase in step. | 1 | 2023 | | 0.15 | 0.75 | \$12.9 | \$64.5 | \$2,480.0 | \$785.5 | 8 |
| 19 | 2 | S42b | Change Building Codes to Require Soil Amendment using Local Compost | <u>Staff time:</u> 10% FTE for development of ordinance and working with relevant departments to understand / incorporate into procedures. Assume it is integrated into existing enforcement / inspections of buildings and sites (simplification). <u>Direct Costs:</u> None for City. <u>Funding Source:</u> No significant on-going City costs; if necessary, enterprise fund, generator fee, or rates | 1 | 2021 | | 0.1 | | \$8.6 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 20 | 3 | S7 | Commercial SAYT & ABC Law (adapted), Supporting Bans, and Enforcement | <u>Staff time:</u> First year - 10% - 15% FTE for additional research on development of ordinance and working with relevant departments to understand / incorporate into procedures. <u>On-going staffing needs:</u> Assume enforcement includes 8 staff, per SF. This may decrease over time, but the program involves multiple elements, including a link with the business license department to carry out the enforcement of the ABC law. <u>Direct Costs:</u> 8 cars for commercial hauler and service set out enforcement. <u>Funding Source:</u> Significant on-going City enforcement costs to enforce level playing field; hauler surcharge to cover oversight. If necessary, enterprise fund, generator fee, rates. Fines may cover some costs, but should not be assumed to be a significant revenue source. | 1 | 2022 | | 0.15 | 8 | \$12.9 | \$688.0 | \$0.0 | \$160.0 | 1 |
| 21 | 3 | S12, 13, | Require C&D Deposit System | <u>Staff time:</u> 10% FTE for development of ordinance and working with relevant departments to understand / incorporate into procedures. Assume it is integrated into existing enforcement / inspections of buildings and sites (simplification; may require a portion of a person). <u>Direct Costs:</u> None for City. <u>Funding Source:</u> No significant on-going City costs; if necessary, enterprise fund, generator fee, or rates. Note that this deposit system (unclaimed deposits) has sometimes been a supplemental source of revenues and may cover some portion of the program's cost | 1 | 2024 | | 0.1 | | \$8.6 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 22 | 3 | S16 & 17 | Incentives (Surcharges / Discounts) for Clean Separated Streams and Diversion at Transfer Stations & Disposal Sites | <u>Staff time:</u> 10%-15% FTE to work with attorneys to confirm / identify authority, and with administrative department to work out on-going fund transfer arrangements, and to develop / pass / post / advertise / implement the ordinance. <u>Direct Costs:</u> None for City / no special enforcement envisioned as it is a pricing differential. Periodic checks of signage and separate pricing could be conducted by inspectors checking for violations of bans; inspection of books could be conducted by City inspectors or administration on an as-needed basis as well. <u>Funding Source:</u> On-going City costs are covered as part of the surcharges / self-funding. | 1 | 2025 | | 0.15 | | \$12.9 | \$0.0 | \$0.0 | \$0.0 | 1 |

Table F-27 Metro Budget Assumptions by Year and Strategy; Phasing Reflected in Start Year

Dollars in Thousands. Source: Skumatz Economic Research Associates WDAM Model, 2018

| Row | Phase | Strategy Number | Strategy | Cost Description | Begin In/Out | Start Year | Stop Year | FTE Yr 1 | FTE On-going | Labor Yr 1 (thous) | Labor Ongoing (thous) | Direct Cost Yr1 (thous) | Direct cost Ongoing (thous) | Yrs to Spread |
|-----|--------|-----------------|---|---|--------------|------------|-----------|----------|--------------|--------------------|-----------------------|-------------------------|-----------------------------|---------------|
| 23 | 3 | S18 | Residential Service Contracts / Franchises | <u>Staff Time:</u> Assumes City-delivered collection services do not change; assumption is that City / County implements RFP and contract process for the remainder of the County. City works with City hires consultant to handle independent contracting process. City staffing needs are for RFP contract oversight, administration / attorney / procurement staffing time for review, and staffing / procurement time to participate in evaluation process and to negotiate contracts and briefing council. Assume a total of 75% FTE. On-going staff time is 1 FTE or less, with 50% assistant time to manage contractors, check for violations, etc. Costs can be significantly higher depending on whether City vs. haulers handle billing, outreach, customer service, etc. This can be identified in early phases of the consultant work, provided as options in the RFP so cost assessments can be made; full costs to city cannot be determined without these decisions, but all costs are paid through rates or contract management fees. Significant public outreach needed; included under direct costs. <u>Direct Costs:</u> Consultant to conduct RFP process and for the City (\$40-100K) depending on amount of public input handled by the contractor. <u>Funding Source:</u> Significant on-going City costs, but funded through surcharges through the rates / add-on to hauler costs. | 1 | 2025 | | 0.75 | 1.5 | \$64.5 | \$129.0 | \$100.0 | \$0.0 | 2 |
| 24 | 3 | S22 | SAYT Higher Incentives and Smaller Service Levels | <u>Staff Time:</u> Zero. Rate studies are conducted already; no additional time. A brief set-out survey and/or survey could be conducted to enhance estimation work, but the costs are minimal (less than \$5-10K) and should be conducted periodically as part of metrics and performance work anyway. <u>Direct Costs:</u> Zero. As above, costs would be low. An outside rate study or review by a consultant – which should be considered every few years in any case – should not cost more than \$35-75K, and this element is a tiny incentive design variation. Costs strictly attributable to this study are: a small portion of the rate study, and any investment in container changes that may result, largely planned by attribution / replacement or changes in collection frequency with existing containers. Both are directly paid by the new rates. <u>Funding Source:</u> Small on-going City costs that are covered as part of inspector staff brought on in Phase 1. | 1 | 2023 | | 0 | 0 | \$0.0 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 25 | 3 or 4 | S35 | Add Diapers to Organics Program | <u>Staff Time:</u> Periodic City staff time to research the topic is not significant; it is one of multiple programs the staff should keep on top of. Assume that once the technology is to be triggered, it uses the same 5-10% FTE needed to craft procedures or any ordinances / letters that might be needed, and keeps in touch with regional facilities on any problems once implemented. <u>Direct Costs:</u> None. <u>Funding Source:</u> Minimal to no on-going City costs | 1 | 2028 | | 0.05 | | \$4.3 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 26 | 4 | S23 | More Aggressive Residential Diversion Strategies | <u>Staff Time:</u> 5-10% staff time to discuss diversion performance, and potential new strategies with the (contracted) hauler(s); implements ordinance or contract changes, as needed, to implement the new strategies. Assume it can be handled using contract oversight or in-house staff. <u>Direct Costs:</u> Any container or procedural changes will be implemented into next rates. Several are rate incentives; no direct costs. <u>Funding Source:</u> Minimal to no on-going City costs | 1 | 2028 | | 0.05 | | \$4.3 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 27 | 3 | S25-28, 3 | Add - then Ban - Additional Materials to Residential and Commercial Collection Programs | <u>Staff Time:</u> Assign 5-10% staff FTE to research the option(s) and meet with regional processors and stakeholders (e.g. Goodwill, etc.) when City diversion performance lags and/or MRF or other expansions are planned or become possible. <u>Direct Costs:</u> No new containers assumed; costs assumed included in rates. Changes in market prices and MRF rates are not possible to predict in advance. Our research indicates adding each of these materials (textiles excluded) can be profitable after retrofits, but there are associated pros and cons. <u>Funding Source:</u> Minimal extra on-going City costs; covered by inspectors included in Phase 1 | 1 | 2021 | | 0.1 | | \$8.6 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 28 | 4 | S38 | Contracted Commercial Collection | <u>Staff Time:</u> City hires consultant to handle independent contracting process. City staffing needs are for RFP contract oversight, administration / attorney / procurement staffing time for review, and staffing / procurement time to participate in evaluation process and to negotiate contracts and briefing council. Assume a total of 75% FTE. On-going staff time for overseeing the contract(s) is 1 FTE or less, with 50% assistant time. Costs can be significantly higher depending on whether City vs. haulers handle billing, outreach, customer service, etc. This can be identified in early phases of the consultant work, provided as options in the RFP so cost assessments can be made; full costs to city cannot be determined without these decisions, but all costs are paid through rates or contract management fees. Significant public outreach needed; included under direct costs. This is in addition to the residential contract. <u>Direct Costs:</u> Consultant to conduct RFP process and for the City (\$60-100K) depending on amount of public input handled by the contractor. <u>Funding Source:</u> Significant on-going City costs, but funded through surcharges through the rates / add-on to hauler costs | 1 | 2026 | | 0.75 | 1.5 | \$64.5 | \$129.0 | \$100.0 | \$0.0 | 2 |
| 29 | 4 | S39 | Every Other Week (EOW) Trash Collection Allowed for Commercial | <u>Staff Time:</u> Researched as part of the residential strategy, and early ordinances incorporate – but do not emphasize / invoke – the strategy. When the City needs additional incentive, it starts an outreach campaign and requires the service be available at a lower cost than weekly collection. No staff time; integrated into periodic outreach and existing enforcement. <u>Direct Costs:</u> None; integrated into periodic outreach and existing enforcement. <u>Funding Source:</u> Minimal extra on-going City costs; covered by staff included in commercial contracting and ban-enforcement efforts. | 1 | 2026 | | 0 | 0 | \$0.0 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 30 | 4 | S40 | Implement / Roll-out Multifamily Program / Strategy | <u>Staff Time:</u> TBD. <u>Direct Costs:</u> TBD. <u>Funding Source:</u> Possible significant on-going City costs; if necessary, enterprise fund, generator fee, or rates | 1 | 2026 | | 0 | 0 | \$0.0 | \$0.0 | \$0.0 | \$0.0 | 1 |
| 31 | | S41 | Implementation Consultant | Implementation Consultant | 1 | 2018 | 2030 | | | | | | | |
| 32 | | | Total | Total including all strategies. | | | | | | | | | | |

Table F-28 Metro Budget Additions by Year and Strategy; Phasing Reflected in Budgeting

Dollars in Thousands. Source: Skumatz Economic Research Associates WDAM Model, 2018

| Row | Phase | Strategy Number | Strategy | Pgm In/Out | Start Year | Yrs to Spread 1st cost | Total City Cost in Thousands, By Year | | | | | | | | | | | | | | |
|-----|---------|-----------------|--|------------|------------|------------------------|---------------------------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| | | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 |
| 1a | | | TOTAL INCLUDING ALL | | | | \$ 569 | \$ 1,860 | \$ 4,980 | \$ 14,917 | \$ 15,917 | \$ 17,333 | \$ 18,231 | \$ 18,615 | \$ 19,110 | \$ 19,161 | \$ 19,329 | \$ 19,609 | \$ 19,903 | \$ 21,441 | \$ 23,098 |
| 1b | | | TOTAL EXCLUDING ROW 6 | | | | \$ 569 | \$ 1,860 | \$ 2,442 | \$ 2,443 | \$ 3,257 | \$ 4,482 | \$ 5,188 | \$ 5,376 | \$ 5,673 | \$ 5,522 | \$ 5,486 | \$ 5,558 | \$ 5,641 | \$ 6,077 | \$ 6,547 |
| 2a | | | FTE INCLUDING ALL | | | | 1.0 | 9.0 | 14.0 | 45.0 | 46.0 | 53.0 | 54.0 | 54.0 | 56.0 | 56.0 | 57.0 | 56.0 | 56.0 | 56.0 | 56.0 |
| 2b | | | FTE EXCLUDING ROW 6 | | | | 1.0 | 9.0 | 11.0 | 15.0 | 16.0 | 23.0 | 24.0 | 24.0 | 26.0 | 26.0 | 27.0 | 26.0 | 26.0 | 26.0 | 26.0 |
| 3 | 1 | S1 | Tracking, Goals, & Measurement | 1 | 2018 | 1 | \$ 373.2 | \$ 289.3 | \$ 293.6 | \$ 298.0 | \$ 302.5 | \$ 307.0 | \$ 311.6 | \$ 316.3 | \$ 321.0 | \$ 325.9 | \$ 330.8 | \$ 335.7 | \$ 340.7 | \$ 367.1 | \$ 395.5 |
| 4 | 1 | S2 | Obtain Needed Planning, Service, Enforcement, and Funding Authorities | 1 | 2018 | 1 | \$ 18.9 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 5 | 1 | S3,29-32 | Ordinance - Residential SAYT & 3-Stream Package with Supporting Bans | 1 | 2019 | 1 | \$ - | \$ 65.8 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 6 | 1 | S3,29-32 | Metro Service - Residential SAYT & 3-Stream Package with Supporting Bans | 1 | 2020 | 8 | \$ - | \$ - | \$ 2,538 | \$ 12,473 | \$ 12,660 | \$ 12,850 | \$ 13,043 | \$ 13,239 | \$ 13,437 | \$ 13,639 | \$ 13,843 | \$ 14,051 | \$ 14,262 | \$ 15,364 | \$ 16,552 |
| 7 | 1 | S41 | Landscapers must bring Compostables to Composting Site | 1 | 2018 | 1 | \$ 12.9 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 8 | 1 | S8 & S9 | Enforce Existing Bans | 1 | 2019 | 1 | \$ - | \$ 756.8 | \$ 768.2 | \$ 779.7 | \$ 791.4 | \$ 803.3 | \$ 815.3 | \$ 827.6 | \$ 840.0 | \$ 852.6 | \$ 865.4 | \$ 878.3 | \$ 891.5 | \$ 960.4 | \$ 1,034.6 |
| 9 | 1 | S10 | C&D - Require Recycling Containers with al C&D Trash Service | 1 | 2018 | 1 | \$ 4.3 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 10 | 1-2 | S20 | Public Space Recycling | 1 | 2021 | 5 | \$ - | \$ - | \$ - | \$ 142.0 | \$ 565.3 | \$ 573.8 | \$ 582.4 | \$ 591.1 | \$ 600.0 | \$ 459.6 | \$ 466.5 | \$ 473.5 | \$ 480.6 | \$ 517.7 | \$ 557.8 |
| 11 | 1 & all | S21 | Public Education / Outreach (including Businesses) | 1 | 2019 | 2 | \$ - | \$ 597.7 | \$ 747.0 | \$ 232.8 | \$ 236.3 | \$ 239.8 | \$ 243.4 | \$ 247.0 | \$ 250.7 | \$ 254.5 | \$ 258.3 | \$ 262.2 | \$ 266.1 | \$ 286.7 | \$ 308.9 |
| 12 | 1 | S19 | Small Business Policies / Programs and Space for Recycling Ordinance for MF and Commercial | 1 | 2020 | 1 | \$ - | \$ - | \$ 444.7 | \$ 812.8 | \$ 825.0 | \$ 837.4 | \$ 849.9 | \$ 862.7 | \$ 875.6 | \$ 888.8 | \$ 902.1 | \$ 915.6 | \$ 929.4 | \$ 1,001.2 | \$ 1,078.6 |
| 13 | 1 or 2 | S11 | C&D and Compost - Require / Reward Recycling and Reuse of C&D and Use of Local Compst in City Contracts and Jobs | 1 | 2020 | 1 | \$ - | \$ - | \$ 8.9 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 14 | 2 | S24 | MF Pilots | 1 | 2022 | 2 | \$ - | \$ - | \$ - | \$ - | \$ 259.2 | \$ 216.5 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 15 | 2 | S33-34 | Fee (or Ban) for Single Use Bags | 1 | 2022 | 2 | \$ - | \$ - | \$ - | \$ - | \$ 89.6 | \$ 77.0 | \$ 9.4 | \$ 9.6 | \$ 9.7 | \$ 9.9 | \$ 10.0 | \$ 10.2 | \$ 10.3 | \$ 11.1 | \$ 12.0 |
| 16 | 2 | S4&5 | Enforce Food Waste Ban in the Residential and Commercial Sectors | 1 | 2022 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |

Table F-29 Metro Budget Additions by Year and Strategy; Phasing Reflected in Budgeting

Dollars in Thousands. Source: Skumatz Economic Research Associates WDAM Model, 2018

| Row | Phase | Strategy Number | Strategy | Pgm In/Out | Start Year | Yrs to Spread 1st cost | Total City Cost in Thousands, By Year | | | | | | | | | | | | | | |
|-----|---------|-----------------|---|------------|------------|------------------------|---------------------------------------|----------|----------|-----------|-----------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | | | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2035 | 2040 |
| 1a | | | TOTAL INCLUDING ALL | | | | \$ 569 | \$ 1,860 | \$ 4,980 | \$ 14,917 | \$ 15,917 | \$ 17,333 | \$ 18,231 | \$ 18,615 | \$ 19,110 | \$ 19,161 | \$ 19,329 | \$ 19,609 | \$ 19,903 | \$ 21,441 | \$ 23,098 |
| 1b | | | TOTAL EXCLUDING ROW 6 | | | | \$ 569 | \$ 1,860 | \$ 2,442 | \$ 2,443 | \$ 3,257 | \$ 4,482 | \$ 5,188 | \$ 5,376 | \$ 5,673 | \$ 5,522 | \$ 5,486 | \$ 5,558 | \$ 5,641 | \$ 6,077 | \$ 6,547 |
| 2a | | | FTE INCLUDING ALL | | | | 1.0 | 9.0 | 14.0 | 45.0 | 46.0 | 53.0 | 54.0 | 54.0 | 56.0 | 56.0 | 57.0 | 56.0 | 56.0 | 56.0 | 56.0 |
| 2b | | | FTE EXCLUDING ROW 6 | | | | 1.0 | 9.0 | 11.0 | 15.0 | 16.0 | 23.0 | 24.0 | 24.0 | 26.0 | 26.0 | 27.0 | 26.0 | 26.0 | 26.0 | 26.0 |
| 17 | 2 and 4 | S6 | EOW Trash - Allow / Incentivize and (Eventually) Require at lower cost. | 1 | 2022 | 1 | \$ - | \$ - | \$ - | \$ - | \$ 13.8 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 18 | 2 | S15 | Convenience Center - Minimum Requirements for Access & Services | 1 | 2023 | 8 | \$ - | \$ - | \$ - | \$ - | \$ 349.6 | \$ 1,274.6 | \$ 1,293.8 | \$ 1,313.2 | \$ 1,332.9 | \$ 1,352.9 | \$ 1,373.2 | \$ 1,393.7 | \$ 1,501.5 | \$ 1,617.5 | |
| 19 | 2 | S42b | Change Building Codes to Require Soil Amendment using Local Compost | 1 | 2021 | 1 | \$ - | \$ - | \$ - | \$ 9.0 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 20 | 3 | S7 | Commercial SAYT & ABC Law (adapted), Supporting Bans, and Enforcement | 1 | 2022 | 1 | \$ - | \$ - | \$ - | \$ - | \$ 13.8 | \$ 918.0 | \$ 931.8 | \$ 945.8 | \$ 960.0 | \$ 974.4 | \$ 989.0 | \$ 1,003.8 | \$ 1,018.9 | \$ 1,097.6 | \$ 1,182.5 |
| 21 | 3 | S12, 13, 14 | Require C&D Deposit System | 1 | 2024 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 9.4 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 22 | 3 | S16 & 17 | Incentives (Surcharges / Discounts) for Clean Separated Streams and Diversion at Transfer Stations & Disposal Sites | 1 | 2025 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 14.4 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 23 | 3 | S18 | Residential Service Contracts / Franchises | 1 | 2025 | 2 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 127.7 | \$ 202.6 | \$ 148.2 | \$ 150.4 | \$ 152.7 | \$ 155.0 | \$ 167.0 | \$ 179.9 |
| 24 | 3 | S22 | SAYT Higher Incentives and Smaller Service Levels | 1 | 2023 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 25 | 3 or 4 | S35 | Add Diapers to Organics Program | 1 | 2028 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 5.0 | \$ - | \$ - | \$ - | \$ - |
| 26 | 4 | S23 | More Aggressive Residential Diversion Strategies | 1 | 2028 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 5.0 | \$ - | \$ - | \$ - | \$ - |
| 27 | 3 | S25-28, 3 | Add - then Ban - Additional Materials to Residential and Commercial Collection Programs | 1 | 2021 | 1 | \$ - | \$ - | \$ - | \$ 9.0 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 28 | 4 | S38 | Contracted Commercial Collection | 1 | 2026 | 2 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 129.6 | \$ 205.7 | \$ 150.4 | \$ 152.7 | \$ 155.0 | \$ 167.0 | \$ 179.9 |
| 29 | 4 | S39 | Every Other Week (EOW) Trash Collection Allowed for Commercial Implement / Roll-out Multifamily Program / Strategy | 1 | 2026 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 30 | 4 | S40 | Implement / Roll-out Multifamily Program / Strategy | 1 | 2026 | 1 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - |
| 31 | | S99 | Implementation Consultant | 1 | 2018 | | \$ 160.0 | \$ 150.0 | \$ 180.0 | \$ 160.0 | \$ 160.0 | \$ 160.0 | \$ 160.0 | \$ 140.0 | \$ 170.0 | \$ 70.0 | \$ - | \$ - | \$ - | \$ - | \$ - |

Appendix G

Going Beyond High Performance to Zero Waste

In this appendix, we discuss the following topics:

- Appendix G.1: Developing a Zero Waste Strategy Framework, including the definitions of Zero Waste, circular economy, sustainable materials management, highest and best use hierarchy, and department Vision/Mission statement.
- Appendix G.2: Zero Waste Strategies recommendations to reach 90+% disposal diversion, outlined in three broad categories of Metro Council Policies, Public Education Strategies, and Economic Development Strategies.
- Appendix G.3: Assumptions in the development of the recommended Zero Waste strategies.
- Appendix G.4: Implementation Timeline and Diversion Summary
- Appendix G.5: Implementation Expense Schedule



G.1 Developing a Zero Waste Strategy Framework

One of the most important concepts of the Zero Waste philosophy is the idea of a circular economy. [The Ellen MacArthur Foundation](#) **defines the circular economy** as:

“An economy that looks beyond the current “take, make and dispose” to one that is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to eliminate waste...”

In other words, a circular economy aims to keep resources in use for as long as possible to extract their maximum value. A local community can create a circular economy around the discards of residents and businesses through economic development based on the principles of sustainable materials management. These principles are addressed in the following strategies.

For clarity of what is meant by the phrase Zero Waste, we recommend the community adoption of the international peer reviewed **definition of Zero Waste**, as defined by [Zero Waste International Alliance](#) (2009):

“Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.

Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health.”

Sustainable Materials Management (SMM) provides a coherent framework for pursuing the elusive ‘reduce and reuse, and then recycling’. Waste Management is a linear pathway toward final disposal while Sustainable Materials Management leads toward supporting a circular economy that supports a domestic reuse and recycling infrastructure, local jobs, and sustainable clean feedstock for remanufacturing. Beyond the traditional recycling pathways, Sustainable Materials Management supports the highest and best use principles that bring us back to the basic three R’s: Reduce, then Reuse, then Recycle.

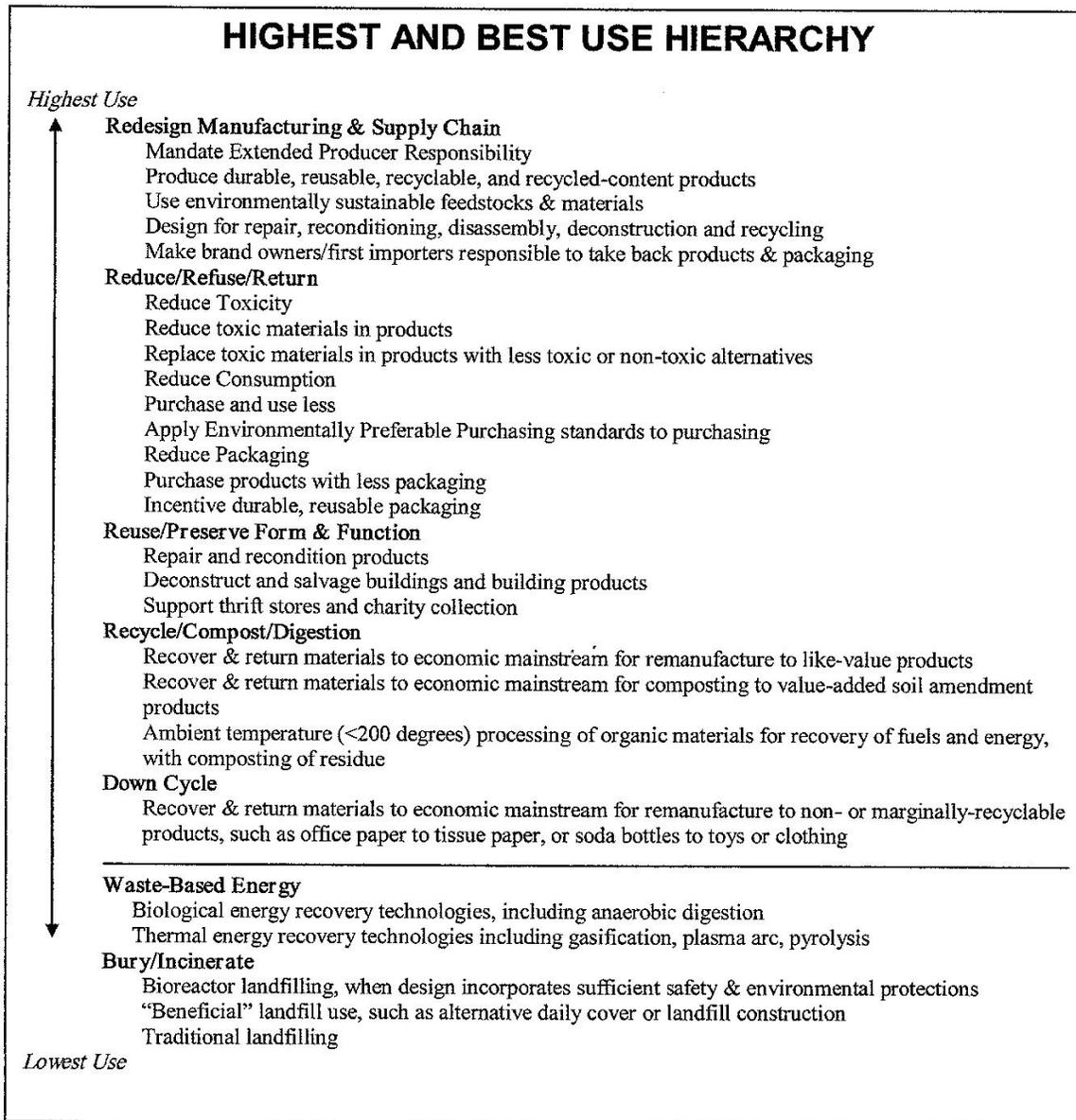
SMM principles can be applied at the street level, within the municipal service framework. The following Zero Waste Strategies are designed within the SMM framework, with Highest and Best Use as a basic priority structure. Highest and Best Use hierarchy offers the prioritization structure, where the evaluation of establishing new diversion programs is based on sustainability practices, lowest energy input needs, and highest embodied energy use of each identified material.

The Highest and Best Use Hierarchy describes a progression of policies and strategies to support the Zero Waste system, from highest and best to lowest use of materials. It is designed to be applicable to all audiences, from policy-makers to industry and the individual. It aims to provide more depth to the internationally recognized 3Rs (Reduce, Reuse, Recycle); to encourage policy, activity and investment at the top of the hierarchy; and to provide a guide for those who wish to develop systems or products that move us closer to Zero Waste. It enhances the Zero Waste definition by providing guidance for planning and a way to evaluate proposed solutions.

The Guiding Questions toward the use of the Highest and Best Use Hierarchy, as described by the [Zero Waste International Alliance](#):

- **Rethink:** What has led us to our present linear use of materials and thus, what needs to evolve to move towards a closed loop model? How do we re-design systems to avoid needless and/or wasteful consumption?
- **Reduce:** What supports the use of less material and less toxic material?
- **Reuse:** What supports the better use of those products we already have in ways that retain the value, usefulness and function?
- **Recycle/Compost:** How do we ensure materials are put back in the materials cycle?
- **Residuals Management:** What is still left and why? What do we need to take out of the system that should not have been circulated in the first place? How do we manage what is left in a flexible manner that continues to encourage movement towards Zero Waste?
- **Unacceptable:** What systems and policies encourage wasting and should not occur?

The basic Highest and Best Use Hierarchy is as follows (source: Austin Zero Waste Master Plan):



Department Vision and Mission

The vision and mission of an organization directs its staff and finances toward a pathway in support of its goals. As Zero Waste is the adopted Goal of the City through its sustainability efforts, then it must follow that the Department should adopt supporting vision and mission statements. In addition, the following strategies can also support the mission and vision of zero waste.

- Adopt the Highest and Best Use Hierarchy and incorporate its principles in department practices and all collection programs.

- Adopt the Sustainable Materials Management (SMM) framework where applicable for the waste management sectors serviced, including the management of materials generated and recovered for secondary reuse, recycling or compost.

G.2 Zero Waste Strategies

The following strategies were selected for inclusion in the Plan based on their proven effectiveness in zero waste model cities; see Zero Waste Case Studies for more direct examples deployed in various municipalities. The strategy descriptions include: explanation of the strategy goal, actions needed to implement the strategy, anticipated challenges, financial impact and diversion impact.

If all the strategies in this plan were implemented then Nashville would, in theory, reach Zero Waste – 90+% disposal diversion. Complete 100% avoidance of landfilling would require 100% citizen participation and an extraordinary level of government investment and private sector funding to pay for all the programs.



Realistically, a selection process is necessary to utilize public funds judiciously. This process will require analysis of the potential diversion capacity of each strategy, the acceptance of the public, the availability of end markets and the funds required to fully implement and maintain the selected diversion programs. The goal is to reach 90+% disposal diversion within a reasonable cost factor.

The selected strategies will require legislative authority to adopt universal requirements in both the GSD and USD districts. This is essential to reaching the stated Zero Waste goals. The diversion calculations presented in this appendix assume that residents and businesses throughout Nashville Metro are subject to the same requirements and regulations. GSD/USD alignment of programs is consistent with the stated target of *Livable Nashville* to provide “...expanded services in Urban and General Services districts.”

To implement these strategies, Metro will need to increase revenues to cover additional program costs and new staff. We recommend numerous new staff positions hired over a ten-year implementation platform as described further in this appendix.

G.2.1 Metro Council Policies (Initiated Year 2 – Year 4)

This appendix offers Zero Waste Strategies recommendations to reach 90+% disposal diversion, outlined in these three categories: **Metro Council Policies, Public Education Strategies, and Economic Development Strategies.**

Best practices observed in model cities show governmental policies are employed extensively to promote zero waste practices. These policies, which may include ordinances, incentives, bans, take-backs, purchasing specifications, and advocacy, are discussed below.

ZW1: Enhance Metro Green Procurement practices that support buying recycled content and minimizing waste ⁵

Strategy Goal: Implement changes in the Metro Green Procurement processes to encourage buying recycled content, minimize waste, and support reuse of discarded office equipment. The current procurement policies assist Metro Government agencies to “implement strategies to prevent waste and pollution by considering environmental impacts along with price, performance, product safety, and availability when evaluating solicitation offers for products and services.” Yet, these policies are voluntary and lead to various interpretations and implementation levels amongst the various departments. Although procurement is decentralized and administered at the department level, this strategy encourages collaboration through a uniform policy that is consistently applied across all departments. This strategy is supportive of the *TDEC 2015-25 Solid Waste Management Plan*, Objective 3.5: “Facilitate sustainable materials management in public purchasing decisions.” And the *Livable Nashville* target to “Lead by Example.”

City Action Plan: Review Metro purchasing practices and establish an Environmentally Preferable Product (EPP) procurement program for electronics and office supplies. Establish office furniture reuse, surplus disposition and related policies.

Challenges: Changing the current practices may require Metro code changes.

City Budget Needs: One new position - Finance Specialist
\$52,200 salary plus \$26,100 benefits = \$78,300 ¹, plus \$50,000 annually in program expenses. ³

Diversion Impact: Supports diversion in other programs, enhancing and expanding the existing green procurement policies, creating consistency across all departments, increasing awareness and indirect diversion impacts on other diversion-oriented programs.

ZW2: Net Zero / Sustainability Ordinance ⁵

Strategy Goal: Require Metro departments to prevent waste, maximize recycling, maximize energy and water efficiency, and appoint a Net Zero Coordinator for each major department (e.g. Fire, Police, Sherriff, IT Services, Mayor’s Office, Council Office, Transportation & Sustainability, Convention & Visitors Corp, Library, Airport Authority, Public Schools, Electric Services, Metro Transit Authority, Parks & Recreation, Public Works, Social Services, Sports Authority, Water Services, and Health Dept) to lead these efforts. This strategy integrates Zero Waste efforts within the larger Metro goal of sustainability and resiliency in reaction to climate change adaptation needs. Although sustainability accountability is administered through the Mayor’s Office of Transportation and Sustainability, the departmental actions are decentralized and administered at the department level, this strategy encourages collaboration through a uniform policy that is consistently applied across all departments.

This strategy is supportive of the *Green Ribbon Committee Report* target to... “Ensure adequate and convenient recycling containers available at all Metropolitan Government buildings, Metro-owned sites and Metro-sponsored functions.” In addition, this strategy is supportive of the *Tennessee Department of Environment & Conservation 2015-25 Solid Waste Management Plan*,

Objective 2.5: “Increase recycling access and participation in state government facilities” and Objective 4.5: “Support organics recovery with updated policy.”

City Action Plan: Require Metro departments to develop Action Plan that encourage waste reduction, recycling and composting, administered through the Mayor’s Office of Transportation and Sustainability. Encourage implementing Action Plans at state facilities as supported in the TDEC Solid Waste Management Plan.

Challenges: This strategy requires coordination between all Metro departments.

City Budget Needs: \$0 new salaries, incorporate in existing department sustainability efforts with defined and measured targets²; coordinated by Finance Specialist noted above, plus \$50,000 annually in program expenses. ³

Diversion Impact: Supports diversion in other programs, enhancing and expanding the existing inter-departmental sustainability policies, creating awareness and indirect diversion impacts on other diversion-oriented programs.

ZW3: Collaboration with local communities toward regional zero waste support ⁶

Strategy Goal: Enter into working agreements with surrounding local governments, universities, school systems, and state/federal facilities to coordinate education and social media messaging in a consistent manner to local citizens.

City Action Plan: Develop and implement interlocal agreements with adjoining communities to create a regional zero waste education effort in the greater Nashville media market and regional school systems. Coordinate social media messaging through local communities and schools. (In addition to the existing school education program.)

Challenges: Each entity will likely have an existing education commitment that will need to be adjusted to fit a unified theme with consistent messaging (e.g. same container labels, same recycling acceptance list, same descriptive language vernacular, etc.)

City Budget Needs: \$0 new salaries², supported through existing department leadership and staff, plus \$50,000 annually in program expenses. ³

Diversion Impact: Supports diversion in other programs, enhancing and expanding the existing local governmental policies, creating collaboration and consistency region-wide, increasing awareness and indirect diversion impacts on other diversion-oriented programs.

ZW4: Metro Government Construction Recycled Content Ordinance ⁷

Strategy Goal: To promote diversion from landfilling of material generated on Metro contracted construction sites.

This strategy is supportive of the *Green Ribbon Committee Report* target to “Implement a Metro-wide program for recycling construction and demolition debris”, and the *Nashville Next Natural Resources Action Plan N.R. 3.1*: “Add policies to utilize composted and recycled products to benefit urban agriculture soil health in Metro Government Procurements.” In addition, this strategy is

supportive of the *Tennessee Department of Environment & Conservation 2015-25 Solid Waste Management Plan*, Objective 2.6: “Increase diversion of construction and demolition materials.”

City Action Plan: Develop recycled content requirements for construction materials. Develop standards for reuse of glass, concrete, asphalt, and residual plastic in road and sidewalk projects. Develop requirements for use of food waste/yard waste compost on road and highway projects.

Challenges: Adapting to new engineering and specification changes will be difficult; this process will require collaboration and patience.

City Budget Needs: \$0 new salaries², incorporate in existing department sustainability efforts; coordinated by Finance Specialist noted above, plus \$50,000 annually in program expenses.³

Diversion Impact: 40,000 tons per year additional diversion.

ZW5: Deconstruction and Reuse of C&D Waste Ordinance (expansion) ⁸

Strategy Goal: Establish a building code ordinance requiring deconstruction, repair, reuse and/or recycling of valuable materials before demolition permits are awarded. This strategy is an expansion of the requirement to recycle construction waste, as noted in the High Diversion strategies noted in Chapter 6.

City Action Plan: Develop and implement new building codes requiring deconstruction, reuse and/or recycling of valuable materials before demolition permits are awarded. Engage and seek advice from Construction & Demolition Recycling Association (CDRA) and the Recycling Certification Institute (RCI) regarding advanced technologies and industry trends toward higher diversion. Create a green award for the building industry that recognizes excellence in deconstruction and reuse efforts.

Challenges: Resistance from the building industry to costs and time required for deconstruction are expected.

City Budget Needs: \$0 new salaries, utilizing the Business Development Officer in coordination with business economic development activities², plus \$50,000 annually in program expenses.³

Diversion Impact: 1,000 tons per year (Supports diversion in other programs, enhancing and expanding the existing local construction recycling and collection policies, creating awareness of deconstruction techniques, and indirect diversion impacts on other diversion-oriented programs.)

ZW6: Special Events and Festivals Zero Waste Ordinance ⁹

Strategy Goal: To provide the public with diversion opportunities at public events and festivals and enhance zero waste awareness that will translate to better recycling habits at the home and office.

City Action Plan: Require public special events and festivals that currently require a Metro permit to achieve sustainability standards such as providing recycling and organics collection, regulating vendor food service-ware and collateral, reducing litter, and other means to increase diversion toward making it a Zero Waste event. Add recycling services to the venues of the Metro Sports Authority. Create a recognition program to reward events that reach Zero Waste and showcase their success on the Metro website. Add Zero Waste Strategies to the Nashville Predators games, as well as other local sports venues, modeling from the NFL Superbowl XLIX diversion program. Consider modeling programs such as Alameda County, CA, Metro of LA, Seattle, Austin, and NY Metro event greening programs.



Challenges: This strategy requires revising existing rules and regulations of Metro permits for public gatherings on public property or on property controlled by Metro.

City Budget Needs: 2 new positions (Program Specialist 1) \$66,000 salary plus \$33,000 benefits = \$99,000 ¹, plus \$150,000 annually in program expenses. ³
 (*Possible fee revenue on public event organizations to offset expenses)

Diversion Impact: 1,000 tons per year (Supports diversion in other programs, enhancing and expanding the existing local collection policies, creating public awareness and indirect diversion impacts on other diversion-oriented programs.)

ZW7: Surplus Food Rescue and Redistribution Ordinance ¹⁰

Strategy Goal: To find ways for surplus food to be made available for consumption rather than disposal.

Surplus food capture is supportive of the target of *Livable Nashville* to “Demonstrate Leadership on Food Waste Reduction”, and the *Green Ribbon Committee Report* target to “implement a food waste program for large producers of food waste.” In addition, this strategy is supportive of the *Tennessee Department of Environment & Conservation 2015-25 Solid Waste Management Plan*, Objective 4.1: “Provide information to Tennessee businesses and citizens about opportunities to reduce food residual disposal.”



City Action Plan: Develop and implement an ordinance that supports a surplus food capture program based on the research supported by the NRDC study *Modeling the Potential to Increase Food Rescue (2017)*. Support the Nashville Food Waste Initiative and the Mayor’s Restaurant Food

Saver Challenge. Establish a surplus food capture task force to research surplus food in commercial restaurants, food caterers and home settings, and implement recommendations from the study. Some of the recommendations from the NRDC study include: streamlining and disseminating Metro Health Department guidance on donating food safely, training and engaging health inspectors to encourage food donation, raising awareness among area businesses about food insecurity issues and the potential benefits of donating food, providing grants and other assistance to increase food recovery infrastructure in the community, provide education on issues of food waste, provide tips for reducing food waste, make it possible to buy food in smaller portions in stores and restaurants.

Challenges: Food collection and redistribution safety issues and concerns need to be addressed in collaboration with local health officials. Some businesses may limit participation due to perceived liabilities, which can be adequately addressed but require Metro staff attention.

City Budget Needs: \$0 new salaries, utilizing the Business Development Officer position discussed in Appendix G.2.3, plus \$50,000 annually in program expenses. ³

Diversion Impact: 2,500 tons per year (Supports diversion in other programs, enhancing and expanding the proposed food collection program in Chapter 6, creating food waste awareness and indirect diversion impacts on other diversion-oriented programs.)

ZW8: Recycling/Organics Collection Compliance and Contamination Ordinance ¹¹

Strategy Goal: Develop and implement enforcement procedures and rules to support universal implementation of mandatory recycling and organics collection.

City Action Plan: Enforcement provisions regarding requirements for recycling and organics collection. Perform frequent route monitoring for participation and contamination. Inspect containers, issue warnings and fines for violations, and provide education materials. (Note Zero Waste Case Studies: Austin and San Francisco cart inspection programs.)

Challenges: Enforcement authority and procedures usually may require Metro Council adoption and Metro Code changes.

City Budget Needs: Financial Impact; 4 new positions (Env. Compliance Officer 1) \$160,000 combined salaries plus \$80,000 benefits = \$240,000 ¹, plus \$150,000 annually in program expenses. ³

Diversion Impact: 75,000 new diversion tons per year, plus 2,500 tons per year of reduced contamination.



ZW9: Extended Producer Responsibility Resolution ¹²

Strategy Goal: Adopt an Extended Producer Responsibility (EPR) resolution to capture difficult-to-divert materials (e.g. chemicals, carpet, paint, sharps, etc.).

City Action Plan: EPR makes producers financially and/or physically responsible for sustainable management of their products in the post-consumer phase. This, in turn, provides incentive to

producers to improve product designs for recycling and reuse. Engagement in nationally established take-back efforts for products such as: batteries, sharps, pharmaceuticals, carpet, fluorescents and pesticides are one-way Nashville Metro can implement EPR. An example is the battery take-back program offered by [Call2Recycle](#), a producer funded national take-back program. Also, join the [National Stewardship Action Council](#) and [Upstream](#) to receive periodic updates on new take-back opportunities.

Challenges: Extended Producer Responsibility requirements are usually enacted by Federal and State governments. Some local governments have led in this area when the state does not take action, however there may be state limitations on local units of government. Municipalities can establish take-back programs (e.g. batteries, paint, carpet, propane tanks, sharps, pharmaceuticals, etc.) through existing national producer co-funded or partially funded collection programs. Nashville Metro can also join EPR groups to advocate for state-wide and national policies.

City Budget Needs: Expanded collection at HHW collections to include take-back items; bulking and shipment to contracted recycler/disposal agent will require local Metro collection costs, sometimes partially reimbursed by industry-led EPR coalitions. Initial setup costs estimated to be approximately \$50,000 to expand the current HHW services with additional hard-to-recycle items to be collected (e.g. batteries, paint, carpet, propane tanks, sharps, etc.) through industry EPR partnerships. Depending on volume collected, estimated costs of about \$200,000 per year, plus \$50,000 / annually in outreach program expenses.³

*Extended Producer Responsibility agreements between local governments and third-party industry groups often are self-funded without aide of local government funds (e.g. Canadian EPR examples). There are [more than 200 US cities](#) engaged in EPR policies and collection programs. We recommend placing this activity on hold until EPR is embraced at the State level to reduce local expenses and reduce local liabilities.

Diversion Impact: up to 1,000 tons per year (Supports diversion in other programs, enhancing and expanding the existing HHW collection policies, creating awareness and indirect diversion impacts on other diversion-oriented programs.)

G.2.2 Public Education Strategies (Initiated Year 2 – Year 7)

Strategies that involve public education and outreach can create diversion through better awareness of programs offered by Metro and local service providers. New education programs will require additional Metro staffing and resource dedication.

The public education strategies are supportive of the targets of *Livable Nashville*; “Public education Campaign”, *Nashville Next Natural Resources Action Plan N.R. 3.1*: “...and increase waste diversion by promoting and advocating for these services.” and TDEC’s 2015-25 Solid Waste Management Plan, Objective 6: “Expand and Focus Education and Outreach.”

ZW10: Multi-Year Public Education Campaign ¹³

Strategy Goal: Achieve higher participation, higher capture rate, and stronger bond to zero waste brand by reaching those not engaged in diversion programs. Proposed recycling and compost

collection programs require extensive public education and outreach, especially in program roll-out years. Best practices from Zero Waste model cities note an on-going investment in public education, that results in increased diversion and decreased contamination.

City Action Plan: Develop and implement a multi-year public education campaign. This strategy should roll-out with the food waste ban and the SAYT collection program to realize maximum benefit. A communication action plan is required to address the five stages of effective public education: determining where outreach is most needed, preparation of an execution plan, developing effective partnerships, plan implementation, and on-going messaging. Hiring college interns to engage youth in conversations about the benefits of Zero Waste.

Challenges: Funding approval from Metro Council.

City Budget Needs: 3 new positions (college interns @\$15/hr) \$45,000 salary to assist Metro youth program.¹

Recommended total funding of public education campaign to include \$3 per capita in years one through five, \$2 per capita in years six through ten, and \$1 per capita from year ten onward.

| <u>Years</u> | <u>Average Population</u> | <u>\$ per capita</u> | <u>Public Education Campaign</u> |
|-----------------|---------------------------|----------------------|----------------------------------|
| First 5 years | 705,000 | \$3 | \$2,115,000 /yr |
| Second 5 years | 710,000 | \$2 | \$1,420,000 /yr |
| Year 11 forward | 715,000 | \$1 | \$ 715,000 /yr |

Diversion Impact: up to 10,000 new diversion tons per year. Supports diversion in other programs, enhancing and expanding the existing recycling and composting collection programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.

ZW11: Promote “Reduce, Reuse and Repair” as a priority¹⁴

Strategy Goal: Adopt “Reduce, Reuse and Repair” as a priority message, incorporating the best use hierarchy principles of Zero Waste.

This strategy is supportive of the *Livable Nashville* target “Restructure incentives to encourage reduction of solid waste.”

City Action Plan: Offer grants to promote establishment of reuse businesses (e.g. mattress recycling, electronics disassembly and fix-it clinics). Provide workshops on waste reduction and reuse to businesses and residences. Hold competitions for waste reuse innovations. Conduct tours of businesses with exemplary waste reduction and reuse programs.

Challenges: This is a difficult topic to message to public, requiring physical demonstrations and examples.

City Budget Needs: One new position (Grant coordinator - Program Specialist 1) \$33,098 salary plus \$16,549 benefits = \$49,647¹, plus \$50,000 annually in program expenses.³

Reuse grants: Range from \$100,000 to \$500,000 per year depending on RFP diversion impacts¹⁵

Diversion Impact: up to 4,000 tons per year

ZW12: Develop a brand for Metro Public Works Waste and Recycling Operations ¹⁵

Strategy Goal: Adopt a new title and brand that reflects the City’s commitment to Zero Waste principles.

City Action Plan: Adopt a name and brand change from waste management to resource recovery that will be displayed on vehicles, carts, publications, outreach materials, Metro code references and Metro communications. A phased-in approach minimizes cost impacts, especially on vehicles and carts.

Challenges: Solid waste and recycling vehicles and collection carts name changes may require Metro management authority and Council approval for Metro code reference changes.

City Budget Needs: Approximately \$100,000 for vehicle labels, building signs, letterhead, publications and outreach material logo changes.

Diversion Impact: Supports diversion in other programs, enhancing and expanding the existing local collection policies and programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.

ZW13: Rebrand the collection programs through color identification ¹⁵

Strategy Goal: Utilize new color-coding to reduce contamination levels and as a form of zero waste messaging. Color identification offers residents, apartment tenants, and businesses an easy to identify location for recyclables, compostables, and trash, thus reducing cross contamination. Keep America Beautiful (KAB) and the National Recycling Coalition (NRC) recommend the national adoption of green for composting and blue for recycling. As new residents move to the City, they will be accustomed to this color scheme from their residential origin.



City Action Plan: Color coding equipment and containers reduces confusion regarding which bin to place an item, thus increasing diversion and lowering contamination. Color coding also increases the “branding” of the Zero Waste principles for residents: blue for recycling, green for organics, and brown for trash. Ideally, vehicle colors should match collection container colors, and collection vehicles can carry side panel messaging that is consistent with the zero-waste theme.

Challenges: Color coding will face strong resistance to change. Start with Metro vehicles and, after resistance turns to acceptance, require the color coding for private service providers.

City Budget Needs: One-time building signage and business letterhead change. One-time existing vehicle painting (excluding vehicles to be retired within two years). (\$800/vehicle painting fee.) Vehicles to be ordered in future will be painted using select colors at no extra charge (painting charges generally included in purchase price). New Cart purchase price includes color choice at no extra charge. Change over carts at time of replacement or conversion of services. Existing

carts can be color-coded by lid replacement (with updated lid sticker instructions). A phased-in approach minimizes cost impacts, if coordinated with name and logo change as noted above.

Diversion Impact: Supports diversion in other programs, enhancing and expanding the existing local collection policies and programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.



G.2.3 Economic Development Strategies (Initiated Year 5 – Year 6)

Economic development initiatives can increase diversion through the creation of new programs facilities and public/private partnerships. Given the current export restrictions on recyclables, it is important to develop local end-markets for collected recyclables and compostables. In addition to creating local markets, there is the cost savings of long-distance transportation, the creation of local green jobs, and the reduction in carbon-footprint.

Rebuilding America’s Recycling Industry

The [National Recycling Coalition](#) (NRC) addresses the China recycling import restrictions through the call for local market development. Excerpts from the November 30, 2017 NRC communication addresses the need to build local recycling markets:

- As the recyclables collected are commodities, they are raw material in lieu of virgin materials for manufacturing. The Bureau of International Recycling (BIR) estimates that more than 40% of manufacturers’ raw material needs around the world are met through the recycling of obsolete, off-spec, and end-of-life products and materials. The added value through recycling is directly related to the investment in quality collection and quality processing. In essence, recyclers are generating the feedstock material for industries to make new products and packaging. The past focus was on feeding China’s industrial production system; now the focus is on rebuilding America’s recycling industry.
- The National Recycling Coalition (NRC) strongly supports efforts to invest and improve our country’s aging infrastructure. NRC believes that investing in American recycling infrastructure would provide an excellent return on investment and the leveraging of federal infrastructure funds. Support of American recycling infrastructure would enable America [including Nashville] to bring home recycling jobs from overseas, and dramatically expand the three-quarters of a million jobs and tens of billions of dollars already occurring in economic activity. Instead of shipping half of all recovered recyclables to overseas markets, a refreshed recycling infrastructure will support new American end markets, manufacturers and businesses creating closed loop material streams and lower transportation costs.

- Consider creating a local recycling incubator research lab at your local university, through research grant funds. Innovation can advance recycling to create a new American leadership on the international recycling stage. We are challenged with gaining higher diversion and higher quality, at a low collection and processing cost. Can we invest in the research toward collection changes and MRF processes to gain high quality recyclables?
- Talk to your local economic development office about locating recycling jobs to your community. Note the linkage between local economic development and the recycling circular economy. Note the growing green job network, the ability to control the end destination of your recyclables by placement of end markets in your own community. Recycling remanufacturing offers a new and growing tax base, clean manufacturing, stable employment opportunities, and the synergies of locating processors and end users in the same proximity to the reduce carbon footprint of your recycling program.

The following Sustainable Materials Management chart supplied by the NRC offers a restating of the Highest and Best Use Hierarchy, emphasizing local market development:



This chart notes four areas that can involve public/private partnerships through economic development activities:

- Redesign: through partnerships with local research labs and universities
- Market Development: through partnerships with local and new businesses to consume recyclables
- Reuse: through partnerships with local thrift and second-hand businesses
- Recycle: through partnerships with local service providers and recycling processors

In an effort to develop local end-markets for collected recyclables and compostables, it is recommended to utilize the established economic development program within the Mayor's Office, as noted in the following Economic Development Strategies.

The following strategies are consistent with the recommendation in *NashvilleNext Economic and Workforce Development EWD 1.1* to... "Support entrepreneurs and small businesses by providing locations to develop and grow new businesses, business development training, support for small-business and start-up districts, and clear laws and regulations" and they are supportive of the *TDEC 2015-25 Solid Waste Management Plan*, Objective 2.4: "Work with partners to increase sustainable materials management by businesses and industry" and Objective 3: "Promote Material Processing and End Use in Tennessee".

These new programs will require Metro staffing and resource dedication.

ZW14: Use local economic development tools for support of Zero Waste diversion goals ¹⁶

Strategy Goal: Bring new recycling and reuse industries to Nashville Metro.

City Action Plan: Create a new job position to promote recycling and reuse within the framework of the Mayor's Office of Economic and Community Development and regional collaboration through the Greater Nashville Regional Council (e.g. startup showcases, innovations investment forums, etc.). This position will utilize the tools of the economic development community (such as use of local industrial parks, use of economic develop financial incentives, and included in local economic develop promotions) to forge public/private partnerships for manufacturers that are part of the recycling supply chain.

Challenges: Various financial incentives will have different sources of funding with a variety of restrictions for use. Adding waste diversion to these incentives requires innovation and policy changes.

City Budget Needs: 1 new position (Business Development Officer) = \$57,360 salary plus \$28,680 benefits = \$86,040 ¹, plus \$50,000 annually in program expenses. ³

Diversion Impact: 10,000 tons per year. Supports creation of new domestic markets for local recycling collection programs.

ZW15: Support local Zero Waste businesses ¹⁶

Strategy Goal: Encourage local businesses to support Zero Waste in their business practices. Develop private/public cooperative ventures to support Zero Waste initiatives in the business community. Create public awareness of Zero Waste businesses in the local community.

This strategy is supportive of the *TDEC 2015-25 Solid Waste Management Plan*, Objective 3.2: "Seek and facilitate public-private partnerships."

City Action Plan: Develop and implement cooperative agreements with local businesses to create a regional business incentive package to support Zero Waste initiatives. Offer financial and promotional support to the local business community to encourage regional zero waste

businesses (e.g. Zero Waste Business Rebates, Shop Zero Waste website, Recycling Resource Guide, Zero Waste diversion competitions, Mayor’s Zero Waste awards, etc.)

Challenges: Funding local businesses with Department funds may have restrictions, based on source of funds.

City Budget Needs: \$0 new staffing ², utilizing the Business Development Officer in coordination with business economic development activities, plus \$50,000 annually in program expenses.³ ZW Business Rebates and support expenses: \$100,000 per year

Diversion Impact: 1,000 tons per year. Supports diversion in other programs, enhancing and expanding the existing local collection policies and programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.

ZW16: Support of the Tennessee Materials Marketplace ¹⁶

Strategy Goal: Increase the size of the marketplace and its users.

City Action Plan: Offer grants to develop new local reuse and recycling opportunities for inclusion in the [Tennessee Materials Marketplace](#), an internet-based waste exchange network for office, commercial, and industrial material streams, developed utilizing the US Business Council for Sustainable Development business model for a dynamic internet-based materials exchange.

The Tennessee Materials Marketplace is an online platform allowing businesses and organizations to connect and find reuse and recycling solutions for waste and by-product materials. The program aims to create a closed-loop, collaborative network of businesses, organizations and entrepreneurs where one organization’s hard-to-recycle waste and by-products becomes another organization’s raw material. In addition to diverting waste from landfills, these recovery activities generate significant cost savings, energy savings, and create new jobs and business opportunities. The Materials Marketplace enables participating organizations and project staff to easily post materials available or desired, identifies reuse opportunities, and exchange underutilized materials. The Materials Marketplace’s staff actively pushes out recommendations for matches by leveraging best practices from their case study library, international network of material reuse projects, and technical partners; and overcome barriers through a facilitated process.

Challenges: Generating awareness and getting businesses to use the exchange.

City Budget Needs: \$0 new staffing ², utilizing the Business Development Officer in coordination with business economic development activities, plus \$50,000 annually in program expenses: Materials Exchange grants for expansion to include Nashville businesses. ³

Diversion Impact: 36,000 tons per year. Creates new diversion through reuse and recycling of industrial based materials.

ZW17: Support of Research and Development

Strategy Goal: Development of new strategies that lower costs and increase waste reduction, reuse and recycling.

This strategy is supportive of the *TDEC 2015-25 Solid Waste Management Plan*, Objective 5: “Support New Waste Reduction and Recycling Technology.”

City Action Plan: Offer research grants to develop new strategies. One idea is to identify non-recyclables from Nashville Metro waste composition studies and request redesigns to address recycling concerns. Other ideas include challenging researchers to address MRF sorting problem or finding new end uses for end of life materials.

Challenges: Finding funding sources for the R&D projects. Collaboration with TDEC or other zero waste communities is a possibility.

City Budget Needs: \$0 new staffing ², utilizing the Business Development Officer. Funding might be available through grants from the Ellen MacArthur Foundation.

Recommending \$50,000 annual Grants negotiated with universities and leveraged with other financial sources (e.g. Closed Loop Fund, etc.)

Diversion Impact: Creates new diversion opportunities. Supports diversion in other programs, enhancing and expanding the existing local collection policies and programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.

ZW18: Development and support of Eco-Industrial Park ¹⁶

Strategy Goal: Develop an industrial park to host companies that reprocess locally generated materials. Create local green jobs with living wages. The best way to deal with international export restrictions is to build a local recycling processing and remanufacturing infrastructure, developing new green jobs for the local economy. The co-location of recycling and reuse firms with end-market remanufacturers will create opportunities for synergistic business supply chains, utilizing recyclables as raw material feedstock. To support businesses locating to Nashville Metro region, the use of local economic development tools can be of aide and offer a welcome mat to prospective businesses.



This strategy is supportive of the recommendation in *NashvilleNext Economic and Workforce Development EWD 1.1*: “Conduct market and design feasibility studies of creating a waterfront eco-industrial district.” In addition, this strategy is supportive of the *TDEC 2015-25 Solid Waste Management Plan*, Objective 3.1: “Develop regional recycling hubs in areas where delivery to processors is cost prohibitive.” A Zero Waste Model community for this strategy is the [Austin Re-Manufacturing Hub](#).

City Action Plan: Provide a site for an eco-industrial park to host companies that reprocess locally generated waste materials, and in regional collaboration through the Greater Nashville Regional Council. Create business synergies by co-locating industries that use each other’s byproducts. Offer tax incentives for businesses that support the zero-waste plan. Assist in developing local end markets for their products.

Challenges: Requires economic development funds to set up and manage the park.

City Budget Needs: \$0 new staffing ², utilizing the Business Development Officer in coordination with business economic development activities, plus \$50,000 annually in program expenses. ³

Funding for design may be available through grants from the Ellen MacArthur Foundation.

Site Development Funds: \$10 million for utilities, roadwork, engineering, development permits, and site preparedness.

Diversion Impact: 80,000 tons per year. Supports diversion in other programs, enhancing and expanding the existing local collection policies and programs, creating awareness and indirect diversion impacts on other diversion-oriented programs.

G.3 Assumptions Utilized in the Recommended Strategies

Assumptions in the development of the strategies are noted below and indicated by reference through the superscript number associated with each strategy or issue.

- ¹ Salaries quoted are from Nashville Metro and Davidson County HR Office, Classifications and Positions, effective July 1, 2017. Positions quoted assumed to be the most appropriate for the workload assignment. Benefits quoted are assumed to be 50% of salary, and include all retirement, Social Security, Medicare, and other Metro paid benefits.
- ² Some programs share same staff leads, as noted in descriptions.
- ³ Program expenses, unless otherwise noted, include general office expenses, copying expenses, postage, mailing expenses, parking fees, program brochure printing, other annual program administrative expenses, and/or contracted administrative expenses.
- ⁴ Diversion first measured by tons diverted through recycling, composting, reuse, waste reduction, then divided by 1.6 million tons total generation as base. Assumes diversion activity will increase proportionally to generation tonnage increases, primarily due to population increases over time.
- ⁵ Metro Procurement and Sustainability/Net Zero practices (ZW1 & ZW2 strategies) require Metro Council ordinances, new procurement policies, new staff position, and implementation of policies within Metro/county government. A good model is the Indiana State Government Greening of the Government program.
- ⁶ Regional collaboration (ZW3 strategy) assumes that local communities and school systems will join through inter-local agreements and cost-sharing agreements to create a unified central zero waste branding and messaging campaign. Assumes existing staff and minimal diversion impact but augments the ZW branding efforts Metro-wide.
- ⁷ Metro Government Construction Recycled Content Ordinance (ZW4 strategy) incorporates Metro council ordinance and contract language that requires beneficial reuse and reporting through road construction contractors as well as public building contractors (e.g. fire and police stations, libraries). Tonnage diversion based on Metro of Austin road construction model. Sample contract language is available.

- ⁸ Deconstruction, Reuse C&D Ordinance (ZW5 strategy) assumes there is an existing C&D ordinance and existing C&D processing infrastructure. This ordinance is an expansion to capture deconstruction and reuse requirements. Assumes lower diversion yield than original ordinance but captures “higher and best use” philosophy of zero waste through reuse and augments historical value of antique capture in deconstruction. Estimated expenses assume existing staff and minimal startup costs and implementation costs. Also assumes implementation overlaps with existing regulations. Diversion effect for this strategy is difficult to evaluate as it is case-by-case per deconstruction situation.
- ⁹ Special Events and Festivals Green Ordinance (ZW6 strategy) assumes development of new Metro standards for special events with enforcement procedures on Metro permits, six new positions that offer technical assistance as well as enforcement to permit holders and assumes distribution restrictions for event vendors. Diversion assumptions based zero waste collection programming at special events, modeled from Alameda County, LA County, Metro of San Antonio, and the Metro of Austin.
- ¹⁰ Surplus food capture and redistribution (ZW7 strategy) assumes cooperation and compliance with Health Department rules and regulations. Federal “Good Samaritan Rule” offers reduced liability to corporations offering food donations. USEPA food hierarchy and website as well as NRDC offer significant assistance.
- ¹¹ Recycling/Composting Compliance and Contamination Ordinance (ZW8 strategy) assumes universal distribution and access, and through this ordinance requires usage, and fines for contamination. Also requires food waste collection at food prep and restaurants and establishes inspections program. Assumes collection program moves from voluntary to mandatory usage, for purposes of increased diversion capture. Expenses related to mandatory inspections. Diversion estimates based on Metro of Austin program, scaled to Nashville Metro household counts.
- ¹² Producer Responsibility policies (ZW9 strategy) often are legislated at the state and national level (CA, MN, CT as models), however municipalities can lead with takeback programs through the expansion of their HHW collection networks (San Luis Obispo model). Costs estimates are noted in a wide range based on collection volumes and types of material collected. More research needed to better price out program.
- ¹³ Public Education / Social Media (major expansion) (ZW10 strategy) based on assumption that increased effective education will increase public education and capture rates. Major Zero Waste cities (Oakland, San Francisco, Seattle, Austin) have demonstrated modeling of enhanced and innovative education and social media platforms. Assumption includes phasing high investment in first five years and phasing down investment toward an annual maintenance level by year 10. Assumes best measure of investment is per capita spending, although some cities have explored per housing unit as a measure. Diversion impact based on Metro of Fresno discussions with CSUF Psychology Department regarding implicit and explicit social persuasion impacts, and the Metro of Austin staff research on various social media platform effects.

- 14 Promotes Reduce, Reuse and Repair (ZW11 strategy) assume embracement of Highest and Best Use Hierarchy and funding availability for reuse and waste reduction systems. Reuse programing modeled from the Goodwill electronics disassembly program, SpringBack mattress recycling program, various Metro Fix-it Clinics, Austin Reuse & Recycling Showcases, and Alameda County publications on waste reduction and reuse. Costs estimates are noted in a wide range based on collection volumes and types of material collected. More research needed to better price out program. Diversion estimate based on electronics and mattress collection.
- 15 Changing Business Name (ZW12 strategy) and Color Coding equipment (ZW13 strategy) for public branding assumes public confidence and practice is linked to the “color branding” of each commodity collected, as demonstrated through the Metro of Austin Zero Waste program and modeled from modern business corporate advertising business practices. Assumption that with higher public confidence in the collection programs carries higher participation and capture rates and reduced cross contamination rates through the use of color coding identification. Cost assumptions based on Metro of Austin phased in approach over five years.
- 16 Economic Development tools to support Zero Waste (ZW14-ZW18 strategies), including the Materials Exchange Network, Research & Development, Public/Private cooperative ventures, and Remanufacturing Hub, require coordination and support through the Mayor’s Office of Economic & Community Development, the hiring of a Business Development Officer, and strong financial support for material diversion economic development. Job growth and diversion calculations are based on research performed by the Metro of Phoenix, the Metro of Austin, and the Metro of Edmonton.

G.4 Summary of Diversion Tons Per Strategy

Table G-1 Implementation Timeline and Diversion Summary

Nashville - Above 75% Total Generation = 1,710,208 in 2027
 Aggressive Approach Strategies Above 75% Target = 256,531 in 2027 when programs are fully implemented

| Zero Waste Above 75% Strategy | Above 75% Strategy | Approach Conservative, Moderate, Aggressive | Initial Year of Implementation | Government | | | Commercial, Industrial, Institutional | Total Waste Stream Diversion Potential | Aggressive: % of Generated Waste Stream | Moderate: % of Generated Waste Stream | Conservative: % of Generated Waste Stream |
|-------------------------------|--------------------------------------|---|--------------------------------|---------------|---------------|---------------|---------------------------------------|--|---|---------------------------------------|---|
| | | | | Government | Residential | Mult-Family | | | | | |
| ZW1-City Govt Ord | City Procurement Ord | C/M/A | 1 | - | - | - | - | 0% | 0% | 0% | |
| ZW2-City Govt Ord | Net Zero Ord & Practices | C/M/A | 1 | - | - | - | - | 0% | 0% | 0% | |
| ZW3-City Govt Ord | Regional Collaboration Ord | M/A | 1 | - | - | - | - | 0% | 0% | 0% | |
| ZW4-City Govt Ord | Govt Const Ord & Policies | M/A | 2 | 40,000 | - | - | 40,000 | 2.34% | 2.34% | | |
| ZW5-City Govt Ord | Deconstruction / Reuse Ord | M/A | 2 | - | - | - | 1,000 | 0.06% | 0.06% | | |
| ZW6-City Govt Ord | Special Events Ord | C/M/A | 2 | 1,000 | - | - | 1,000 | 0.06% | 0.06% | 0.06% | |
| ZW7-City Govt Ord | Food Scrap Redistribution Ord | A | 2 | 500 | - | - | 2,000 | 0.15% | | | |
| ZW8-City Govt Ord | Recycling/Org Compliance Ord | M/A | 3 | - | 32,500 | 25,000 | 20,000 | 4.53% | 2.27% | | |
| ZW9-City Govt Ord | EPR Ord & Policies | A | 3 | 1,000 | - | - | 1,000 | 0.06% | | | |
| ZW10-Education | Public Educ / Socia Media | C/M/A | 6 | - | 6,000 | 4,000 | 10,000 | 0.58% | 0.29% | 0.29% | |
| ZW11-Education | Reduce / Reuse / Repair | C/M/A | 2 | - | 2,500 | 1,500 | 4,000 | 0.23% | 0.23% | 0.23% | |
| ZW12 Education | Rebrand Waste & Recycling Operations | C/M/A | 2 | - | - | - | - | 0% | 0.00% | 0.00% | |
| ZW13 Education | Color Rebranding | C/M/A | 2 | - | - | - | - | 0% | 0% | 0% | |
| ZW14- Econ Dev | Econ Dev Tools | A | 4 | - | - | - | 10,000 | 0.58% | | | |
| ZW15- Econ Dev | Support ZW Businesses | A | 4 | - | - | - | 1,000 | 0.06% | | | |
| ZW16- Econ Dev | Materials Marketplace | A | 4 | - | - | - | 36,000 | 2.11% | | | |
| ZW17- Econ Dev | R&D in Technologies | A | 4 | - | - | - | - | 0% | | | |
| ZW18- Econ Dev | Remanufacturing Hub | A | 5 | - | - | - | 80,000 | 4.68% | | | |
| Totals: | | | | 42,500 | 41,000 | 30,500 | 150,000 | 264,000 | 15.44% | 5.25% | 0.58% |

Aggressive Moderate Conservative
ZW Target: 90+%

| | Baseline Diversion | High Performance Diversion | Above 75% Diversion | Total Diversion |
|---|--------------------|----------------------------|---------------------|-----------------|
| High Performance and Above 75% Strategies: Aggressive | 304,700 | 969,300 | 264,000 | 1,538,000 |
| | 18% | 57% | 15% | 90% |
| High Performance Strategies: Moderate | 304,700 | 549,600 | 89,750 | 943,950 |
| | 18% | 32% | 5% | 55% |
| High Performance Strategies: Conservative | 304,700 | 283,100 | 10,000 | 600,700 |
| | 18% | 17% | 1% | 35% |

G.5 Summary of Estimated Expenses Per Strategy

Table G-2 Implementation Expense Schedule

| Zero Waste Above 75% Strategy | Above 75% Strategy | Phase | Initial Year of Implementation | Initial Year Salary Cost | Capital Costs | Ongoing Program Cost | City Cost per ton/month | City cost per HH/month | Year 1 | Year 2 | Year 3 |
|-------------------------------|--------------------------------------|-------|--------------------------------|--------------------------|---------------|----------------------|-------------------------|------------------------|-----------|-------------|-------------|
| ZW1-City Govt Ord | City Procurement Ord | 1 | 1 | \$78,000 | \$0 | \$50,000 | \$1,066.67 | \$0.04 | \$128,000 | \$131,200 | \$134,480 |
| ZW2-City Govt Ord | Net Zero Ord & Practices | 1 | 1 | \$0 | \$0 | \$50,000 | \$416.67 | \$0.02 | \$50,000 | \$51,250 | \$52,531 |
| ZW3-City Govt Ord | Regional Collaboration Ord | 1 | 1 | \$0 | \$0 | \$50,000 | \$416.67 | \$0.02 | \$50,000 | \$51,250 | \$52,531 |
| ZW4-City Govt Ord | Govt Const Ord & Policies | 1 | 2 | \$0 | \$0 | \$50,000 | \$0.10 | \$0.02 | \$0 | \$50,000 | \$51,250 |
| ZW5-City Govt Ord | Deconstruction / Reuse Ord | 1 | 2 | \$0 | \$0 | \$50,000 | \$41.67 | \$0.02 | \$0 | \$50,000 | \$51,250 |
| ZW6-City Govt Ord | Special Events Ord | 1 | 2 | \$99,000 | \$0 | \$150,000 | \$207.50 | \$0.08 | \$0 | \$249,000 | \$255,225 |
| ZW7-City Govt Ord | Food Scrap Redistribution Ord | 1 | 2 | \$0 | \$0 | \$50,000 | \$0.10 | \$0.02 | \$0 | \$50,000 | \$51,250 |
| ZW8-City Govt Ord | Recycling/Org Compliance Ord | 1 | 3 | \$240,000 | \$0 | \$150,000 | \$0.42 | \$0.13 | \$0 | \$0 | \$390,000 |
| ZW9-City Govt Ord | EPR Ord & Policies | 1 | 3 | \$0 | \$50,000 | \$250,000 | \$1,250.00 | \$0.10 | \$0 | \$0 | \$300,000 |
| ZW10-Education | Public Educ / Social Media | 2 | 6 | \$45,000 | \$0 | \$2,115,000 | \$18.00 | \$0.69 | \$0 | \$0 | \$0 |
| ZW11-Education | Reduce / Reuse / Repair | 1 | 2 | \$50,000 | \$0 | \$300,000 | \$7.29 | \$0.11 | \$0 | \$350,000 | \$358,750 |
| ZW12 Education | Rebrand Waste & Recycling Operations | | 2 | \$0 | \$100,000 | \$0 | \$833.33 | \$0.03 | \$0 | \$100,000 | \$0 |
| ZW13 Education | Color Rebranding | 1 | 2 | \$0 | \$200,000 | \$0 | \$1,666.67 | \$0.06 | \$0 | \$100,000 | \$100,000 |
| ZW14- Econ Dev | Econ Dev Tools | 2 | 4 | \$86,000 | \$0 | \$50,000 | \$1.13 | \$0.04 | \$0 | \$0 | \$0 |
| ZW15- Econ Dev | Support ZW Businesses | 2 | 4 | \$0 | \$0 | \$150,000 | \$1,250.00 | \$0.05 | \$0 | \$0 | \$0 |
| ZW16-Econ Dev | Materials Marketplace | 2 | 4 | \$0 | \$0 | \$50,000 | \$0.12 | \$0.02 | \$0 | \$0 | \$0 |
| ZW17-Econ Dev | R&D in Technologies | 2 | 4 | \$0 | \$0 | \$50,000 | \$416.67 | \$0.02 | \$0 | \$0 | \$0 |
| ZW18- Econ Dev | Remanufacturing Hub | 2 | 5 | \$0 | \$10,000,000 | \$50,000 | \$10.47 | \$3.23 | \$0 | \$0 | \$0 |
| Support Consultant | Implementation Consultant | 1 | 1 | \$50,000 | \$0 | \$0 | \$0.00 | \$0.02 | \$50,000 | \$50,000 | \$50,000 |
| | | | | | | | | \$4.69 | \$278,000 | \$1,182,700 | \$1,797,268 |

| Zero Waste Above 75% Strategy | Above 75% Strategy | Phase | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 |
|-------------------------------|--------------------------------|-------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| ZW1-City Govt Ord | City Procurement Ord | 1 | \$137,842 | \$141,288 | \$144,820 | \$148,441 | \$152,152 | \$155,956 | \$159,854 | \$163,851 | \$167,947 |
| ZW2-City Govt Ord | Net Zero Ord & Practices | 1 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 | \$62,443 | \$64,004 | \$65,604 |
| ZW3-City Govt Ord | Regional Collaboration Ord | 1 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 | \$62,443 | \$64,004 | \$65,604 |
| ZW4-City Govt Ord | Govt Const Ord & Policies | 1 | \$52,531 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 | \$62,443 | \$64,004 |
| ZW5-City Govt Ord | Deconstruction / Reuse Ord | 1 | \$52,531 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 | \$62,443 | \$64,004 |
| ZW6-City Govt Ord | Special Events Ord | 1 | \$261,606 | \$268,146 | \$274,849 | \$281,721 | \$288,764 | \$295,983 | \$303,382 | \$310,967 | \$318,741 |
| ZW7-City Govt Ord | Food Scrap Redistribution Ord | 1 | \$52,531 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 | \$62,443 | \$64,004 |
| ZW8-City Govt Ord | Recycling/Org Compliance Ord | 1 | \$399,750 | \$409,744 | \$419,987 | \$430,487 | \$441,249 | \$452,280 | \$463,587 | \$475,177 | \$487,057 |
| ZW9-City Govt Ord | EPR Ord & Policies | 1 | \$256,250 | \$262,656 | \$269,223 | \$275,953 | \$282,852 | \$289,923 | \$297,171 | \$304,601 | \$312,216 |
| ZW10-Education | Public Educ / Socia Media | 2 | \$0 | \$0 | \$2,160,000 | \$2,160,000 | \$2,160,000 | \$2,160,000 | \$2,160,000 | \$1,465,000 | \$1,465,000 |
| ZW11-Education | Reduce / Reuse / Repair | 1 | \$367,719 | \$376,912 | \$386,335 | \$395,993 | \$405,893 | \$416,040 | \$426,441 | \$437,102 | \$448,030 |
| ZW12 Education | Rebrand Waste & Recycling Ops. | 1 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| ZW13 Education | Color Rebranding | 1 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| ZW14- Econ Dev | Econ Dev Tools | 2 | \$136,000 | \$139,400 | \$142,885 | \$146,457 | \$150,119 | \$153,872 | \$157,718 | \$161,661 | \$165,703 |
| ZW15- Econ Dev | Support ZW Businesses | 2 | \$150,000 | \$153,750 | \$157,594 | \$161,534 | \$165,572 | \$169,711 | \$173,954 | \$178,303 | \$182,760 |
| ZW16-Econ Dev | Materials Marketplace | 2 | \$50,000 | \$51,250 | \$52,531 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 |
| ZW17-Econ Dev | R&D in Technologies | 2 | \$50,000 | \$51,250 | \$52,531 | \$53,845 | \$55,191 | \$56,570 | \$57,985 | \$59,434 | \$60,920 |
| ZW18- Econ Dev | Remanufacturing Hub | 2 | 0 | \$550,000 | \$550,000 | \$550,000 | \$550,000 | \$550,000 | \$550,000 | \$550,000 | \$550,000 |
| Support Consultant | Implementation Consultant | 1 | \$50,000 | \$50,000 | \$50,000 | \$50,000 | \$50,000 | \$50,000 | \$50,000 | \$50,000 | \$50,000 |
| | | | \$2,074,449 | \$2,676,310 | \$4,889,468 | \$4,943,955 | \$4,999,804 | \$5,057,049 | \$5,115,725 | \$4,480,868 | \$4,542,515 |

Assumptions:

- 2016 Households = 259,427
- Salary and cost inflation of 2.5% per year
- Utilized City of Nashville salary charts for initial salary year
- Remanufacturing Hub capital cost ammortized over twenty (20) years
- Displayed to charge against households to demonstrate relative expense- will be charged against a variety of income sources

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Appendix H

Materials Management Infrastructure

H.1 Processing and Disposal Infrastructure

Implementation of the diversion strategies proposed in Sections 6 and 7 and Appendices F and G will shift infrastructure needs away from transfer stations and regional landfills and towards diversion related infrastructure such as single stream recycling MRFs, C&D recycling, and composting/anaerobic digestion. As new diversion strategies are phased in, material quantities will eventually exceed the capacity of existing infrastructure – prompting the need for new infrastructure that could be publicly- or privately-owned facilities and highlighting the need for aggressive waste reduction strategies to help reduce the overall generation of discarded material.

Existing materials management infrastructure in the Nashville area is predominantly served by the landfilling management strategy as shown in **Table H-1** (over 80% of waste materials are disposed of in MSW and C&D landfills). Recycling and composting facilities in the area currently have excess capacity but that is expected to be exceeded over the first 10 years of the diversion planning period.

Table H-1 Existing Management Strategies and Associated Infrastructure for Processing or Disposal

| Management Strategy | Annual Quantity (2016 tons) | Percent of Total Waste | Current Infrastructure | Processing Capacity/Remaining Life |
|------------------------------|-----------------------------|------------------------|--|---|
| MSW Landfilling | 885,048 | 58% | WM Antioch Transfer Station | Not Available ¹ |
| | | | Republic Services Transfer Station | 1,500 tpd Site has room for expansion |
| | | | Republic Services Middle Point Landfill | 2027 |
| | | | WM Cedar Ridge Landfill | 2030 |
| | | | WM West Camden Landfill | 2043 and beyond ² |
| C&D Landfilling | 350,175 | 23% | WM Southern Services C&D Landfill | 2025 for current footprint Site has room for expansion |
| Single Stream Recycling | 27,617 | 2% | WM River Hills Recycling Center | 48,000 tpy |
| Separate Commodity Recycling | 176,393 | 12% | 13 Facilities (refer to Table 2-17) | (refer to Table 2-17) |
| C&D Waste Recycling | 3,094 | <1% | Atomic Resource Recovery, LLC | 89,700 tpy |
| Composting | 69,151 | 5% | The Compost Company Living Earth Ground Up Recycling AEP, Inc | (refer to Table 2-17) |
| Total | 1,511,478 | 100% | | |

Notes:

1. CDM Smith contacted WM for this information but did not receive a response.
2. Reported remaining capacity to TDEC is 2043 with undisclosed substantial additional capacity from future expansions per WM representative.

Comparison of additional diversion tonnage projections, provided in **Table H-2**, to the existing processing capacities in Table H-1 shows a significant shortfall in Year 10 - prompting a need for new diversion infrastructure as summarized in **Table H-3**.

Table H-2 Additional Processing Capacity Requirements for Diversion Strategies in Year 10

| Modeling Scenario | Single Stream MRF (tons) | Food Waste Composting/Digestion (tons) | C&D Debris Recovery (tons) |
|-------------------|--------------------------|--|----------------------------|
| Aggressive | 368,000 | 207,100 | 298,600 |
| Moderate | 132,500 | 89,000 | 298,600 |
| Conservative | 109,600 | 89,000 | 58,600 |

Table H-3 Additional Facility Requirements for Diversion Strategies in Year 10

| Modeling Scenario | Single Stream MRF (each) | Food Scraps Composting or Anaerobic Facility (each) | C&D Debris Recovery Facility (each) |
|-------------------|--------------------------|---|-------------------------------------|
| Aggressive | 2 | 5 | 2 |
| Moderate | 1 | 2 | 2 |
| Conservative | 1 | 2 | 0 |

Single Stream Material Recovery Facility (MRF)

Additional single stream recycling tonnages in Year 10 are projected to range from 109,600 tons (Conservative Scenario) to 368,000 tons (Aggressive Scenario). Assuming that each new facility would process material at a rate of 35 tons per hour, development of **two** additional MRFs would be required for the Aggressive Scenario or **one** additional facility for the Moderate and Conservative Scenarios.

MRF Facility Specifications

| | |
|-----------------------------------|-----------------------|
| Tons per Hour: | 35 TPH |
| Tons per Year (2 shifts per day): | 136,500 TPY |
| Sq. ft. tipping floor: | 6,000 sq. ft. |
| Sq. ft. building: | 60,000-75,000 sq. ft. |
| Acreage Recommended per Facility: | 14 acres |

Opinion of Probable Cost for One Facility

| | |
|----------------------------------|--------------------|
| Annual Capital Cost ¹ | \$2,345,000 |
| Annual Operating Cost | <u>\$6,100,000</u> |
| Total Annual Cost | \$8,445,000 |

Notes: 1. Capital cost include: building, electrical, stationary equipment, rolling stock, engineering, and contingency (land costs are not included). The building capital cost is amortized over 20 years at 5%. Equipment costs are amortized over 10 years at 5%.

C&D Waste Processing Facility

Additional C&D waste tonnages in Year 10 are projected to range from 58,600 tons (Conservative Scenario) to 298,600 tons (Moderate and Aggressive Scenarios). Assuming that each new facility would process material at a rate of 75 tons per hour, development of **two** additional facilities would be required for the Aggressive and Moderate Scenarios. Atomic Resource Recovery appears to have sufficient capacity to process the projected tonnages for the Conservative Scenario and therefore, **no** additional facilities would be required under that scenario.

C&D Waste Processing Facility Specifications

| | |
|-----------------------------------|----------------|
| Tons per Hour: | 75 TPH |
| Tons per Year (1 shift per day): | 146,250 TPY |
| Sq. ft. tipping floor: | 8,000 sq. ft. |
| Sq. ft. building: | 75,000 sq. ft. |
| Acreage Recommended per Facility: | 14 acres |

Opinion of Probable Cost for One Facility

| | |
|----------------------------------|--------------------|
| Annual Capital Cost ¹ | \$2,450,000 |
| Annual Operating Cost | <u>\$6,750,000</u> |
| Total Annual Cost | \$9,200,000 |

Notes: 1. Capital cost include: building, electrical, stationary equipment, rolling stock, engineering, and contingency (land costs are not included). The building capital cost is amortized over 20 years at 5%. Equipment costs are amortized over 10 years at 5%.

Food Scraps Processing Facility

Additional food scraps tonnages are projected to range from 89,000 tons (Moderate and Conservative Scenarios) to 207,100 tons (Aggressive Scenario) in Year 10. Food scraps could be processed entirely using composting or anaerobic digestion technologies or a combination of the two technologies. Assuming that each new composting or anaerobic digestion facility would process food scraps at a rate of 100 tons per day, development of **five** additional facilities would be required for the Aggressive Scenario or **two** additional facilities for the Moderate and Conservative Scenarios.

Composting Facility

Facility cost and site acreage estimates for composting assume the use of covered aerated static piles¹ and use of a bulking agent mixed at a ratio of 2 parts bulking agent per 1-part food waste.

Composting Facility Specifications

| | |
|-----------------------------------|-------------------------|
| Food Waste Tons per Day: | 100 TPD |
| Food Waste Tons per Year: | 40,000 TPY ² |
| Acreage Recommended per Facility: | 40 acres |

Opinion of Probable Cost for One Facility

| | |
|-----------------------|-------------------------|
| Annual Capital Cost | \$ 586,000 ³ |
| Annual Operating Cost | <u>\$ 885,000</u> |
| Total Annual Cost | \$1,471,000 |

- Notes:
1. Covered Aerated Static Pile (ASP) - Food scraps are mixed with a bulking agent and placed in windrow piles on concrete pads with a built-in aeration system. Covers are placed over the piles to control temperature, moisture and odors (if necessary). The piles are not turned.
 2. Does not include bulking agent tonnage.
 3. Capital costs are amortized over 20 years at 5% and include: covers, concrete pads, electrical, equipment, rolling stock, engineering, and contingency (land costs are not included).

Anaerobic Digestion Facility

Facility cost and site acreage estimates for anaerobic digestion assume the use of wet anaerobic digestion technology¹ at a stand-alone facility (i.e.; not co-located at a wastewater treatment facility).

Anaerobic Digestion Facility Specifications

| | |
|-----------------------------------|-----------------------|
| Food Waste Wet Tons per Day: | 100 TPD |
| Food Waste Wet Tons per Year: | 40,000 TPY |
| Acreage Recommended per Facility: | 10 acres ² |

Opinion of Probable Cost for One Facility

| | |
|----------------------------------|-------------------|
| Annual Capital Cost ³ | \$ 800,000 |
| Annual Operating Cost | <u>\$ 582,000</u> |
| Total Annual Cost | \$1,382,000 |

- Notes:
1. Wet Anaerobic Digestion – the food waste is made into a slurry and digested in a covered tank at a solids content between 10 and 15 percent.
 2. Siting assumes 2 acres for AD facility, 2 acres for covered ASP to compost digestate and 6 acres for roads, stormwater controls, compost and equipment storage, office/lab and other support facilities.
 3. Capital costs are amortized over 20 years at 5% and include: food scraps receiving module, equalization and digester tanks, dewatering building, odor control system, electrical, equipment, rolling stock, engineering, and contingency (land costs are not included)

Transfer Stations and Landfill Facilities

Waste disposal will decrease as much as 50% when the diversion strategies are fully implemented. The existing transfer stations have adequate capacity to meet the long-term transfer needs of the area and, based on conversations with Republic and Waste Management representatives, they can operate indefinitely with proper maintenance and upkeep. For example, Republic resurfaces their tipping floor once every three years to prevent structural damage to the flooring as part of their maintenance program.

Republic's Middle Point Landfill in Rutherford County receives the majority of MSW from Nashville but is slated to close sometime in the next 5 to 10 years. With no new landfills known to be planned for middle Tennessee, the remaining long-term disposal option is Waste Management's West Camden Landfill located 95 miles from the center of Nashville. In comparison to the 40-mile haul distance to the Middle Point Landfill the hauling costs to the West Camden Landfill are expected to be more than double the current hauling cost. Lack of competition is also expected to result in an increase in tipping fee from the current rate.

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Appendix I

Managing the Remainder

I.1 Material Remaining after Diversion

The diversion models employed in Sections 6 and 7 were used to estimate the amount of material remaining after the diversion programs have been fully-implemented (assumes Year 2027), as provided in **Table I-1**.

Table I-1 Remaining Waste for Aggressive, Moderate, and Conservative Diversion Scenarios in Year 9

| | Aggressive (tons) | Moderate (tons) | Conservative (tons) |
|--|----------------------|--------------------|------------------------|
| Total Waste Generated (2027) | 1,710,208 | 1,710,208 | 1,710,208 |
| Current Baseline Diversion (all sectors) | 304,700 | 304,700 | 304,700 |
| Additional Diversion from High Performance Programs | | | |
| Residential Diversion | 214,500 | 169,600 | 153,000 |
| Commercial Diversion (incl. C&D) | 754,800 | 380,000 | 130,100 |
| Total Additional High Performance Diversion | 969,300 | 549,600 | 283,100 |
| | | | |
| Remaining Waste after New Programs | 436,208 | 855,908 | 1,119,508 |
| | | | |
| Zero Waste Program Diversion | 264,000 | 89,750 | 10,000 |
| Remaining Waste after New Diversion Programs | 172,208 | 766,158 | 1,109,508 |
| Total Percent Diversion | 90% | 55% | 35% |

Without employing the aggressive approach, Metro will continue to heavily rely on private MSW landfill and C&D landfill infrastructure to manage the growing waste stream. The remainder of this appendix assumes that Metro will implement the aggressive diversion approach which significantly reduces the use of landfills for managing waste materials.

The strategies utilized for High Performance and Zero Waste are directed towards typical recyclable materials, organics, and C&D material. Appendix H discussed the infrastructure requirements necessary to support the processing of these materials. Therefore, the next step involves managing the remaining types of materials left to be managed such as:

- Household hazardous waste (HHW)
- Contaminated recyclables and organics
- Biosolids
- Bulky waste, mattresses, carpet, etc.
- Electronic waste

- Waste material from non-compliant residents and businesses
- Sharps and pharmaceuticals (not including medical facility sources)
- Materials without viable end-use markets

These materials represent the most difficult and/or most costly items within the waste stream to manage. Sustainable management of these materials will require the use of existing and new facilities and alternative technologies-some of which have not been commercially developed yet. Therefore, it is realistic to assume some portion of the remaining waste will ultimately require disposal in a landfill.

I.2 Processing and Disposal Infrastructure

With new policies in place that promote diversion, opportunities will arise for investment in new technologies and processes that will diversify the markets for Metro's waste materials. These new investments will reduce reliance on out-of-county disposal and promote economic development within the region. The following options/technologies are alternatives for managing the remaining waste:

- Biosolids beneficial reuse
- Plastics to biofuels – synthetic diesel
- Enhanced e-waste recycling and metal recovery (including non-ferrous and precious metals)
- Refuse Derived Fuel (RDF)/Engineered solid fuel production as substitute for coal at cement kilns, coal power plants, and industrial furnaces
- Waste-to-Fuels/Engineered liquid biofuels (aviation fuel, ethanol, methanol)

Production of Engineered Fuel and RDF would require a mixed waste processing (MWP) facility for removal of any metals, marketable recyclables, inerts, and possibly plastics containing chlorides. MWP was evaluated during the research stage of the plan development; but it was not advanced as a primary method of diversion due to concerns of contamination. However, an MWP facility could be viable as a secondary processing approach to address the remaining waste stream not diverted through the programs and strategies identified in Sections 6 and 7. Using MWP facilities is discussed solely as a potential technology that could be introduced by a private developer to manage the materials remaining in the waste stream after the recommended high-performance diversion strategies are implemented.

In recent years, the solid waste industry has been working to identify advanced waste conversion and processing technologies that have achieved or are close to achieving a commercially viable, proven operation. Proven waste conversion and processing technologies are those which have been fully tested and commercially operated under design conditions for three or more years. Several of the technologies listed above are considered emerging technologies which have not been successfully operated under full-scale conditions for an extended period of time, and are therefore not components of the analysis and recommendations presented in this Plan. **Appendix**

E provides a detailed analysis of the disadvantages to many of the emerging technologies presented above, and discussion of their respective incompatibility with the pursuit of Zero Waste.

There are several private and Metro-owned facilities available to support the management of difficult-to-divert materials. **Table I-2** provides a summary of disposal and processing outlets for specialty waste materials.

Table I-2 Specialty Material Disposal/Processing Outlets

| Waste Material | Current Collection or Disposal Facility | Location(s) | Current Processing Facility | Program Expansion Options | Potential Other Outlets |
|-----------------------|--|--|--------------------------------------|--|--|
| HHW | Convenience Centers | Ezell Pike Center & East Center | Clean Harbors Environmental Services | Addition of at least one new center for West Nashville | New end-uses for oil-based paints |
| Electronic Waste | Convenience Centers (residential only) | Ezell Pike Center, East Center, & Omohundro Center | Dynamic Recycling, Inc. | Use existing centers and add at least two new centers for West Nashville | EPR collection & recycling |
| MRF Residual | MSW Landfill | Middle Point, Cedar Ridge, and West Camden | N/A | Further sorting for marketable recyclables | Plastics to biofuels, fiber to composting |
| Biosolids | Class A pellets for agricultural land application and landfilling of Class B biosolids | Metro Water Services Central and Dry Creek Wastewater Facilities | Metro Water Biosolids Facility | | 100% production of Class A pellets for agricultural applications |
| Bulky Waste | MSW Landfill | Middle Point, Cedar Ridge, and West Camden | N/A | Further sortation for reuse and recycling opportunities | Plastics to biofuels, shredded wood to composting |
| Carpet | MSW Landfill | Middle Point, Cedar Ridge, and West Camden | Southeastern Recycling, LLC | Expandable through EPR programming | EPR collection & recycling |
| Non-recycled material | MSW Landfill | Middle Point, Cedar Ridge, and West Camden | N/A | Further sortation for marketable recyclables | Product redesign and creation of new end-use markets, Plastics to biofuels |
| Tires | Convenience Centers and Liberty Tire Recycling Holdco, LLC | Ezell Pike, East Center, Omohundro, & Anderson Lane | Liberty Tire Recycling Holdco, LLC | Utilize four existing centers and add at least one new center for | Grind/recycle; creation of new end-use markets |

| Waste Material | Current Collection or Disposal Facility | Location(s) | Current Processing Facility | Program Expansion Options | Potential Other Outlets |
|------------------------|---|-----------------------------------|-----------------------------|------------------------------------|-------------------------|
| | | | | West Nashville | |
| Medical Waste (sharps) | MSW Landfill | | | Expandable through EPR programming | Regulated waste stream |
| Pharmaceuticals | Metro Police Precincts | 8 precincts across the Metro area | | Expandable through EPR programming | Regulated waste stream |

Subtitle D and C&D Landfills

As Metro advances and meets its Zero Waste goal, Subtitle D and C&D landfills will serve a decreasing role in the integrated solid waste management system. The Republic Middle Point Landfill (Rutherford County) and Waste Management’s West Camden (Benton County) and Cedar Ridge (Marshall County) Landfills are the Subtitle D facilities currently handling disposal of almost 900,000 tons of waste generated within Metro Nashville and Davidson County. The Middle Point Landfill accepts approximately 54% of the waste disposal stream. The Cedar Ridge Landfill accepts the next largest portion (24%) of the Davidson County waste stream.

Davidson County is also home to Waste Management’s Southern Services C&D Landfill which accepts approximately 90% of Davidson County C&D waste that is landfilled.

The Tennessee Department of Environment and Conservation (TDEC) prepares an annual survey of the remaining life for sanitary landfills. The 2018 survey indicates that the Republic Middle Point Landfill has between 5 and 10 years of remaining waste disposal capacity, while Cedar Ridge and West Camden have 12 years and > 25 years of disposal capacity, respectively. The Southern Services C&D Landfill is projected to exhaust its disposal capacity within five years.

The availability of long-term landfill disposal capacity for managing materials remaining after 90% diversion will be dependent upon the West Camden Landfill. Since this landfill is almost 100 miles away from Nashville, Metro should continuously evaluate new programs and end markets to minimize the amount of materials where landfills are the last management option.

Furthermore, with Metro Nashville aggressively working to reduce reliance on landfills, this Plan does not include recommendations for any new or expanding landfills in Davidson County. Permitting new or expanding landfills would be inconsistent with the goals of the Plan.

Convenience Center Sites

Expansion of Metro’s existing convenience center infrastructure is discussed as Strategy #15 within Section 6/Appendix F of the Plan. In addition to the role convenience centers will play in reaching the 75% High Performance goal, these facilities are also critical to managing the materials remaining after 90% diversion has been achieved.

The addition of at least one and possibly two new convenience center sites, as implemented over time, will provide convenient staffed and secured facilities where residents could properly

dispose of HHW, electronic waste, tires, and other waste materials not captured through the High Performance and Zero Waste strategies provided in Sections 6 and 7/Appendices 6 and 7. Ultimate disposal or processing of these materials can continue to be managed through contracts with private companies with the expertise and capacity to provide the services.

Beneficial Use of Biosolids

In accordance with the Tennessee definition of “Beneficial use of biosolids” (Chapter 0400-40-15 Biosolids Management – Appendix H), beneficial use of biosolids means the application of biosolids to the land for the purposes of improving soil characteristics including tilth, fertility, and stability to enhance the growth of vegetation consistent with protecting human health and the environment.

Wastewater treatment plant operators are increasingly viewing their residuals as a resource – a product that can be beneficially reused rather than being disposed at a landfill. Depending on the level of treatment and local demand, biosolids can be beneficially reused in many ways. For example, dewatered biosolids meeting Class B standards can be used as a feedstock for composting and fertilizer-manufacturing operations, or it can be directly applied at permitted land application sites as a soil amendment. Liquid biosolids meeting Class B standards can also be applied at permitted land application sites. Treated biosolids, such as dried and pelletized biosolids meeting Class A standards, can be used in agriculture, and they can also be sold or given away to the general public for use in lawns and gardens.

Metro Water Services (MWS) manages the treatment and disposal of sludge from the wastewater treatment plants using anaerobic digestion (AD). MWS currently operates a biosolids facility at the Central Wastewater Treatment Plant which produces dried Class A fertilizer pellets and a biosolids facility at the Dry Creek Wastewater Treatment Plant that produces Class B biosolids that are currently disposed of via landfill. A key infrastructure requirement of the Plan is the use of AD as a method for processing increased amounts of diverted food waste. In addition to considering a stand-alone AD facility, Metro is planning to evaluate the potential of a Metro-owned food waste co-digestion facility at the Dry Creek WWTP. This facility can support the management of both food waste and WWTP biosolids that are currently being disposed at the Middle Point Landfill.

The selection of a biosolids management strategy requires the careful evaluation of not only future solids production, but also future biosolids regulations, availability of land for biosolids application, life-cycle costs, and the local and regional market for the biosolids product. Public acceptance of biosolids beneficial reuse is also a crucial component of the selected management strategy.

Mixed Waste Processing (MWP) Facility

MWP facilities are generally considered as ineffective and unsuitable as a primary system for achieving recycling and diversion goals. The closure of the Infinitus Renewable Energy Park (IREP) in Montgomery Alabama re-ignited the discussion on this technology and for some in the industry confirmed the arguments against its use. MWP facilities face many challenges including operational yield (i.e. recovery), quality end products, commodity prices, costs, and available feedstock.

The diversion strategies outlined in this Plan do not include the development or use of an MWP facility to achieve 90% diversion. Even though the history of MWP facilities as primary recycling operations has not proven to be a successful approach, the technology is still often considered as a secondary (post-recycling) approach to capture recyclable or recoverable materials that are not collected through traditional curbside collection, drop-off sites, or other best management programs. MWP facilities may also serve the role of pre-processing facilities for alternative conversion technologies.

The use of MWP facilities is being discussed in this portion of the Plan solely as a potential future technology to be evaluated for the specific role of managing the materials remaining in the waste stream after implementation of the recommended High Performance diversion strategies.

Ultimate inclusion of MWP technology would be dependent upon many factors such as: technological advancements; proven successful operations; types of materials remaining in the waste stream; viability and availability of end-use markets; and processing costs.

Tire Recycling

The Solid Waste Management Act of 1991 (Act) specifically bans the disposal of whole tires in a landfill. In 2002, the requirements related to tire disposal were amended to prohibit the disposal of tire shreds in a landfill if the net cost for shredding, transporting and disposing of waste tire exceeds the cost of an available beneficial end use. The Act also requires TDEC to provide assistance grants to counties and develop a program to find beneficial reuses for their waste tires.

TDEC recognizes the following as grant eligible beneficial end uses:

- Cement manufacturing
- Using tire-derived fuel (TDF) in cement kilns or industrial boilers for the capture of energy.
- Production of TDF provided TDEC approves of the specific end-use.
- Crumbling or pyrolysis of tire material provided TDEC approves of the specific end-use.
- Civil engineering applications, such as Class I landfill construction, road construction, and subsurface sewage disposal system aggregate.
- Recreational applications, including but not limited to, playgrounds, running tracks, and walking paths.

Commercial pyrolysis facilities have been developed for select homogeneous wastes and feedstocks, such as tires, plastics, and wood wastes for the production of bio-oils. The oils from these facilities can be used for boiler fuels or refined into higher value chemicals and liquid fuels.

Metro's tire program currently manages approximately 7,500 tons of tires annually. The majority of tires are provided by private companies like Walmart and Firestone with a small amount received at the convenience center sites. Metro contracts with Liberty Tire Recycling to process the tires managed under the program. Liberty receives tires directly from private companies, tractor trailers placed at Metro's convenience centers, and illegally dumped tires collected and delivered by Metro. Liberty Tire processes scrap tires into a variety of beneficial use products

such as crumb rubber, rubber mulch, tire-derived fuel, tire-derived aggregate, and rubberized asphalt.

Continued utilization of companies that process scrap tires into beneficial use products is considered an integral part of the Plan. Metro shall also continue to support state-level efforts to develop scrap tire recycling and beneficial use end markets.

Develop New End-Use Markets/Facilities

A critical aspect of any waste diversion plan is to identify and understand the secondary materials markets that exist for the materials that will be diverted or recycled. As a rule, the secondary materials markets follow the fluctuations of their corresponding primary materials markets with respect to demand and pricing. These fluctuations are created by changes in the global, national, regional and local manufacturing environments which, in turn, are influenced by a variety of factors that determine the demand for the manufactured products. To compete, local governments that enter this marketplace must be prepared to implement recycling and diversion facilities and systems that produce high quality secondary materials. In addition, their budgets must be able to accommodate significant fluctuations in the revenues received for these materials. Finally, their systems must be able to store unmarketable products on a temporary basis; and, as well as economically ship materials to buyers who are often located overseas in China, Indonesia and other Pacific Rim countries.

Given the current export restrictions on recyclables, it is important to develop local end-markets for collected recyclables and compostables. Economic development initiatives can increase diversion through the creation of new programs facilities and public/private partnerships. In addition to creating local markets, there is the cost savings of long-distance transportation, the creation of local green jobs, and the reduction in carbon-footprint.

In an effort to develop local end-markets for collected recyclable and compostable materials, Metro Public Works should partner with the Mayor's Office of Economic & Community Development to develop and implement new economic development strategies as previously outlined in Appendix G of the Plan.

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Appendix J

Triple Bottom Line

J.1 About the Triple Bottom Line

A detailed analysis of the direct financial effects of the high performing strategies to both Metro and the residential and commercial generators was provided in Appendix F. However, financial effects represent only part of a comprehensive analysis of environmental strategies such as solid waste management and its broader effects. This appendix assesses the Triple Bottom Line (TBL) – Economic, Environmental, and Social – impacts of the Metro program recommendations.

The TBL is a framework that combines Economic, Environmental and Social dimensions for any type of sustainability proposal for programs and the subsequent program analysis.¹ The TBL model includes traditional measures of profits as well as environmental and social dimensions that result in a more comprehensive, and quantitative investment picture of a program to be implemented. It is at base an accounting framework of cost-benefit analysis incorporating three dimensions of performance, including: economic, environmental, and social.

The advantage of using TBL modeling is incorporating benefits into the model in a way that can communicate a true overall investment cost-benefit analysis to the public or, private sector stakeholders. The use of TBL is growing for businesses (where it is increasingly popular for businesses that value sustainability). The literature includes case studies in which incorporating social and environmental impacts, or being a “sustainable” company, can help their financial bottom line.

Many sustainable communities are also interested in applying TBL to programs. Our review of publications from communities, and our interviews with communities nationally show it has become increasingly popular to use TBL analysis in internal evaluations. The goal is to take into consideration environmental and social factors in addition to traditional financial consideration. An increasing number of communities have started including elements of this metric in association with sustainability plans and program decision-making. SERA’s research shows that for some communities (such as Eugene, OR; Fort Collins, CO; or Boston, MA), the inclusion of societal and environmental, along with financial, impacts are required for project proposals.

However, as popular as the concept of TBL is – and as potentially important to decision-making – we find most communities have conducted only a partial TBL analysis. Looking at the actual studies in detail, we commonly find quantified information for financial and environmental results, but only qualitative information included for the social analysis, the element that is much harder to quantify.² However, social factors are arguably the most important for government consideration.

¹ This discussion is based on Skumatz and D’Souza, “TBL in Solid Waste Programs: Best Practices”. White Paper. Skumatz Economic Research Associates, Superior CO, 2016.

² Lists, or descriptions of potential effects, and so on. A SERA review of the TBL reports from a number of leading communities finds their analysis actually includes no analysis of the social elements, or includes non-quantified discussions of the social

The financial and environmental impacts are fairly easily translated into dollar amounts, but the societal impacts are more difficult, because the impacts are varied, project- and neighborhood-specific, and often represent “hard to measure” effects that defy easy categorization into transferable “multipliers”³.

The lack of quantitative analysis in existing TBL literature is unfortunate, because benefit-cost computations used to analyze programs and investment can accommodate quantitative entries, but are not structured to consider qualitative or checklist input *on a similar footing*, and this is true of TBL as well. When numbers are not included in an equation (like TBL or benefit-cost), the missing value is essentially treated as a zero. To the extent these impacts are valued and valuable, this biases the decision-making on programs and investments that the TBL is meant to inform and leads to underinvestment in important programs.⁴ Beyond one or two innovative communities (see case studies in **Section J.7**), checklists, or word discussions are the most common elements of social impacts, when they are successfully included in reports.

Our Metro study includes a specific focus on addressing this gap. The study focuses on:

- Providing strong quantifications for the financial elements of government and generator expenditures.
- Strong quantification for the environmental aspects.
- Providing quantitative estimates for multiple aspects of the social impacts.
- A “break even” quantification, showing the level of additional social impacts that are needed in order to produce a positive TBL for the recommended programs.

J.2 Measuring Environmental and Social Impacts for TBL

The TBL calculations focus on the changes from the status quo current system for solid waste management in the Metro area – the changes represented by the recommended programs and policies. Three steps are involved in the TBL analysis:

- Identifying or inventorying the potential impacts (pillars are economic / financial, environmental, and social), defined for consumers and stakeholders.
- Developing ways to quantify the impacts (or at least “bracket” the size of important impacts).
- Applying the results in the TBL analysis.

Measuring the direct financial impacts of the programs is straightforward, has a long history and that discussion and analysis was largely included in Appendix F. In that Appendix, we addressed

effects. The more sophisticated reports are mostly in the form of checklists and best practices. Some of the social impacts include, social justice, health and safety, and quality of life impacts such as noise, odor, and employment. The few that have dollar amounts relate to health impacts and are part of transportation projects, energy utilities, and some sewer projects, but almost never solid waste projects or programs, according to SERA’s literature review.

³ For which the research from one community can be applied elsewhere without new, original, expensive, tailored research

⁴ Skumatz, ACEEE, 2014.

the direct financial impacts of the high performing strategies on both the city and generators. Monetizing environmental and social impacts is more complicated.

Calculating Emissions Impacts from Recycling vs. Landfilling Materials (environmental):

Emissions of greenhouse gases (GHG) are reduced when materials are recycled as a new resource or composted rather than going to a landfill. We used EPA’s WaRM model, an easily-citable resource, for computing the emissions reductions from the new diversion rates from the set of programs. The following **Table J-1** shows the emission factors used in our modeling of TBL impacts.

Table J-1 Emission Factors by Material Type

| Net Emissions Impacts per 100 Tons of landfilled material diverted as... | Metric ton of carbon dioxide equivalent (MTCO ₂ e) | Metric ton of carbon equivalent (MTCE) | Energy use equivalents - million BTU |
|--|---|--|--------------------------------------|
| Recycling | -286.7 | -78.2 | -1199.4 |
| Mixed organics to composting | -36.1 | -9.9 | -231.7 |
| Yard waste to composting | 3.4 | 0.1 | 44.7 |
| Food scraps to composting | -68.4 | -18.7 | -203.4 |
| Food scraps to Anaerobic digestion | -60.7 | -16.6 | -137.8 |
| C&D (mixed) to 50% recycling* | -44.4 | -12.1 | -183.2 |

Table note: () SERA assumptions about C&D composition and recycling approximately 50% of eligible materials
Source: EPA’s WaRM Model, SERA calculations*

Calculating Effects on Emissions from Truck Vehicle Miles Traveled / VMT (environmental):

Vehicle miles traveled by trash and recycling trucks change when new collections are introduced (increasing the VMT) and when contracts are introduced (reducing VMT) also affects the emissions computations. VMT affects emissions, especially because trucks are largely diesel, and get very few miles to the gallon.⁵ The information available to develop estimates of changes in VMT were sparse. We used information on fuel consumption for MPW trash and recycling trucks, and divided by customers served to develop ratios of fuel use and associated emissions. From these records, we estimate Metro’s annual fuel use per trash customer served is 0.21 gallons, reflecting 0.0021 MTCO₂e. Metro’s annual fuel use per recycling customer is estimated as 0.38 gallons, reflecting 0.0039 MTCO₂e. The factors for associated emissions were available from the web and are presented in **Table J-2**. We calculate the emissions due to an additional service routed across all households (or all businesses) Metro-wide in **Table J-3**. These figures can be used for adding routes for organics or universal recycling, or changing the frequency of routes. However, they are more difficult to use for the effects of contracting because it is unknown how many haulers provide service in the Metro area now, or how overlapping are their service territories. We did not estimate the social effects including neighborhood effects or noise effects associated with more or different routes, routing through neighborhoods to different facilities, etc.

⁵ The Plan does not recommend a switch to CNG. The benefits and costs of this equipment are close to balancing out.

Table J-2 GHG Emissions from Medium and Heavy Diesel Trucks

| GHG Emissions from Medium and Heavy Trucks by Fuel Type | Diesel |
|---|--------|
| Carbon Emissions per Gallon (kg CO ₂ E/gal) | 10.21 |
| Methane Emissions (g CH ₄ /mile) | 0.0051 |
| Nitrous Oxide Emissions (g NO _x /mile) | 0.0048 |
| Sulfur Oxide Emissions (SO ₂ ppmv*) | 84.04 |
| Carbon Monoxide Emissions (g CO/mile) ⁶ | 0.76 |

Table Notes: (*): part per million volume (unit it is not directly a mile, gallon, or mass based metric like the remainder of the table. Source: SERA research.

Table J-3 Estimated Fuel Use and Emissions per Customer, Route, and Metro-wide for Trash and Recycling

| Calculating emissions from VMT for service routes | Trash | Recycling |
|---|--------|-----------|
| Annual gallons per served customer | 0.21 | 0.38 |
| MTCO ₂ e per year per served customer | 0.0021 | 0.0039 |
| MTCO ₂ e per route/yr (assuming 930 for trash, 660 for recycling) | 1.98 | 2.57 |
| MTCO ₂ e City-wide, residential, 1 new weekly service (190,000 SF-4 households) | 405 | 740 |
| MTCO ₂ e City-wide, commercial, 1 new weekly service (68,000 firms) - assuming same efficiency factor (approximation) ⁷ | 146 | 266 |

Source: MPW fuel records and SERA research.

Valuing Environmental Effects and Emissions: The most common basis for measuring environmental impacts is in terms of GHG and the associated impacts related to climate change, human health, and other factors. Models exist for developing estimates of the GHG impacts from programs⁸. Valuation assigned is most commonly derived from research on the externalities associated with carbon impacts. Multiple sources and values are available (see **Section J.8** for more information).

The ‘Market Value’ of Carbon emissions is the value, in terms of economic damage or externalities, that the United States now uses to guide current energy regulations, and possibly future mitigation policies. Values from multiple sources are presented in **Table J-4**. A U.S. government study concluded that an additional ton of carbon dioxide emitted would cause \$37

⁶ <https://www.afdc.energy.gov/pdfs/32863.pdf>.

⁷ Although routes for the commercial sector have far fewer stops per route, these factors are based on fuel gallons per customer served for residential vs. commercial service, so we make no additional adjustments related to routes and stops.

⁸ Common sources are EPA’s WaRM model, ISO sources and other more sophisticated models and user-friendly tools that quantify the upstream effects of using recycled products rather than virgin materials in goods production. Detailed Life Cycle Cost modeling work also includes the environmental effects, but they are expensive, data intensive, and only available for a limited number of situations – and are sometimes conducted by industry or others that may not be considered independent or “third party”.

worth of economic damages, which are expected to take various forms including decreased agricultural yields, harm to human health and lower worker productivity, all related to climate change.

Table J-4 Market Value vs Social Cost of Carbon (\$/MTCO2E)

| Market Value vs Social Cost of Carbon | Source | \$/MTCO2E | 2018 dollars |
|---------------------------------------|--------------------------|---------------|--------------|
| Market Value for Carbon | EPA (2015) | \$ 37 | \$39 |
| Market Value for Carbon (Obama Admin) | Clean Power Plan | \$ 42 in 2020 | \$42 in 2020 |
| Market Value for Carbon | GAO (2017) | \$ 50 | \$51 |
| Social Cost of Carbon | Stanford (2015) | \$ 220 | \$233 |
| Social Cost of Carbon | NRDC (2013) ⁹ | \$ 226 | \$244 |

A new study out of Stanford suggests that the current Market Value, \$37/MTCO2E (\$39 in 2018), is far lower than the true social cost of carbon, which was estimated to be \$220/MTCO2E (\$233 in 2018).¹⁰ The study incorporates additional, previously unaccounted for economic damages by assuming that climate change will slow down economic growth rates, particularly in less affluent areas. The EPA value represents a more conservative approach.

We use the Stanford Study, which we are using as a reflection of the “social” impacts of carbon.¹¹ Both are respected sources and are in the range of other values from the literature. In a TBL analysis, we are interested in reflecting the full social costs of program impacts, and compute the effects using the values from the Stanford study. This approach is most in tune with TBL. However, as with other assumptions, it is worth examining the sensitivity of final results to input assumptions. If a favorable vs. unfavorable outcome and resulting decision from the TBL hinges on the difference of \$193.80/MTCO2e¹², then a more robust discussion of the assumption may be considered.

Tailored analyses of other environmental impacts can also be conducted; this appendix focuses on “easily quantified” TBL values.

⁹ Johnson, L.T., Yeh, S., and Hope, C.J. *Environmental Studies in Science* (2013) 3:369; <https://doi.org/10.1007/s13412-013-0149-5>

¹⁰ The EPA study (market value) designed an economic integrated assessment model (IAM) using empirical findings that concluded an additional ton of carbon dioxide emitted would cause \$37 worth of economic damages, which are expected to take various forms including decreased agricultural yields, harm to human health and lower worker productivity related to climate change. The Stanford study (social cost of carbon) takes the Dynamic Integrated Climate Economy (DICE) model (an IAM model) and incorporates additional, previously unaccounted-for economic damages by assuming climate change will slow down GDP growth rates, particularly in less affluent areas. Social cost adds impacts related to: increased heat-related mortality, changed water supply and demand, decreased agricultural yields, decreased shellfish harvests, harm to human health, lower worker productivity, increased road damage, increased energy demand, increased coastal infrastructure damage and other effects.

¹¹ To be conservative and allay concerns, we can apply just the “increment” of the Stanford value over the EPA value, but the results do not change materially. In addition, we provide information on a “break-even analysis”, showing that the social cost of carbon does not have to be very high to exceed the value needed to push the TBL to “positive”.

¹² Translated into dollars per ton of mixed residential recyclables, this difference in assumptions represents \$61.60 per recycling ton (using the factor that 100T of recycling reduces emissions by 315 MTCO2e from the USEPA WaRM model).

A third element of the environmental costs has to do with the embedded energy saved from use of recyclables.¹³ The most advanced quantification of this effect was conducted by the Oregon DEQ starting in 2012, and updated periodically.¹⁴ This work showed that there are substantial energy savings from using recycling feedstock compared to the various steps of converting raw materials into production inputs – with the impacts particularly high for the metals (see **Figure J-1**). The Oregon work translated the energy savings into common units (MMBtu), shown in **Figure J-2**. Metals and plastics contain the highest embedded energy per ton. Figure J-2 also shows how important this embedded energy could be in the overall picture for use of recyclables. The break-even calculations on the right-hand-side of Figure J-6 presents the point at which energy used to transport the recyclables equals the energy saved when recyclables displace virgin feedstocks for three different methods of transport. If this embedded energy was explicitly valued for aluminum, for example, the material would be worth shipping by freighter twice to the moon (**Figure J-3**).¹⁵



Figure J-1
Percent of Energy Saved Using Recycled vs. Virgin Material (Source: ISRI 2011 Fact Sheet)

| Material | Production Savings (MMBTU ton collected) | “Break-Even Point” (miles) | | |
|--------------------|---|----------------------------|---------|-----------|
| | | Truck | Rail | Freighter |
| Aluminum | 177 | 121,000 | 475,000 | 538,000 |
| LDPE | 61 | 41,000 | 162,000 | 184,000 |
| PET | 59 | 40,000 | 157,000 | 178,000 |
| Steel | 19 | 13,000 | 52,000 | 59,000 |
| Newspaper | 16 | 11,000 | 43,000 | 49,000 |
| Corrugated | 12 | 9,000 | 33,000 | 38,000 |
| Office Paper | 10 | 7,000 | 27,000 | 31,000 |
| Boxboard | 6.5 | 4,400 | 17,400 | 19,800 |
| Glass (to bottles) | 1.9 | 1,300 | 5,100 | 5,800 |

“Break-Even Point” is where energy used to transport the recyclables equals energy saved when the recyclables displace virgin feedstocks.

Figure J-2
Production Savings in MMBTU Ton Collected and Breakeven Hauling Distances (Source: Allaway, 2012)

¹³ Derived from Skumatz and D’Souza, “TBL in Solid Waste Programs: Best Practices”. White Paper. Skumatz Economic Research Associates, Superior CO, 2016.

¹⁴ Allaway, David, Oregon DEQ Presentation, personal communication with the author, 2012. Results were used in SERA presentation mentioned below.

¹⁵ A carbon tax would automatically bring these costs forward and change the relative cost of virgin and recycled materials.



Figure J-3
Breakeven Hauling Distances for Selection Commodities
 (Source: Skumatz 2013)¹⁶

Table J-5 brings these various factors and calculations together in one place. For a combination of simplicity and local tailoring, we use the Nashville energy rates, even though materials would not be processed within the state.¹⁷ The \$360/ton is a significant value, and of course, outweighs other TBL benefits like the direct value of landfill savings (between \$37 and \$60/ton), or the social cost of carbon (\$233/ton). When added to the TBL calculations, an addition of \$360/recycling ton diverted adds substantial amounts to the benefits assessment. This value has not historically been added to the equation, and we will review whether the addition of this valuation is the deciding factor in the TBL calculations.

For social benefits, using a monetary or dollarization model has proved to be an area where municipalities have struggled. There can be considerable subjective or philosophical grounds around how the monetary values are calculated, and this can add an element of distrust for many stakeholders as they may have different ideas about these valuations.¹⁸ Not only is the quantification of these benefits rarely done, the cost of conducting a detailed social analysis of each program for this Plan is prohibitive; it takes extensive work for each individual program’s tailored impacts, whether conducted quantitatively or qualitatively.

¹⁶ Skumatz, Lisa A., “Want to Save Lots of Energy? Get a Smaller Trash Can!”, Switch #3, Boulder Colorado, 10/25/13.

¹⁷ Note that Nashville rates are very similar to national average electricity rates (within about 2%).

¹⁸ An alternative to assigning a dollar amount is to use an index, and SERA has identified multiple TBL Tools which assigns points as a value system. These have been used in various cities, counties and even states but does not produce a quantitative value for Triple Bottom Line analysis. Instead, it is an organized indicator variable which can be useful in TBL analysis. See Appendix K for additional information.

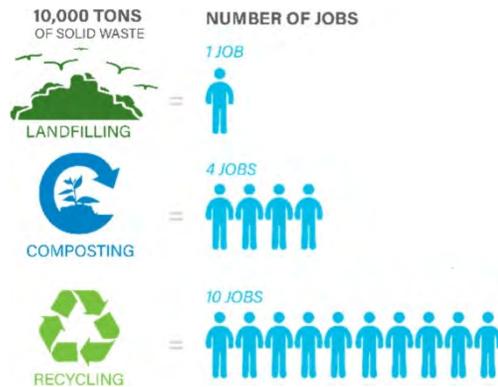
Table J-5 Calculation of Value of Embedded Energy per Recycled Ton

| Material | Prod'n Sav (mmbtu/ton collected) | Share in "typical residential mix" | Share in "typical commer- cial mix" |
|--------------------------------------|--|---|--|
| AL | 188 | 1.6% | 0.5% |
| LDPE | 61 | 2.2% | 0.4% |
| PET | 59 | 3.8% | 0.7% |
| Steel | 19 | 2.1% | 0.4% |
| News | 16 | 10.8% | 0.5% |
| OCC | 12 | 26.1% | 68.2% |
| Office Paper | 10 | 5.4% | 4.9% |
| Boxboard | 6.5 | 8.3% | 6.1% |
| Glass (to bottles) | 1.9 | 3.8% | 1.5% |
| Rest | | 35.9% | 16.8% |
| Result: MMBTU/average recycled ton | | 13.0 | 10.9 |
| Factor: kWh/mmbtu | | 293 | 293 |
| Result: kWh per tons recycled | | 3809.8 | 3179.6 |
| Factor: TN cost per kWh | | \$0.103 | \$0.103 |
| Result: Value of energy embedded/ton | | \$392.41 | \$327.50 |
| Average | | \$359.96 | |

Source: SERA calculations

Beyond the social benefits incorporated in the carbon valuations and other computations described above, another fairly straightforward type of social benefit that can be quantified are economic development benefits. These include jobs as well as direct and indirect output multipliers associated with changes in collection and changes in the management of solid waste streams toward more recycling and away from landfilling. The effects are more widespread than just direct employment; those employees spend their dollars on goods and services, affecting those industries and jobs. The programs can enhance (or harm) the local economy, depending on the types of programs being analyzed, and the community’s mix of local industries.

Large, complex, economic input-output models are used to estimate these impacts. As a simple indicator of this effect, the Institute for Local Self Reliance developed a job multiplier for three methods of managing 10,000 tons of solid waste. Landfilling 10,000 tons represents one job, composting the 10,000 tons represents four jobs, and recycling 10,000 tons is ten jobs.¹⁹ The work is more labor intensive, and there are upstream benefits associated with “doing more” with the material than just burying it. This can be measured in a tailored way for the community, or simple and general multipliers like this may be applied to quantify impacts of social effects from program changes.²⁰ More tailored estimates can be developed using third-party models.



¹⁹ Institute for Local Self Reliance (ISLR), www.islr.org

²⁰ We describe our more sophisticated analysis approach for this project later in this appendix.

As mentioned, most other social benefits are highly individualized in their analysis, are data and labor intensive, and have rarely been included in TBL work in solid waste analysis.

J.3 Calculating Economic, Development, and Social Impacts

The previous appendix notes that a number of cities have worked on TBL analyses, but when the work is assessed in detail, the social part of the TBL tends to be less rigorous. Qualitative work is valuable as it points out key issue and benefits that may be hard-to-measures (HTM) but should not be ignored. However, including these factors in a benefit-cost equation is difficult, and we have found that studies rarely exclude costs, but if they do not include all the benefit, the ultimate decision-making, planning, and investment is biased and not optimal.

The following summarize the key steps undertaken by SERA to estimate the easily-quantified elements of the Economic, Environmental, and Social impacts that are included in the financial and TBL performance analyses.

- **Program costs** to City and Generators (economics): These costs were estimated and discussed in Appendix F.
- **Tipping fee difference** (economics): There are savings from fewer tons being managed at the landfill, and the majority of previously disposed materials going to other facilities. We estimate the incremental tip fee difference and assign this to the economic performance. Note that managing materials at recycling and processing facilities other than landfills is not cheaper in many cases.²¹ For modeling assumptions, we use the following assumptions: landfilling and transport cost is \$37/ton, but in later years, the cost is closer to \$60; recycling processing is expected to be about \$100/ton; and we use factors of \$28 for yard waste, and \$55/ton for food scraps. For C&D we used a landfill tip fee of \$20/ton and a processing fee of \$75/ton.
- **Effects on Street Repairs from Truck Vehicle Miles Traveled (VMT)** (social; Metro economic): Vehicle miles traveled by trash and recycling trucks change when new collections are introduced (increasing the VMT) and when contracts are introduced (reducing VMT), and Public Works directors are commonly concerned about the effects on street repairs from changes in heavy truck traffic. However, the number of vehicle miles traveled within Metro currently is unknown. On the residential side, Metro collects from each household in the USD area with efficient routes, but the remainder of the GSD has multiple haulers, with service on some streets by one or multiple haulers, leading to more (and unknown) VMT. The VMT for changes in commercial collection are also unknown.²² Therefore, we used “higher level” method for estimating the costs of residential program and policy changes on costs for street repair; the estimation method is included in **Section J.9**. These computations, reviewing data from around the nation, imply that the addition or

²¹ Note that the economic comparison of the costs, whether broken out as changes in collection plus new processing tipping fees or the net tipping fee portion in a separate column is equivalent.

²² Therefore, even though the literature and web includes multiple suggestions of factors for “number of car” equivalencies for trash and recycling trucks, the share of streets that are different quality (thickness and thus, durability, with variations in cost for repair), in Metro is unknown, and the share of VMT by trash trucks on each of these roads is unknown. In addition, information on the cost of repair based on street traffic is not strong. Thus, we used a different method for estimating these costs. See Appendix K for additional information.

deletion of a trash or recycling route city-wide, leads to only about \$7,100 in extra street repairs Metro-wide. This small number is consistent with the information from the quantitative work completed, and the low number may help explain the lack of quantitative work. Our analysis did not include these numbers on the residential side because they are small and because the net changes to routes are unknown.²³ Because the numbers are certainly similarly small and with unknown quantities, we did not construct estimates for the commercial programs.

- **Valuing Emissions (environmental and social):** Valuing the emissions – from either tonnage diversion / resource effects or from changes in vehicle miles traveled – was conducted in two ways. We used the value of social cost of carbon of \$233/MTCO_{2e} from the 2015 Stanford Study to reflect the social value of carbon. These valuations were discussed earlier in this Appendix.
- **Economic Activity and Jobs (Economic and Social):** New programs change labor, expenditures, and economic activity in a region. Labor and staffing are directly changed when collection routes are added or subtracted, and these have ripple effects in expenditures across the economy. With more income, households spend more in stores, eat out, and make other expenditures that affect the local economy indirectly; these are indirect and induced effects. Similarly, jobs and economic activity change when materials are treated as trash vs. managed as recyclables or compost. SERA estimated the economic development benefits attributable to the programs using the IMPLAN model²⁴, which estimates the job and economic development (output, value added, labor income) deriving from the array of individual economic jobs and sectors affected by changes in solid waste management and programs.

To develop an estimate we could use across such a long list of programs that vary so much, we estimated the economic impacts for each material separately, and considered residential and commercial programs separately. We also estimated the impacts from both new collections (e.g. addition of new routes for recycling / organics in the residential and commercial sectors, which creates jobs) and separately estimated the economic impacts from managing waste as recycling or organics rather than landfilled material.

We used the total of direct, indirect, and induced impacts that result from the change in solid waste management associated with these programs.

The computations show the effects at the county level; **Table J-6** presents the multipliers estimated by SERA from a 10,000 ton shift from landfilling to material diversion as part of the programs. The stated effects include collection and processing effects, and are the net change from a baseline of landfilling. We present results separately for tons diverted from the residential and commercial sector, and the impacts include the net change in collection and processing activities from treatment as landfilled trash. *Recycling 10,000 more tons leads to county increases*

²³ The estimate of route impacts depends on the unknown number of current haulers operating and the repetitiveness of their routes

²⁴ IMPLAN model documentation. IMPLAN provides estimates of the direct, indirect, and induced effects on jobs, labor income, value added, and economic output.

in labor income of \$290,000 per year, and increases in economic output of \$478,000 per year. The impact at the state level is higher, but the data indicate that the largest impact is in the local economy. In this case, 83% of the total state-level output impact, and nearly 94% of the labor impact is experienced at the county level. Figure J-9 indicates that the economic output impacts of yard waste and food waste are substantially lower than recycling, owing to the low value and low economic multiplier effects for these output products relative to recycling's market and economic contributions. Interestingly, the labor income effects for commercial are almost 50% higher than residential diversion, but the ultimate output contributions are similar.

- **Toxics (social):** Some of the programs have the potential to reduce toxics (education, and other programs); however, we did not quantify these impacts.

Table J-6 Economic Effects Attributable to Transfer of 10,000 tons from Landfilling to Diversion

| 10,000 from landfilling to... | Labor Income/yr (in thous) | Total Value Added/yr (in thous) | Economic Output/yr (in thous) |
|---|-------------------------------|------------------------------------|----------------------------------|
| County level effects – Residential | | | |
| Recycling | \$290 | \$343 | \$478 |
| Yard waste | \$175 | \$238 | \$31 |
| Food scraps | \$176 | \$239 | \$30 |
| State level effects - Residential | | | |
| Recycling | \$310 | \$375 | \$572 |
| Yard waste | \$186 | \$253 | \$75 |
| Food scraps | \$188 | \$254 | \$75 |
| County level effects – Commercial | | | |
| Recycling | \$432 | \$467 | \$463 |
| Yard waste | \$170 | \$225 | \$26 |
| Food scraps | \$170 | \$225 | \$25 |
| State level effects – Commercial | | | |
| Recycling | \$448 | \$495 | \$556 |
| Yard waste | \$177 | \$240 | \$71 |
| Food scraps | \$177 | \$240 | \$70 |

Source: SERA IMPLAN modeling for Nashville area.

J.4 Dollar Value of the TBL Computations

We use these factors to compute results for all the Scenarios - Aggressive, Moderate, and Conservative packages for the High-Performing and Zero Waste program packages, and for the combined effects in this appendix. The benchmark year is 2027, so full rollout of one of the ZW programs is not quite realized. The results include computations of the benefit-cost and Triple Bottom Line elements and the resulting values for each factors are presented in Tables J-7 through J-13.

Table J-7 summarizes the results of the diversion, by major material type, by Scenario. The conservative Scenario adds only 17% new diversion in total (17% for the High Performing Package, and 1% for the ZW strategies), and the County's total diversion rate is just 35% after roll-out. The Moderate scenario adds 37 percentage points of recycling (32% from High

Performance Portfolio and 5% from the ZW strategies). The Figure shows that the Aggressive Scenario adds 67 percentage points of diversion, for a total (including current diversion) of 85%. The additional 5%, to get the County to 90%, occurs after this benchmark year of 2027, and is achieved through additional capture from the Remanufacturing Hub ZW program.

Table J-7 Tonnage Diverted by Stream

| Tonnages Diverted (Year 2027; not full roll-out); Total Generation=1.71 million/yr | Total Tonnage Diverted (MSW & C&D) | Diverted from C&D Landfill | Recycling | Yard Waste | Food Scraps | C&D | Reduction | Total MSW & C&D diverted | New Percent Diverted | Total Diversion with Existing |
|--|------------------------------------|----------------------------|-----------|------------|-------------|---------|-----------|--------------------------|----------------------|-------------------------------|
| High-Performing Programs - Aggressive | 969,300 | 298,500 | 368,100 | 22,500 | 207,200 | 298,500 | 73,200 | 969,500 | 57% | 75% |
| High-Performing Programs - Moderate | 549,600 | 298,500 | 132,500 | 7,400 | 89,000 | 298,500 | 21,500 | 548,900 | 32% | 50% |
| High-Performing Programs - Conservative | 283,100 | 58,600 | 109,600 | 7,000 | 89,000 | 58,600 | 21,500 | 285,700 | 17% | 35% |
| ZW Programs - Aggressive | 179,000 | 0 | 174,000 | 0 | 0 | 0 | 5,000 | 179,000 | 10% | 28% |
| ZW Programs - Moderate | 89,750 | 0 | 87,250 | 0 | 0 | 0 | 2,500 | 89,750 | 5% | 23% |
| ZW Programs - Conservative | 10,000 | 0 | 10,000 | 0 | 0 | 0 | 500 | 10,500 | 1% | 18% |
| High-Performing Plus ZW - Aggressive | 1,148,300 | 298,500 | 542,100 | 22,500 | 207,200 | 298,500 | 78,200 | 1,148,500 | 67% | 85% |
| High-Performing Plus ZW - Moderate | 639,350 | 298,500 | 219,750 | 7,400 | 89,000 | 298,500 | 24,000 | 638,650 | 37% | 55% |
| High-Performing Plus ZW - Conservative | 293,100 | 58,600 | 119,600 | 7,000 | 89,000 | 58,600 | 22,000 | 296,200 | 17% | 35% |

Note: Total tonnage diverted (MSW and C&D) in the second column of Table J-7 differs slightly from total MSW & C&D diverted in the ninth column due to rounding of the tonnages diverted by stream in columns three through eight.

Table J-8 summarizes the changes in tip fees needed to achieve this diversion. There are savings from tonnage that no longer pays a disposal tip fee at the MSW and C&D landfills, which results in savings. However, there are tipping fees to be added to reflect the processing costs for the recycling, compost, and C&D that is now delivered to different facilities. The costs used were: \$60.15/ton for MSW landfill, \$20/ton for C&D landfill, \$100/ton for recycling MRF, \$28/ton for yard waste composting, \$55/ton for food scraps composting, \$75/ton for C&D processing, and no fee for waste reduced. The computed savings and costs are shown in the figure. The savings is less than the costs in all scenarios; it costs more in direct charges to process materials than to bury them (there are other benefits discussed below). This extra cost ranges from \$6 million per year for the conservative scenario to \$31.5 million per year for the aggressive scenario in net extra material management fees than simply landfilling materials. The calculated additional cost per ton across all tons diverted is \$20/diverted ton for the conservative scenario, \$36/ton for the moderate scenarios, and \$27/ton for the aggressive scenario. The extra cost per ton is shown in the last column through the array of individual programs discussed earlier in the report.

Table J-8 Net Tipping Fee Savings (Costs)

| Net Tip Fee Savings (Positive=Pay More; Negative=Savings) NOTE: results indicate costs are greater than savings. | Avoided MSW LF Costs (thous) | Avoided C&D LF (thous) | New Recy (thous) | New YW (thous) | New Food (thous) | New C&D (thous) | Reduction (thous) | Savings (thous) | Costs (thous) | Net Tip Fee Costs (savings) Total (thous) | Net Extra Tip Cost/ton diverted (MSW&C&D) |
|--|------------------------------|------------------------|------------------|----------------|------------------|-----------------|-------------------|-----------------|---------------|---|---|
| High-Performing Programs - Aggressive | -\$40,350 | -\$5,970 | \$36,810 | \$630 | \$11,400 | \$22,390 | \$0 | -\$46,320 | \$71,230 | \$24,910 | \$26 |
| High-Performing Programs - Moderate | -\$15,080 | -\$5,970 | \$13,250 | \$210 | \$4,900 | \$22,390 | \$0 | -\$21,050 | \$40,750 | \$19,700 | \$36 |
| High-Performing Programs - Conservative | -\$13,680 | -\$1,170 | \$10,960 | \$200 | \$4,900 | \$4,400 | \$0 | -\$14,850 | \$20,460 | \$5,610 | \$20 |
| ZW Programs - Aggressive | -\$10,770 | \$0 | \$17,400 | \$0 | \$0 | \$0 | \$0 | -\$10,770 | \$17,400 | \$6,630 | \$37 |
| ZW Programs - Moderate | -\$5,400 | \$0 | \$8,730 | \$0 | \$0 | \$0 | \$0 | -\$5,400 | \$8,730 | \$3,330 | \$37 |
| ZW Programs - Conservative | -\$600 | \$0 | \$1,000 | \$0 | \$0 | \$0 | \$0 | -\$600 | \$1,000 | \$400 | \$40 |
| High-Performing Plus ZW - Aggressive | -\$51,120 | -\$5,970 | \$54,210 | \$630 | \$11,400 | \$22,390 | \$0 | -\$57,090 | \$88,630 | \$31,540 | \$27 |
| High-Performing Plus ZW - Moderate | -\$20,480 | -\$5,970 | \$21,980 | \$210 | \$4,900 | \$22,390 | \$0 | -\$26,450 | \$49,480 | \$23,030 | \$36 |
| High-Performing Plus ZW - Conservative | -\$14,280 | -\$1,170 | \$11,960 | \$200 | \$4,900 | \$4,400 | \$0 | -\$15,450 | \$21,460 | \$6,010 | \$20 |

Table J-9 summarizes the costs to achieve this diversion through the array of individual programs discussed earlier in the Plan. It shows that Metro’s cost for the combined High Performing and Zero Waste Programs are \$6.5 million for the conservative scenario, \$8.5 million

for the moderate scenario, and \$9.5 million for the aggressive scenario.²⁵ However, examining the costs per ton demonstrates the value from the aggressive scenario. Metro's cost is \$22/ton for the conservative scenario, falls to \$13/ton for the moderate scenario, and is just \$8/ton for the aggressive scenario.

In this figure, we also identify the costs for all generators plus Metro. These costs are much higher than Metro costs because they include the cost of brand new collections (recycling and organics) across all residents and businesses, among other costs. These costs are on the order of 5-6 times Metro costs, but are spread across thousands of households and businesses. When summed, the costs range from \$32 million (conservative scenario) to \$60 million (aggressive scenario). Again, the cost per ton diverted shows the value from the high performing scenario. Combined generator and Metro costs per ton – adding in the cost of the incremental tipping fees – are \$127/ton for the conservative scenario, \$89/ton for the moderate scenario, and \$80/ton for the aggressive scenario.

Table J-9 Direct Program Costs (excluding Tip Fee Element)

| Direct Costs to Metro and Generators | Tons diverted from LF & C&D/yr | Metro Annual Cost (thous) | Resident cost (thous) | Commercial Cost (thous) | Total Cost: Metro & Generator (thous) (excludes Marginal tip fee above) | Cost per ton (Generator and Metro Costs) | Cost per ton - Generator & Metro costs plus tip fee | Metro Cost per ton diverted (MSW&CD) (excl tip fee) |
|---|--------------------------------|---------------------------|-----------------------|-------------------------|---|--|---|---|
| High-Performing Programs - Aggressive | 969,300 | \$6,100 | \$32,110 | \$18,170 | \$56,380 | \$60 | \$84 | \$6 |
| High-Performing Programs - Moderate | 549,600 | \$4,720 | \$22,210 | \$2,980 | \$29,910 | \$50 | \$90 | \$9 |
| High-Performing Programs - Conservative | 283,100 | \$3,330 | \$22,210 | \$2,980 | \$28,520 | \$100 | \$119 | \$12 |
| ZW Programs - Aggressive | 179,000 | \$3,399 | \$0 | \$0 | \$3,399 | \$20 | \$56 | \$19 |
| ZW Programs - Moderate | 89,750 | \$3,727 | \$0 | \$0 | \$3,727 | \$40 | \$79 | \$42 |
| ZW Programs - Conservative | 10,000 | \$3,187 | \$0 | \$0 | \$3,187 | \$320 | \$359 | \$319 |
| High-Performing Plus ZW - Aggressive | 1,148,300 | \$9,499 | \$32,110 | \$18,170 | \$59,779 | \$50 | \$80 | \$8 |
| High-Performing Plus ZW - Moderate | 639,350 | \$8,447 | \$22,210 | \$2,980 | \$33,637 | \$50 | \$89 | \$13 |
| High-Performing Plus ZW - Conservative | 293,100 | \$6,517 | \$22,210 | \$2,980 | \$31,707 | \$110 | \$127 | \$22 |

Table J-10 shows the calculations of the emission benefits from material diversion and from changes in vehicle miles traveled for collection truck routes. The impacts from materials are large – especially true for recycling, which benefits from avoided mining and processing upstream. The benefits from net changes in routing vehicle miles traveled are very small relative to the material benefits.²⁶ There are multiple changes, but routes are added for new services (recycling and organics) and reduced though every other week collections and contracting. The net was a fairly low change in emissions. The results show the reductions in metric tons of carbon dioxide equivalents (MTCO_{2e}), with substantially higher reductions realized in the aggressive program scenario (-1.8 million vs. -0.43 million for the conservative scenario. Valued at the social cost of carbon from the Stanford Report (\$233/MTCO_{2e}), we see very large benefits. The total benefits are \$100 million for the conservative case, and more than \$420 million in social benefits from the carbon reductions in the aggressive case. The value per ton of material diverted is \$300-\$340/ton.

²⁵ Note that no generator costs were assumed for the ZW scenarios.

²⁶ But we were also conservative about assumptions of how many haulers are providing services in the region, and how inefficient is the resulting routing.

Table J-10 Net Emissions Benefits (Environmental and Social Benefits)

| Net Emissions Benefits (MTCO2e) & Value (\$ thous) | Recycling (thous) | Yard waste (thous) | Food scraps (thous) | C&D (thous) | Res. Route Count changes (thous)* | Com'l. Route Count changes (thous)* | Total Emissions (thous) (negative= reductions) | Value at \$233/ MTCO2e (thous) | Emission Value per MSW & CD ton diverted |
|--|-------------------|--------------------|---------------------|-------------|-----------------------------------|-------------------------------------|--|--------------------------------|--|
| High-Performing Programs - Aggressive | -1,060 | 0 | -140 | -130 | 0.7 | 0.2 | -1,329 | \$309,700 | \$320 |
| High-Performing Programs - Moderate | -380 | 0 | -60 | -130 | 0.7 | 0.2 | -569 | \$132,600 | \$241 |
| High-Performing Programs - Conservative | -310 | 0 | -60 | -30 | 0.7 | 0.2 | -399 | \$93,000 | \$325 |
| ZW Programs - Aggressive | -500 | 0 | 0 | 0 | 0.7 | 0.2 | -499 | \$116,300 | \$650 |
| ZW Programs - Moderate | -250 | 0 | 0 | 0 | 0.7 | 0.2 | -249 | \$58,000 | \$646 |
| ZW Programs - Conservative | -30 | 0 | 0 | 0 | 0.7 | 0.2 | -29 | \$6,800 | \$680 |
| High-Performing Plus ZW - Aggressive | -1,550 | 0 | -140 | -130 | 0.7 | 0.2 | -1,819 | \$423,900 | \$369 |
| High-Performing Plus ZW - Moderate | -630 | 0 | -60 | -130 | 0.7 | 0.2 | -819 | \$190,900 | \$299 |
| High-Performing Plus ZW - Conservative | -340 | 0 | -60 | -30 | 0.7 | 0.2 | -429 | \$100,000 | \$338 |

Table Note: () The change in routes increases emissions.*

Table J-11 computes the value of the program changes to the local economy, through job creation resulting in additional labor income, and benefits in terms of economic output. Note that we used multipliers reflecting the average multipliers for residential vs. commercial programs. The economic benefits are very substantial, netting almost \$12 million per year to Metro economy in the conservative scenario, up to almost \$50 million for the aggressive scenario. These represent both economic benefits and social benefits, bringing a stronger economy and jobs to the County. Note that the total value to the state is also shown, but adds only about 20% extra value; most of the benefits “stay at home” in the County. The added economic / social value for the County is estimated to be \$50/ton diverted for the aggressive scenario.

Table J-11 Economic Benefits (Economic and Social Elements)

| Economic Multipliers - County Level Impacts (and State Totals) | Recycling, County benefit (thous) | Yard Waste, County benefit (thous) | Food Waste, County benefit (thous) | C&D (not est.), County benefit (thous) | Total County Value (thous) | Total State Value (thous) | County Value per ton of MSW & CD diverted |
|--|-----------------------------------|------------------------------------|------------------------------------|--|----------------------------|---------------------------|---|
| High-Performing Programs - Aggressive | \$30,600 | \$500 | \$4,200 | \$0 | \$35,300 | \$40,600 | \$42 |
| High-Performing Programs - Moderate | \$11,000 | \$100 | \$1,800 | \$0 | \$12,900 | \$15,000 | \$27 |
| High-Performing Programs - Conservative | \$9,100 | \$100 | \$1,800 | \$0 | \$11,000 | \$12,800 | \$45 |
| ZW Programs - Aggressive | \$14,500 | \$0 | \$0 | \$0 | \$14,500 | \$16,400 | \$92 |
| ZW Programs - Moderate | \$7,300 | \$0 | \$0 | \$0 | \$7,300 | \$8,200 | \$91 |
| ZW Programs - Conservative | \$800 | \$0 | \$0 | \$0 | \$800 | \$900 | \$90 |
| High-Performing Plus ZW - Aggressive | \$45,100 | \$500 | \$4,200 | \$0 | \$49,800 | \$57,000 | \$50 |
| High-Performing Plus ZW - Moderate | \$18,300 | \$100 | \$1,800 | \$0 | \$20,200 | \$23,200 | \$36 |
| High-Performing Plus ZW - Conservative | \$9,900 | \$100 | \$1,800 | \$0 | \$11,800 | \$13,800 | \$47 |

Table J-12 brings all of these easily-computed and monetized Triple Bottom Line benefits together into one table. The table includes a column for Metro and all costs, and identifies total tip fee costs (costs outweighed savings), emissions and social benefits, as well as the economic and social benefits. The highlighted column shows that the total TBL benefits are:

- \$105 million for the conservative scenario
- \$188 million for the moderate scenario, and
- more than \$440 million for the aggressive scenario.

By far (by a factor of nearly 8), the largest contributor to these TBL values are the social cost of carbon value applied to the emission savings.

The TBL value, after subtracting the costs borne by Metro to deliver these programs, shows a net benefit ranging from \$99 million for the conservative scenario and more than \$433 million for the aggressive scenario.

The net TBL benefits minus all the combined generator and Metro costs (including tip fees) are also positive. These net TBL benefits show a value of \$68 million on benefits for the conservative scenario, \$131 million for the moderate scenario, and \$351 million for the aggressive scenario.

Sensitivity Review: We tested the sensitivity of the net TBL results to the assumption about the value used for social cost of carbon. If the \$39/MTCO2e value is used instead of \$233/MTCO2e, the programs are still a net benefit to Metro and the County. The total TBL benefits are \$22 million, \$29 million, and \$89 million for the conservative, moderate, and aggressive scenarios, respectively. The net TBL benefits, after subtracting Metro’s costs, are \$16 million, \$21 million, and \$80 million. The net TBL benefits after subtracting all generator, tip fee, and Metro costs are not positive. They are negative values of \$15 million, \$28 million, and \$2 million for the conservative, moderate, and aggressive scenarios.

We also note that we did not add in the extra TBL value generated from the embedded energy in recycling (discussed earlier in the chapter). This addition of \$360/recycled ton would push these positive values even higher. Given that recycling represents approximately one-third of the diverted tons, this \$360/ton value would increase the TBL values by about \$120/ton diverted. The numbers are already positive, and exceed Benefit-Cost thresholds. These values are not shown in the tables.

Table J-12 Triple Bottom Line Calculations Summary

| TBL Summary - Thousands per year, 2027 | Total Annual Costs: Metro (thous) | Total Annual Costs: All Gen and Metro (thous) | Tip Fee Net Costs (thous) (costs exceeded savings) | Value of Emission & Social Benefits (thous) | Value of Econ & Social Benefits (thous) | Total TBL Benefits (thous) | Net TBL (Benefits-Metro Costs) (thous) | Net TBL (Benefits-All generator and Metro and tip costs) (thous) |
|---|-----------------------------------|---|--|---|---|----------------------------|--|--|
| High-Performing Programs - Aggressive | \$6,100 | \$56,380 | \$24,910 | \$309,700 | \$35,300 | \$320,090 | \$313,990 | \$238,800 |
| High-Performing Programs - Moderate | \$4,720 | \$29,910 | \$19,700 | \$132,600 | \$12,900 | \$125,800 | \$121,080 | \$76,190 |
| High-Performing Programs - Conservative | \$3,330 | \$28,520 | \$5,610 | \$93,000 | \$11,000 | \$98,390 | \$95,060 | \$64,260 |
| ZW Programs - Aggressive | \$3,399 | \$3,399 | \$6,630 | \$116,300 | \$14,500 | \$124,170 | \$120,771 | \$114,141 |
| ZW Programs - Moderate | \$3,727 | \$3,727 | \$3,330 | \$58,000 | \$7,300 | \$61,970 | \$58,243 | \$54,913 |
| ZW Programs - Conservative | \$3,187 | \$3,187 | \$400 | \$6,800 | \$800 | \$7,200 | \$4,013 | \$3,613 |
| High-Performing Plus ZW - Aggressive | \$9,499 | \$59,779 | \$31,540 | \$423,900 | \$49,800 | \$442,160 | \$432,661 | \$350,841 |
| High-Performing Plus ZW - Moderate | \$8,447 | \$33,637 | \$23,030 | \$190,900 | \$20,200 | \$188,070 | \$179,623 | \$131,403 |
| High-Performing Plus ZW - Conservative | \$6,517 | \$31,707 | \$6,010 | \$100,000 | \$11,800 | \$105,790 | \$99,273 | \$68,073 |

Table J-13, the last figure in this chapter, summarizes the performance statistics for the “easily calculated” portion of this Triple Bottom Line analysis. The table shows that the ratio of the TBL benefits are many times higher than the cost that Metro is estimated to invest to deliver these programs. The first entry, the TBL Benefit-cost ratio, illustrates these ratios. The total ratios range from 16 times costs for the conservative program, to 47 times costs for the aggressive

program.²⁷ The ratios are a bit higher for the high-performing programs than the ZW programs, but that is to be expected since the ZW programs are going for the very hardest tons.

The TBL benefits are also multiple times the total of the costs to all generators, Metro, and tip fee increases. In this case, the ratios are four times costs for the conservative scenario, six times cost for the moderate scenario, and eight times cost for the aggressive scenario. This benefit-cost ratio exceeds the threshold of “1” in all cases (meaning benefits exceed costs, signaling a positive investment).²⁸

The figure also shows the values for Metro cost per ton (repeated from above) and the TBL benefits per ton, which range from \$357/ton for the conservative scenario overall to \$385/ton for the aggressive scenario.

The net TBL per ton – that is, the total TBL benefits minus Metro costs, are \$377/ton for the aggressive scenario. Subtracting all costs from the TBL benefits still yields a net benefit of \$306 per ton diverted for the aggressive scenario.

Table J-13 Triple Bottom Line Benefits Relative to Costs – Performance and Ratios

| Benefit-Cost and TBL Ratio Summary | TBL Benefit/Cost Ratio (Metro cost) | TBL Benefit-Cost Ratio (All generator and Metro costs Plus Tip fee) | Metro Cost/Ton, (MSW&CD) | All costs per ton (generator and Metro and Tip) | TBL Benefits/ Ton Diverted | Net TBL / Ton Diverted (Metro costs subtracted) | Net TBL / Ton Diverted (All Gen, Metro, and Tip costs subtracted) |
|---|-------------------------------------|---|--------------------------|---|----------------------------|---|---|
| High-Performing Programs - Aggressive | 52 | 6 | \$6 | \$84 | \$330 | \$324 | \$246 |
| High-Performing Programs - Moderate | 27 | 5 | \$9 | \$90 | \$229 | \$220 | \$139 |
| High-Performing Programs - Conservative | 30 | 4 | \$12 | \$119 | \$344 | \$332 | \$225 |
| ZW Programs - Aggressive | 37 | 38 | \$19 | \$56 | \$694 | \$675 | \$638 |
| ZW Programs - Moderate | 17 | 18 | \$42 | \$79 | \$690 | \$649 | \$612 |
| ZW Programs - Conservative | 2 | 2 | \$319 | \$359 | \$720 | \$401 | \$361 |
| High-Performing Plus ZW - Aggressive | 47 | 5 | \$8 | \$80 | \$385 | \$377 | \$306 |
| High-Performing Plus ZW - Moderate | 22 | 3 | \$13 | \$89 | \$294 | \$281 | \$206 |
| High-Performing Plus ZW - Conservative | 16 | 3 | \$22 | \$127 | \$357 | \$335 | \$230 |
| Total Values | | | | | Per Ton Values | | |
| | Conservative | Moderate | Aggressive | | Conservative | Moderate | Aggressive |
| Costs - Metro (thous) | \$6,517 | \$8,447 | \$9,499 | | \$22 | \$13 | \$8 |
| Costs - Generators plus tip plus Metro (thous) | \$37,717 | \$56,667 | \$91,319 | | \$127 | \$89 | \$80 |
| Total Triple Bottom Line Benefits (thous) | \$105,790 | \$188,070 | \$442,160 | | \$357 | \$294 | \$385 |
| Net TBL Benefits (Benefits - All Costs) (thous) | \$68,073 | \$131,403 | \$350,841 | | \$230 | \$206 | \$306 |
| TBL benefits divided by Metro Costs | 16 | 22 | 47 | | | | |
| TBL Benefits divided by All Costs | 3 | 3 | 5 | | | | |

The results show that the easily-calculated Triple Bottom Line benefits exceed Metro’s costs, and exceed all generator costs, and show Benefit-Cost ratios greater than 1 in all cases. The highest benefits and performance ratios are for the aggressive scenario.

The key results from this (easily-calculated) portion of the Triple Bottom Line (TBL) analysis include:

²⁷ Using the lower value for carbon, these ratios are still greater than one, resulting in a ratio of 3 for the conservative scenario, 3 for the moderate scenario, and 9 times as many benefits as costs for the aggressive scenario. The ratios including all generator costs fall below about 0.1 using this emissions value.

²⁸ Even using the lower value (\$39/ton vs. \$233/ton) for the social cost of carbon, the conclusions still hold. The benefit-cost ratio relative to Metro costs falls to 3, 3, and 9, respectively for conservative, moderate, and aggressive programs, and the benefit-cost ratio relative to all generator, Metro, and tip fee costs falls to 1, 2, and 2 respectively. All benefit-cost ratios still exceed the threshold of “1”. Again, the introduction of the additional TBL benefits from the embedded cost of energy in recycling is not necessary; the performance of the Benefit-cost ratio (B/C ratio) still exceeds “1” without the addition.

- TBL Benefits exceed Metro costs for delivering these programs, on the order of \$106-442 million/year (for the conservative and aggressive programs, respectively). The largest share of this value comes from the social value of the avoided Greenhouse Gas emissions from recycling rather than landfilling from the new programs. Other contributors to value are the economic activity generated from the new programs.
- These benefits can be translated to a total of \$294-385 per ton of material diverted from the landfill.
- Total “easily-calculated” TBL benefits are 16 to 47 times as high as Metro costs for these program portfolios. These benefits are between four and eight times as high as all generator and Metro costs, showing very high benefit-cost ratios for these programs when TBL values are included. In both cases, the highest benefit-cost ratio is for the aggressive program scenario.
- The greatest benefits come from the most aggressive programs, in both dollar terms and benefit-cost ratio terms. Gross TBL benefits are \$442 million, net benefits (after Metro costs) are \$433 million, TBL benefits are 47 times the Metro costs, 8 times as high as all-generator and Metro costs, and the net TBL benefit per ton diverted from landfill is \$377/ton.
- The benefits exceed the sum of all costs to all generators for the new set of programs.
- The performance numbers are slightly better for the High Performance portfolio than for the ZW programs, because the ZW programs are targeting more difficult, or marginal tons. Both sets of programs are necessary in order to achieve ZW (or close, at 90%).
- These TBL calculations do not include all the benefits from the programs. Additional benefits, that are not as easily quantified are described in the following appendices.

J.5 Discussion of Qualitative Analysis of Social Impacts

The following aspects have been identified as potential social impacts that Metro would see materialize from implementing the Master Plan and achieving the Zero Waste goal.

J.5.1 Community Involvement and Well-Being

Metro’s Master Plan would educate and spread awareness to community members and businesses about the need for the programs and their efficient and effective implementation.

A Cincinnati study found that recycling education programs significantly increased the number of times schoolchildren recycled materials, heightened their knowledge of the recycling process and improved their attitudes towards environmental action. [4] Another study found that introducing a composting program at two universities resulted in more positive attitudes towards composting and increased environmental awareness. [5] Numerous studies have similarly indicated that improved education and outreach through the Master Plan would lead to more positive attitudes towards environmental action and increased participation.

The personal satisfaction from taking a positive environmental action, such as recycling or composting, has a compounding effect. The individual, upon being rewarded intrinsically, is motivated to continue their positive environmental behaviors. This is intensified with positive rewards from the Master Plan, such as cost savings from reducing landfill waste. According to the Handbook of Environmental Psychology, these “extrinsic benefits maintain and reinforce pro-environmental actions.” [6]

Increased environmental action as a result of the Master Plan may also lead to increased community happiness and well-being. At the country, state, and city levels, sustainable behaviors have been repeatedly linked to societal happiness. [7] [8] [9] With the implementation of the Master Plan, Davidson County residents are expected to become increasingly supportive of and involved in environmental activism, resulting in greater happiness and well-being.

J.5.2 Environmental Justice

Across the United States, low-income and minority communities bear an unequal burden of pollution than do other communities within the population. [10] A study evaluating a range of “locally unwanted land use” facilities in Massachusetts, including landfills and transfer stations, found that communities with a high minority population were nearly nine times more exposed to environmental hazards than the general population. [11] Similar trends have been seen across the country. [12]

By reaching the Zero Waste goal, Metro would reduce its dependence on landfills and avoid hauling materials farther away and the eventual the siting of an additional one. Avoiding the siting of a new landfill would save a community from the negative impacts these facilities tend to impose on adjacent neighborhoods.

To accommodate the region’s growing waste stream and reach the Zero Waste goal, the Master Plan calls for the addition of the following facilities:

- Five material recovery facilities (MRFs)
- Two construction and demolition (C&D) processing facilities
- Additional recycling transfer stations

Additionally, the Master Plan would increase the supply of recyclables and organic materials, spurring development of recycling and composting facilities. This appendix analyzes the social costs and benefits associated with the development of new landfills and the alternative diversion facilities.

J.5.2.1 Municipal Waste Landfill

Municipal solid waste landfills are areas of land designed to receive household and nonhazardous wastes. They are operated and monitored for signs of groundwater contamination and landfill gas as regulated the Resource Conservation and Recovery Act (RCRA). [13] Although landfills are regulated, there are several environmental concerns, such as landfill gas and leachate. There are also social concerns due to associated nuisances such as odors, flies, noise, traffic, debris, aesthetics, and negative property value impacts. [14]

Landfills, considered an “undesirable use of land,” translate into property value reductions. High-volume landfills (500 tons per day or more) decrease residential property values by 13.7% on average, with the impact diminishing 5.9% per mile. For low-volume landfills, adjacent property values decrease by 2.7% with a gradient decrease of 1.3% per mile. [15] A similar study found that landfills adversely affected home values by 12% at the landfill boundary and 6% one mile away. [16]

As mentioned earlier, the negative impacts associated with landfills have been found to disproportionately affect low-income and minority communities. This has incited environmental justice debates across the country. [12]

J.5.2.2 Waste Transfer Station

Waste transfer stations aggregate and screen municipal solid waste before it is transported to its final destination. Consolidating smaller loads from collection vehicles into larger vehicles makes operations more efficient by reducing hauling costs, fuel consumption, traffic, air pollution, and greenhouse gas emissions. The screening that takes place at the transfer station also reduces waste stream contamination and costs. [17]

Although waste transfer stations reduce some waste and costs, this type of facility is also considered an undesirable use of land and has been found to disproportionately affect minority and low-income communities. While regional transfer stations will be key in achieving Metro’s Zero Waste goal efficiently, best practices should be implemented to mitigate negative impacts.

The EPA has drafted a strategy to avoid disproportionately affecting minority and low-income communities and address environmental injustice concerns. [18] When faced with the need of new transfer stations, cities such as Seattle have found innovative ways to mitigate negative impacts. For example, Seattle’s North Transfer Station was designed to enhance community benefits and is located in an affluent urban neighborhood. Prominent features include underground operations, a basketball court, solar panels, a green roof, and odor and noise reducing technologies. [19] To promote social equity, measures to mitigate the negative impacts of these types of facilities should be incorporated in the planning and design process.

J.5.2.3 Materials Recovery Facility

MRFs are facilities that take in large loads of waste to sort and prepare for later use as raw materials. [20] The Master Plan proposes opening two clean MRFs, which would only receive recyclables and no organic material. Although enough research hasn’t been done on property value impacts from clean MRFs, these facilities are enclosed and have less associated nuisances since they only process inert materials.

To avoid the negative effects of MRFs, facilities often have odor-neutralizing technology and ventilation systems. Additionally, MRFs don’t pose a threat to the water table and soil due to their sealed concrete floors. Efforts to mitigate property value impacts also focus on architectural and landscape design and aesthetics. [21] Industrial areas are ideal locations because of existing access to utility service and highways. In this case, residential areas would be undisturbed and neighboring businesses would already be accustomed to high volumes of truck traffic. [22]

J.5.2.4 Composting Facility

Metro's Master Plan identifies organics as the leading waste category being landfilled and calls for a residential and commercial ban on this category to address the problem. With the implementation of the ban, a portion of organic waste would be redirected to composting facilities. These facilities enable an aerobic microbial ecosystem to decompose food scraps, yard trimmings, and other organic material. Composting is a more environmentally responsible alternative to landfilling that provides multiple benefits. First, it reduces the amount of organic materials in landfills, lowering methane emissions and the risk of groundwater contamination. Since the decomposition of organics is oxygenated, composting facilities exude less odor than landfills. Additionally, the final compost product has the ability to regenerate poor soil, suppress plant disease and pests, reduce the need for chemical fertilizers, and promote higher crop yields. [23]

Proper operational procedures are key to minimize odor, leachate, and pathogen emission concerns surrounding composting facilities. The process can be conducted in an enclosed system – such as an in-vessel or a static aerated system. By enclosing the organic material with a controlled outlet, odors and other potentially hazardous particles are significantly reduced. [24] [25]

With the proper infrastructure in place, composting organics rather than sending them to a landfill is expected to be less detrimental to adjacent communities and facility employees. Additionally, the final compost product allows nutrients and carbon to return to the soil and provides an alternative to synthetic fertilizers.

J.5.2.5 Anaerobic Digester (AD)

Another alternative to landfilling organic material is digesting it to produce two valuable products: renewable energy from biogas that can replace natural gas and digestate to supplement local composting infrastructure. [26] Co-digestion presents another alternative, where multiple organic materials can be digested at a time, such as sewage sludge and food scraps. Currently, Metro Water Services anaerobically digests most of Metro's sewage sludge, producing a significant amount of biogas that is used to heat the dryers that produce Class A biosolid pellets that are sold to be land applied. [27] Currently, the methane (CH₄) produced by the anaerobic digestion of organics in the Middle Point landfill is being flared and released into the atmosphere as carbon dioxide (CO₂), while the gas could be captured and used beneficially as a source of energy.

Although food waste AD tends to have a higher capital cost than composting facilities, co-digestion would have a lower capital cost because of the AD infrastructure that is already in place.

It has been found that anaerobic digestion paired with digestate composting has a better environmental performance than exclusively composting municipal waste organics. Impacts studied include human health, global warming potential, acidification, terrestrial and freshwater eutrophication, water usage, etc. Composting was outperformed on every category except for global warming potential because of the biological processes involved and gas engines for cogeneration. [29] Although the study accounted for the reuse of biogas, it did not assume any level of methane destruction through biogas flaring which could have attributed to the difference.

While aerobic digestion GHG emissions are predominantly carbon dioxide (CO₂), anaerobic digestion GHG emissions would be predominantly methane, which has 21 times the GHG potential than the latter. Anaerobic digestion can supply Metro’s grid with clean, renewable energy. To estimate the energy generation potential, **Table J-14** lists the assumptions for the calculation. If food donation is maximized and the remaining non-recoverable or edible organic waste from Metro is digested, the energy generated would be enough to power up to 3,170 households (**Table J-15**).

Table J-14 Anaerobic Digestion Electricity Potential Assumptions

| Assumption | Value | Source |
|--|--------|---|
| Energy produced per ton of organic municipal waste (kWh) ²⁹ | 250 | Environment Canada (2013) |
| Average annual household electricity consumption (kWh) | 20,193 | U.S. Energy Information Administration (2016) |

Table J-15 Annual Energy Generation Potential from Food Waste

| | |
|--------------------------------------|---------------------|
| Non-recoverable organic waste (tons) | 256,147 tons |
| Energy generated by AD | 64,036,710 kWh |
| Households powered | 3,171 households |

J.5.2.6 C&D Recycling

Up to 98% of Construction & Demolition (C&D) debris can be diverted from landfills through reduction, reuse and recycling, which could save contractors on material purchases and reduce or eliminate tipping fees. [29] [30] [31] [32] Supplying industries with recycled materials reduces the need for virgin materials and alleviates pressure on scarce natural resources and the habitats they provide. [33] Recycling C&D debris reduces the need for logging and mining, which have detrimental social and environmental effects.

Encouraging C&D reuse over landfilling creates the opportunity for businesses to donate reusable materials to charities working to provide construction materials in disadvantaged communities (e.g. Habitat for Humanity). This also provides an economic benefit for participating companies. [34]

Finally, recycling C&D materials increases job site safety through immediate disposal of materials into recycling containers, eliminating loose debris from accumulating on-site. Contractors and subcontractors have been found to “buy-in” more when they are trained and participate in recycling, leading to better morale among work crews. [35]

²⁹ Assumes an engine at 35% efficiency, value is averaged from a 200-300 kWh estimate

J.5.3 Promoting Social Equity Through Commercial Food Donation

Forty percent of food produced in the United States goes uneaten. When food is wasted, all the water, energy, pesticides, fertilizer and other resources needed to grow, process, store and transport it are also wasted. In 2008, this cost the U.S. economy as much as \$165 billion, or \$390 per person. [36]

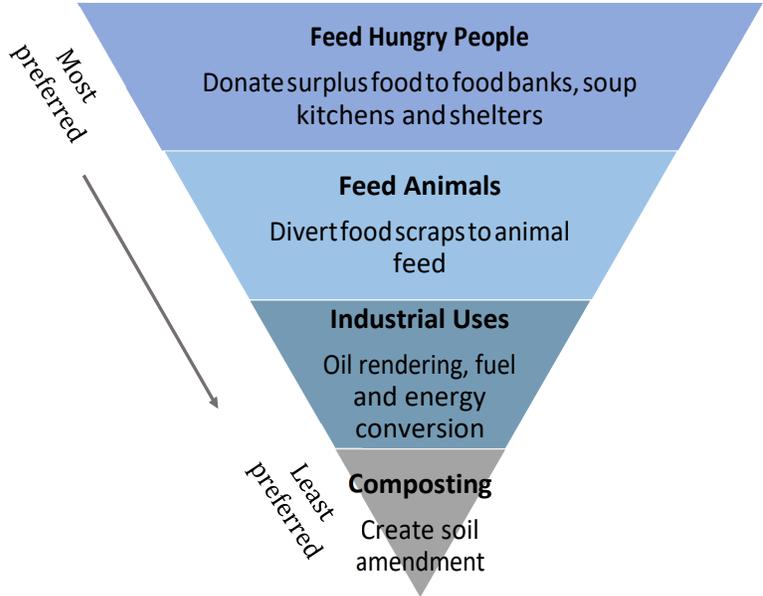
The waste characterization study conducted for Metro, as a part of this Plan, found that food scraps were the single-most prevalent landfilled category, at 15.4%. This includes residential, industrial, commercial, and institutional (ICI) refuse. At the same time, Feeding America estimates that 16.4% of Metro's population experiences food insecurity – in other words, has limited or uncertain access to food. Davidson County's rate is higher than both the Tennessee (15.4%) and U.S. (13.7%) values. [37]

The EPA's Food Recovery Hierarchy (**Figure J-4**) suggests that to address the challenge, strategies should focus on first preventing food waste, then on redirecting surplus to people followed by animals, and finally on food recycling (e.g. composting and anaerobic digestion). [38]

There are multiple benefits from keeping organics out of landfills, from compost and energy production to reducing methane emissions from anaerobic decomposition. However, a significant percentage of organics going to landfills is edible surplus food that could have been prevented. Since societal benefits would result from providing food-insecure individuals with fresh food, surplus donation should be prioritized over composting or anaerobic digestion. [39]

Based on Nashville's food insecurity rate of 16.4%, the city has an estimated "meal gap"³⁰ of 19.3 million meals per year. [40] The Nashville Food Waste Initiative estimates that existing meals served from donated foods by Second Harvest Food Bank and other organizations only address about 45% of the gap. [41] However, only about 9% is attributed to donations from businesses in Nashville. Under the assumptions listed in **Tables J-16 and J-17**, the potential of the Master Plan's organics ban to address Davidson County's food insecurity was estimated. To adjust values to the Master Plan's first year of full implementation, assumed to be 2030, projected population growth rates from Nashville's Metropolitan Planning Organization's Land Use Model were utilized. It is worth noting that the estimations do not include sectors such as events and recreation facilities, food wholesalers, distributors, processors or manufacturers, which contribute about 16% of Nashville's food waste generation, [42] because of lack of data on donation potential.

³⁰ Conversion of the total annual food budget shortfall in a specified area divided by the weighted cost per meal in that area. It represents the translation of food budget shortfall into a number of meals.



Source: US EPA

Figure J-4 Food Recovery Hierarchy

Table J-16 Assumptions Used to Estimate Food Potential Donation in Davidson County

| Assumption | Value | Source |
|--|---------|--|
| Total food waste diversion in 2030 in the aggressive scenario (tons) | 162,200 | CDM Smith |
| Percentage of the meal gap addressed with regional and local donations | 45% | Nashville Food Waste Initiative (2017) |
| Annual local food donations (tons) | 1,210 | NRDC 2017 |
| Meal gap in 2017 (meals) | 11.6M | NRDC 2017 |
| Meal equivalent in pounds | 1.2 | Feeding America |

Assuming that the annual shortfall of meals increases proportionally with population growth, a gap of 21.9 million meals is estimated for 2030. Assuming the diversion of the aggressive scenario, by 2030 162,200 tons of food waste will be diverted from the landfill. Based on the surplus recovery potential by industry in Nashville as estimated by the NRDC in **Table J-18**, the number of meals that could be served because of the incentives for surplus waste donations were estimated.

Table J-17 Potential Food Surplus Recovery by Industry in Nashville in 2030

| | Restaurants and caterers | Grocers and markets | Institutions ³¹ | Sources |
|--|---------------------------|---------------------|----------------------------|---------------------------|
| Food waste generation | 34% | 9% | 8% | NRDC 2017 |
| Potential for recovery | 2.50% | 37% | 7.5% | NRDC 2017 |
| Potential recovery in 2025 (tons) | 1,379 | 5,401 | 973 | |
| Total potential recovery (tons) | 7,753 tons | | | |
| Potential meals donated locally | 12.9 million meals | | | |

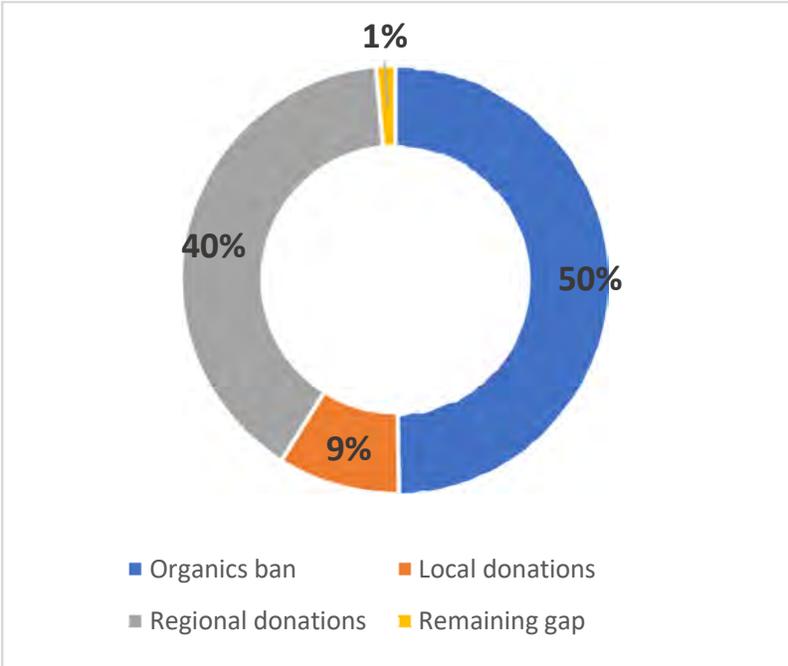
Table J-18 Impact of Food Surplus Recovery on Meals Gap

| Food Donations to Metro Nonprofits | Meals in 2017 | Meals in 2030 |
|------------------------------------|---------------|---------------|
| Zero Waste Master Plan | - | 10,905,267 |
| Local donations | 2,016,667 | 2,016,667 |
| Regional donations | 8,683,790 | 8,683,790 |
| Remaining gap | 8,599,543 | 319,986 |
| Total meal gap | 19,300,000 | 21,925,709 |

In an ideal scenario in which surplus food from the predominant commercial sectors gets recovered with the Master Plan's implementation in 2030, 12.9 million meals could be served annually to Nashville's food insecure population (Table J-4), addressing most of the meal gap, of which 10.9 million meals could be attributed to the organics ban (Table J-6) which corresponds to 50% of the meal gap as depicted on **Figure J-5**.

Currently, most of the meal gap is being met by out-of-county donations of non-perishable food. Enhancing food donations from restaurants, caterers, and institutions would increase the quality of foods being served to Nashville's food insecure population. Additionally, increasing donation supply may reduce the organization's food purchase costs and allow them to reinvest internally and expand services. [41]

³¹ Includes the hospitality, healthcare and college and university sectors, potential for recovery for the different sectors were averaged for this estimation.



**Figure J-5
Potential to Meet the Meal Gap with Donations with the Full Implementation of the Master Plan in 2030**

Vermont has proven to be a success story of how phased-in organic materials bans can increase fresh food donation. Since 2014, the state has been working with businesses to educate them about the best use of organics. In 2015, the Vermont Foodbank reported a 25-30% increase in food donation, which was followed by another 40% increase in 2016 resulting from the Universal Recycling Law. A Salvation Army representative from the area reported being able to reduce food cost per meal from \$1.47 to \$0.07 while increasing the quality of the food being served. [43]

To prioritize food donation over composting, the Master Plan includes a provision that incentivizes food donation to local organizations.³² Such an effort should be paired with an educational campaign on existing tax incentives, liability protections and food donation regulations. Additionally, food donation may be more favorable for grocery stores and wholesalers because de-packaging is not typically required.

While increasing the quality and quantity of food in the donations system does not address the causes of poverty that drive hunger – low wages, unemployment, unequitable access to housing, education, healthcare, and transportation – it does address short-term food insecurity.

J.5.4 Litter and Illegal Dumping

Metro’s Master Plan has a significant education component paired with enhanced enforcement to reach the Zero Waste goal. This combined approach is expected to encourage litter prevention. Litter is not only costly to clean up, it also impacts quality of life, economic development,

³² The State of California is in the process of drafting a bill that requires the recovery of 20% of disposed edible food for human consumption (SB-1383).

recreation value, and waterway cleanliness. [44] Every year, the Tennessee Department of Transportation spends more than \$15 million cleaning roadways. [45] This figure does not include the \$285,000 that Metro spent in 2017 to clean up and dispose over 644 tons of litter and illegal dumps.³³ [46]

Illegal dumps impose indirect costs to the environment, tourism, and other economic activity. The “broken window theory” states that vandalism activities encourage the persistence of these types of attitudes. This theory can be applied to the presence of litter, which has been found to negatively alter perceptions and is often referred to as a symptom of social decay and associated with crime prevalence. [47] [48] Perceptions about the presence of litter translate to decreases in property values by more than 7%. [49]

Despite the efforts to avoid litter, 18% still enters the waterways, [50] where it may cause ecosystem degradation and impose additional costs by clogging drains and contributing to flooding. [49] Cleaning and maintaining storm drains costs an estimated \$251,890 annually to cities. [51]

In 2009, national littering rates were found to have reduced by 61% since 1969. [49] However, litter is still a problem that is costly to the state, county and Metro residents. The Master Plan’s education and enforcement component have the potential to curb litter’s impacts.

J.5.5 Zero Waste City Brand

In 2016, the Livable Nashville Committee drafted recommendations to develop a shared vision for protecting and enhancing Nashville’s environmental quality and livability. One of the goals is to “reduce, reuse, recycle our waste for a healthier, cleaner, more prosperous Nashville” and sets the following targets: [52]

- Reduce food waste by 10% by 2020 (50%) by 2030
- Increase landfill diversion rate to 35% by 2020, 50% by 2030 and Zero Waste by 2050

Similarly, Sustainable Development Goal 11.6, as set by the United Nations, commits to “reduce the adverse per capita environmental impact of cities, including paying special attention to air quality, municipal and other waste management” by 2030. [53] With the implementation of the Master Plan, Metro would be on track to meet these goals.

Cities are increasingly taking a “branding” approach to shape an identity and market themselves to tourists, potential residents, and businesses. [54] Making “Zero Waste” part of Metro’s brand has the potential to attract businesses and residents with similar interests and cultural identities.

To accommodate for sustainable growth, **Table J-19** shows that most of the fastest-growing cities in the country tend to have incorporated Zero Waste goals.

³³ Illegal dumping is defined as an accumulation of items (small and large) placed illegally on the right of way.

Table J-19 Cities by Growth Rate with a Zero Waste Goal

| City | Fastest Growing Cities | Zero Waste Goal |
|-------------------------|------------------------|-----------------|
| Boise City, IN | #1 | No |
| Seattle, WA | #2 | Yes |
| Dallas, TX | #3 | Yes |
| Orlando, FL | #4 | Yes |
| Ft. Worth-Arlington, TX | #5 | No |

Sources: Forbes (2018), Earth911 (2016)

All of these cities are experiencing strong industry growth, especially due to tech company relocations. Cities that value sustainability also tend to draw and retain a highly skilled workforce. [55]

Sustainability is quickly becoming a priority for forward-thinking businesses of all sizes. Cities with a population of less than 1 million residents, like Nashville, hold much potential for economic growth with commitment to sustainability acting as a major pathway. [56] Making our waste stream more efficient by reusing and recycling 90% of the city’s production is one facet of sustainability that would drive smart growth.

J.6 Summary for High Performance and ZW Strategies

There are several main outcomes from this TBL analysis. Recall that the set of programs we developed can deliver 75% diversion for the City but can only do so if the aggressive strategies are undertaken. The positive side of working with the more aggressive program mix is that the cost per ton is relatively low - including the cost to all generators. The progress comes from all sectors – residential, commercial and schools / institutional sector, government sector, construction, multifamily, and public spaces. The core performers include:

- Enforcement of existing bans and enforcement of service maximums from the regulations
- SAYT incentive-based rates for both residential and commercial sectors, including universal access to three-bin systems (trash, recycling, and organics) at no separate fee, and a system of supporting food scraps bans
- Introduction of collection of new materials in the recycling programs, turning into bans of those materials, and associated enforcement. New materials include glass, textiles, and others.
- Enhancements over time to make the SAYT programs perform better – including introduction of enhanced incentives, and introduction of every-other-week collection of

trash to provide greater cost savings opportunities and to drive diversion into the food scraps bin and recycling container.

- In the near-term, construction and demolition sites must receive recycling bins in addition to trash service. Metro’s contracting for projects involving C&D should introduce requirements for a threshold percentage of C&D recycling and reuse.
- Construction and debris deposit program, using a recoverable financial deposit to incentivize builders and small commercial programs, and offer technical assistance to provide greater opportunities for these generators.
- Incentive surcharges, increasing the cost of trash disposal relative to recycling streams, to provide greater incentives for uptake of recycling initiatives, and to provide incentives to self-haulers.
- A multi-family innovations grant program to identify programs that are Nashville-centric and designed to work here, and then roll-out of the most successful strategies to the wider multifamily sector.
- Contracts for collection in the residential and commercial sector, to gain program uniformity, collection efficiencies, and potentially lower cost.
- Public education designed to focus on incentives, barriers, and motivation.

Table J-20 shows that the Triple Bottom Line (TBL) results from the overall list of strategies (combining the High Performing strategies and the ZW strategies) shows that the TBL is highly positive, even without the addition of the non-quantified TBLs. The benefits exceed costs, and the Benefit-Cost ratios are greater than one in all cases.

Table J-20 Triple Bottom Line

| | Total Values | | |
|---|--------------|-----------|------------|
| | Conservative | Moderate | Aggressive |
| Cost - Metro (thous) | \$6,517 | \$8,447 | \$9,499 |
| Costs - Generator, Tip Fee and Metro (thou) | \$34,530 | \$52,940 | \$87,920 |
| Total TBL Benefits (thous) | \$111,800 | \$211,100 | \$473,700 |
| Net TBL Benefits (thous) | \$80,093 | \$177,463 | \$413,921 |
| TBL Benefits divided by Metro Costs | 16 | 22 | 47 |
| TBL Benefits divided by All Cost | 3 | 4 | 5 |

| | Per Ton Values | | |
|--|----------------|----------|------------|
| | Conservative | Moderate | Aggressive |
| | \$22 | \$13 | \$8 |
| | \$127 | \$89 | \$80 |
| | \$384 | \$335 | \$419 |
| | \$257 | \$246 | \$339 |

The strategies recognize and embrace the goals, recommendations, and directions from previous task forces and work conducted in Nashville. Based on the “readily calculated” Benefit cost and Triple Bottom Line analysis, these programs provide an array of benefits to Metro and its residents, and, when considered in total, are beneficial to Metro.

The implementation of Metro’s Long-Term Zero Waste Master Plan is expected to have multiple benefits to the region, Metro residents and the environment. It would support a circular economy by making more efficient use of resources. Implementing the Master Plan will create better quality jobs than the waste management industry and will attract businesses with similar goals to the area. To support this effort, several facilities such as transfer stations, MRFs and composting or anaerobic digesters must be put in place. If planned and designed with an inclusive approach that mitigates the potential negative impacts, these facilities may become an asset to these communities while reducing the need to develop another landfill or truck waste long distances to another landfill. Additionally, it has the potential to promote social equity by addressing Metro’s meal gap through the enhancement of local donations of fresh foods to Metro’s disadvantaged populations.

J.7 Triple Bottom Line Background and Application for Solid Waste Programs

Background

The Triple Bottom Line (TBL) is a framework that combines Economic, Environmental and Social dimensions for any type of sustainability proposals for programs and the subsequent program analysis³⁴. The TBL model includes traditional measures of profits, then includes environmental and social dimensions to result in a more comprehensive, and hopefully quantitative investment picture of a program to be implemented. It is at base an accounting framework of cost- benefit analysis incorporating three dimensions of performance previously stated as: Economic/Financial, Environmental, and Social.

The overall benefits from using the TBL modelling is incorporating benefits into the model in a way that can communicate a true overall investment cost-benefit analysis to the governmental or, in some cases private sector stakeholders.

A literature review of the Triple Bottom Line (TBL) found it is a popular “buzz word” and is centered mostly around its application to businesses; how incorporating social and environmental impacts, being a “sustainable” company, can help their financial bottom line.

Publications from communities show it is increasingly popular to use TBL analysis in their internal evaluations, taking into consideration environmental and social factors in addition to traditional financial consideration. Following the business trend, communities have started including this metric as part of their long-term sustainability plans and as part of their decision-making process. For some communities (such as Eugene, OR; Fort Collins, CO; or Boston, MA), the

³⁴ The discussion in this appendix is based on Skumatz and D’Souza, “Triple Bottom Line: Best Practices”, Skumatz Economic Research Associates, Superior, CO. White paper. 2016.

inclusion of societal and environmental, along with financial, impacts are required for project proposals.

The financial and environmental impacts are often defined in dollar amounts, but the societal impacts are not. They are mostly in the form of checklists and best practices. Some the social impacts include, social justice, health and safety, and quality of life impacts such as noise, odor, and employment. The few that have dollar amounts relate to health impacts and are part of transportation projects, energy utilities, and some sewer projects.

Methods of Applying Triple Bottom Line Analysis in the Solid Waste Industry

The foundational approach of a TBL analysis is identifying what are the program benefits and costs to each of three pillars (Economic/Financial, Environmental, and Social). The second step is the benefits and costs/benefits within each of the three areas and defining them for consumers and the stakeholders whom include both the public sector and private companies.

There are different methods of applying the TBL model including monetizing all three areas, however, monetizing environmental and social benefits can be more difficult. The most common approach uses a positive or negative rating scale for environmental and societal benefits.

“By adding the TBL qualifier to the Cost Benefit Analysis, it becomes absolutely clear that all of the relevant social and environmental factors must be rigorously quantified in dollars and included in the analysis”³⁵.

Environmental impacts are often included in term of GHG or amounts of contamination. For social benefits, using a monetary or dollarization model has proved to be an area where municipalities have struggled. There can be a lot of subjective or philosophical grounds around how the monetary values are calculated, and this can add an element of distrust for many stakeholders as they may have different ideas about these valuations.

Typically, when communities establish a goal for TBL analysis it is applied in general, not dollar specific terms. An example of a municipality explaining the embracement of the model for their long-term sustainability practices is from the Canadian City of Calgary: “TBL thinking means that the Council and staff will consider and address social, economic, environmental and smart growth impacts. This includes programs, planning, policies, strategies, services, operations and approvals.”³⁶

Another alternative to assigning a dollar amount is to use an index, such as U.S. Economic Development Administration TBL Tool which assigns points as a value system. This has been used in many different cities, counties and even states but is not at its core a true Triple Bottom Line analysis, it is more of an indicator variable when used in quantitative analysis. This does not discount the value of creating an index or an indicator (which often use 25+ variables) and can be helpful to create comparisons and/or a baseline to begin with for a program.

³⁵ Autocase, “4 Myths about TBL-CBA”, www.autocase.com

³⁶ <http://www.calgary.ca/CA/cmo/Documents/TBL%20Framework.pdf>

TBL Usage in Solid Waste Program Evaluation

Not only is there no standardized way of assigning a dollar value to the environmental and social impact for TBL analysis, but a literature review revealed that few, if any, communities are applying cost values to these impact in solid waste. There is some attempt to do this in the water reclamation industry and some sewer projects, but most of the triple bottom line analysis for solid waste programs as projects are similar to the two examples provided below in **Tables J-21 and J-22**.

Table J-21 Provided Sample TBL Analysis for Zero Waste Businesses in San Diego

| Profit (Economic) | Planet (Environment) | People (Social) |
|--|--|---|
| Collection: <ul style="list-style-type: none"> • In one month, 9 pick-ups saved. • Estimate of \$125 a pull savings of \$819 x 12 months. \$9,825 | <ul style="list-style-type: none"> • 12,161 ml BTU's Total energy savings from waste reduction and recycling • 326.68 MTCE Net savings of greenhouse gas emissions from recycling, as compared to disposal • 99,544 Gallons of gasoline saved through reuse and recycling | <ul style="list-style-type: none"> • Inspire people to take positive action and prove that being a force for good is really good business • Identify the program with the brand imaging • Container standardization • Utilize all means of employee communications to get your message across |

Table J-22 City of Fort Collins Triple Bottom Line Analysis Plastic Bag Ban

| Triple Bottom Line Evaluation | | | |
|---|--|--|--|
| Option 2: Fee on Plastic and Paper Bags | | | |
| 52 percent estimated reduction in bag use (see Table 4) | | | |
| Social | | Environmental | Economic |
| <p>City Staff/Workforce</p> <p>Strengths</p> <ul style="list-style-type: none"> Reduces contamination at recycling facilities Reduces impacts on litter cleanup efforts <p>Weaknesses</p> <ul style="list-style-type: none"> Requires more City resources to implement, administer, and enforce than no action option or outright ban Education will be required to communicate fee to community | <p>Community</p> <p>Strengths</p> <ul style="list-style-type: none"> Retains customer choice compared to outright bans Residents have quickly adapted in other communities to fee by reducing bag consumption Has been preferred option for larger retailers in other communities among fee and ban options Less opposition from paper and plastic industries compared to bans <p>Weaknesses</p> <ul style="list-style-type: none"> May not reduce bag use as much as outright bans – not as significant a behavior change lever | <p>Strengths</p> <ul style="list-style-type: none"> Documented reduction in use of disposable bags - plastic and paper - in other communities resulting in lower overall energy, water, and GHG emissions Acknowledges that life-cycle impacts of plastic and paper are similar (energy, water, fossil fuels, GHG emissions) Supports an overall shift away from disposable bag use <p>Weaknesses</p> <ul style="list-style-type: none"> Does not decrease bag use as dramatically as bans | <p>Strengths</p> <ul style="list-style-type: none"> Option to recover costs to city for implementation and administration as well as to fund other source-reduction campaigns Can allow retailers to retain some or all of fee to offset implementation and administration costs Shifts bag use to a “polluter pays” model where users of disposable bags pay for the negative impacts <p>Weaknesses</p> <ul style="list-style-type: none"> Increased costs may affect low-income households negatively Retailer costs associated with employee training, point-of-sale system upgrades, and administration of fees |

Source: City of Fort Collins Triple Bottom Line Evaluation Plastic Bag Policy Options October 2012

Common Factors included in Triple Bottom Line Analysis

Economic

Economic and financial data are usually quite easily available through either existing public data sources or the local stakeholder databases.

- Personal Income
- Job creation at industry level
- Overall employment growth
- Sales tax collection/Consumer Spending variable
- Tip fees avoidance or additions
- Collection costs

- Sales from recyclable material
- Costs of additional infrastructure / equipment
- Higher investment interest / businesses moving into the community
- Other tax effects (income, etc.)

Environmental Data

Environmental impact on cost and benefits is also well documented in literature and practice depending on the program that is being evaluated.

- Use of post-consumer and industrial recycled material
- Amount of waste to landfill, and the amount diverted recorded once the program is in place
- Special costs of carbon, GHG diversion (Including impacts from transportation, waste to energy)
- Energy usage
- Ground water impacts
- Soil Contamination

Social benefits considered and set up for data collection in the TBL framework

- Quality of life: home values if affected to noise of trucks or new landfills/plants being build
- System resilience
- Ratepayer affordability
- Employment
- Cultural resources near infrastructure
- Odors
- Noise
- Land Use adjacency
- Construction impacts
- Worker safety
- Relative poverty
- Education (% with post-secondary degree)
- Average commute time around SW facilities

- Violent Crimes per capita
- Health and safety of community-adjusted life expectancy, additional medical bills or illnesses
- Change in nearby crop or agricultural or other land uses

J.8 The Market Value and True Social Cost of Carbon Emissions

Carbon trading is a market-based tool used to limit Greenhouse Gas (GHG) emissions by allowing the carbon market to trade emissions under 'cap-and-trade' schemes or with credits that pay for or offset GHG reductions. The current market value, or social cost, of carbon emissions is the average dollar amount paid for a unit (MTCO₂E) of carbon emissions within this market.³⁷

The market value of carbon emissions is the value, in terms of economic damage, that the United States now uses to guide current energy regulations, and possibly future mitigation policies. Therefore, an accurate estimate of the value of carbon emissions is crucial to successfully mitigating the negative impacts of climate change on society. A US government study^{38 39} designed an economic integrated assessment model (IAM) using empirical findings that concluded an additional ton of carbon dioxide emitted would cause \$37 worth of economic damages, which are expected to take various forms including decreased agricultural yields, harm to human health and lower worker productivity, all related to climate change.

With carbon emissions, like many other products, there are substantial environmental, social, and economic impacts which are not reflected in the market price of the good. In other words the current market price does not match the true social cost of carbon emissions. The total combined value of these impacts is referred to as the social cost of carbon and includes additional factors such as:

- Increased heat related mortality
- Changed water supply and demand
- Decreased agricultural yields
- Decreased shellfish harvests
- Harm to human health
- Lower worker productivity
- Increased road damage

³⁷The discussion in this appendix is based on Skumatz and D'Souza, "Triple Bottom Line: Best Practices", Skumatz Economic Research Associates, Superior, CO. White paper. 2016.

³⁸https://19january2017snapshot.epa.gov/climatechange_.html

³⁹<http://costofcarbon.org/faq>

- Increased energy demand
- Increased coastal infrastructure damage

A new study⁴⁰ out of Stanford suggests that the current market value, \$37/MTCO₂E, is far lower than the true social cost of carbon, which was estimated to be \$220/MTCO₂E. The EPA market value for carbon emissions is estimated from three separate Integrated Assessment Models (IAMs) and is limited in its ability to account for how the damages associated with climate change might persist through time subsequently underestimating the true social cost of carbon emissions. The Stanford report takes the Dynamic Integrated Climate Economy (DICE) model, a well-known IAM, and incorporates additional, previously unaccounted for economic damages by assuming that climate change will slow down GDP growth rates, particularly in less affluent areas. This study and the estimated social cost of carbon justify rapid and early emissions mitigation techniques. **Table J-23** provides a summary of the market value of carbon and social cost of carbon.

Table J-23 Market Value vs Social Cost of Carbon (\$/MTCO₂E)

| Market Value vs Social Cost of Carbon | Source | \$/MTCO ₂ E |
|---------------------------------------|------------------|------------------------|
| Market Value for Carbon | EPA (2015) | \$ 37 |
| Market Value for Carbon (Obama Admin) | Clean Power Plan | \$ 42 in 2020 |
| Market Value for Carbon | GAO (2017) | \$ 50 |
| Social Cost of Carbon | NRDC (201X) | \$ 226 |
| Social Cost of Carbon | Stanford (2015) | \$ 220 |

The Stanford estimate of \$220 per ton incorporates widely acknowledged impacts of carbon emissions but is not currently used by any federal government agencies. This cost is higher than the average estimate, but certainly within a reasonable range. The NRDC estimates the true social cost of carbon emissions to be \$226 per ton⁴¹. US government agencies still use the current market value of \$37/MTCO₂E for the total social cost of carbon emissions when planning climate change mitigation policy and programs, although a 2017 study⁴² from the Government Accountability Office (GAO) reported that a majority of economists think the value is closer to \$50 per ton. The Obama administration pegged the social cost of carbon at about \$42 per ton by 2020, but the repeal of the 'US EPA's Clean Power Plan' proposed by the current administration would lower the estimate, placing it between \$1 and \$6 per ton.

Truck Emissions: Diesel vs CNG

Diesel and CNG trucks emit different compositions of Greenhouse Gases (GHGs) so by changing the type of trucks in a trash fleet a community can lower their emissions in order to meet climate goals. Similarly, emissions change directly with changes in vehicle miles traveled (VMT) from adoption of new programs and strategies; examples include addition of collection routes for recycling, reductions for changes to every-other-week collection for efficiencies, or consolidation

⁴⁰ <https://www.nature.com/articles/nclimate2481>

⁴¹ http://switchboard.nrdc.org/blogs/ljohnson/co2pollutioncost_part2.html

⁴² <https://www.gao.gov/assets/690/687466.pdf>

of routes through contracting, etc.). The main GHGs of concern being emitted by medium and heavy-duty trucks are:

- Carbon Dioxide (CO₂)
- Methane (CH₄)
- Sulfur Oxide (SO_x)
- Carbon Monoxide

As shown in **Table J-24** below, Diesel trucks emit an array of compounds, and CNG trucks emit less of certain GHGs per gallon of fuel consumed or per mile driven, however they emit more of other gases, like methane, so there are trade-off that must be considered.

Table J-24 GHG Emissions from Medium and Heavy Trucks by Fuel Type (Diesel & CNG)

| GHG Emissions from Medium and Heavy Trucks by Fuel Type | Diesel | Compressed Natural Gas (CNG) |
|--|---------------|-------------------------------------|
| Carbon Emissions per Gallon (kg CO ₂ E/gal) | 10.21 | 6.914* |
| Methane Emissions (g CH ₄ /mile) | 0.0051 | 1.966 |
| Nitrous Oxide Emissions (g NO _x /mile) | 0.0048 | 0.175 |
| Sulfur Oxide Emissions (SO ₂ ppmv ^{***}) | 84.04 | 0** |
| Carbon Monoxide Emissions (g CO/mile) ⁴³ | 0.76 | 0.044 |

Table Notes: ()*: CNG=0.05444 kg CO₂E/scf (127 standard cubic foot=1 GGE or gas gallon equivalent) or 6.914 kg/GGE. *(**)*: CNG fuel does not contain any sulfates so there are virtually no SO₂ emissions created during the burning process (some studies have found insignificantly small amounts of SO₂ emissions from burning CNG fuels). *(***)*: part per million volume (just explaining the unit because it is not directly a mile, gallon, or mass based metric like the rest of this table. Source: SERA research

The main gas in terms of mass emitted by these trucks, regardless of fuel type, is carbon dioxide (CO₂). CNG trucks emit about 30% less CO₂ per gallon fuel consumed when compared with trucks running on diesel fuel. They do however, emit significantly more methane and nitrous oxide, which are more potent GHGs. There is far less data of sulfur oxide and carbon monoxide emissions, but from early testing CNG trucks seem to emit less of both of these gases. CNG fuel doesn't contain any sulfates so there are no SO₂ emissions created during the burning process. CNG also emits significantly less carbon monoxide. Emissions for carbon dioxide, methane and nitrous oxide are well studied and the above data are accepted by federal agencies. There is less consensus on sulfur oxide and carbon monoxide emissions for diesel and CNG trucks, but the above results were estimated by a DOE study.

⁴³ <https://www.afdc.energy.gov/pdfs/32863.pdf>

J.9 Derivation of Cost of Street Repairs

Overview:

Street maintenance costs⁴⁴ represent a significant percentage of any city's budget. Public works officials are concerned about wear to local streets and often look for ways to reduce the damage done to roadways as well as opportunities to extend the overall pavement life.

A growing body of literature suggests that a single trash truck can cause the same amount of damage, in terms of street maintenance costs, as 800-1,300 passenger cars. Logically, these types of studies would lead community decision makers to believe that there are achievable savings from either consolidating routes through RFP process (i.e. one hauler per street) or indirectly by avoiding the extra costs from more trucks (i.e. additional weekly services). While many studies postulate this issue and express concern, few have actually derived estimates of street maintenance damage, in dollar terms, caused by increases or decreases in trash truck traffic.

SERA decided to investigate if marginal changes in traffic from garbage collection is truly a significant factor for communities to consider when attempting to achieve savings on road maintenance. Based on the few reports that actually quantify these costs, we constructed order of magnitude range for the impact based on street maintenance costs specifically attributable to garbage collection, number of truck visits experienced per street, demographic data and other calculations.

The calculations began with available data on the total annual street maintenance costs attributed specifically to the damage caused by trash trucks in certain municipalities. These data were normalized to represent the annual cost of one weekly truck visit using a range of possible truck visit frequencies based on local hauling conditions within those municipalities. The normalization calculation provided SERA with a range of data on the annual street maintenance cost per weekly truck visit. Some outliers were removed and then the data was once again normalized using census data on number of households in order to calculate the annual street maintenance cost per weekly truck visit per household. This information was then scaled up by the number of households in Nashville to provide a range of estimates for the total annual street maintenance cost of adding one weekly truck visit to the entire Nashville service area. The conclusion is that there is only a small effect, in dollar terms, on street maintenance costs from adding more trash truck routes to the Nashville service area (see Figure 1 for results).

Estimate:

A SERA analysis estimated the projected street maintenance cost induced to Metro by adding more trash⁴⁵ truck routes. The analysis found that one additional truck visit per week to each household in the city would result in additional street maintenance costs ranging from \$5,772-\$9,234 annually (median \$7,100, midpoint \$7,970). The data used for calculations were estimates from three US states (CA, CO, MN) of the amount of damage, in dollar terms, caused to public roadways that could specifically be attributed to trash trucks. Routing and demographic

⁴⁴ The discussion in this appendix is based on Skumatz and D'Souza, "Triple Bottom Line: Best Practices", Skumatz Economic Research Associates, Superior, CO. White paper. 2016.

⁴⁵ or generally, more recycling or organics, with some differences related to loads.

information were combined with these data to project trash truck induced street maintenance costs for Nashville. **Table J-25** displays the minimum, median, and maximum value from the SERA analysis, which estimates the total annual street maintenance cost increase projected for Nashville if the city were to add one weekly collection visit to each household. Results are in the table below.

Table J-25 Estimated Effect of Streets Wear and Tear from Additional Trash Route per Week (SERA computations)

| | |
|---|----------|
| For Nashville’s 249,002 Households | |
| Min Total Annual Marginal Street Maintenance Cost of One Additional Truck Visit per week to each household | \$ 5,772 |
| Median Total Annual Marginal Street Maintenance Cost of One Additional Truck Visit per week to each household | \$ 7,103 |
| Max Total Annual Marginal Street Maintenance Cost of One Additional Truck Visit per week to each household | \$ 9,234 |

These estimates may seem low considering that the majority of literature from roadway engineering consultants suggests that trash trucks do cause damage to city streets. However, the actual amount of damage, in dollar terms, caused by trash trucks is not only difficult to quantify, but, based on the available information, also seems to be fairly insignificant compared to other factors including environmental impacts (freeze-thaw cycles). An engineering consultant contracted by a community in Minnesota concluded that reductions in heavy vehicle traffic would technically result in less damage to roadways however, because environmental factors are generally responsible for the majority of pavement wear and deterioration significant extensions of pavement life are unlikely. Proper design and maintenance standards are far more likely to impact city road budgets than any variation in vehicle traffic including trash truck routes. It may be that a more rigorous field study in the Public Works arena is needed to estimate these effects, but based on the analysis of the existing studies, we do not include this factor in our TBL analysis.

Annotated Sources:

Moore Engineering Report:

http://www.haulersforchoice.com/uploads/9/6/9/6/9696305/2011_03.00.11_city_street_budg ets_cost_comparision_analysis.pdf. ‘Generally, it appears there is not a definitive correlation between the type of garbage collection system and the cost per mile to maintain streets.’

Four factors impacting city road budgets:

- Environmental Impacts
 - ‘Freeze-thaw cycles and the presence of water below the bituminous surfacing of the roadway have a significant impact on a roadway’s load bearing capacity and life expectancy. A community’s policies and maintenance practices for preventing the

introduction of water into the pavement section directly impact a pavement's life expectancy.'

- Historical Design Standards
- Maintenance Practices
- Sub-grade Material

'A focus on the factors above will provide a lower maintenance cost per mile for most cities. Although a reduction in vehicle traffic will always have an incremental benefit on any street, converting this to hard dollar savings will be difficult for any City given the factors outlined above. The inconsistent application of roadway design standards and maintenance operations which vary from community to community make cost comparisons extremely complicated.'

http://www.haulersforchoice.com/uploads/9/6/9/6/9696305/2015_09.23.15_ghcc_letter_to_mounds_view_considering_oc.pdf

URS, Inc. working for the City of Arden Hills, stated, "Environmental factors are generally responsible for the majority of pavement wear and deterioration for Arden Hills streets."

"Although vehicle types and loading contribute to the wear of the pavement section, environmental factors also contribute to the deterioration of the pavement section. A properly designed bituminous surface should be able to handle the traffic loading over its design life including heavy truck loadings experienced in Arden Hills. Reducing the number of heavy truck loadings should have positive effects on the lifespan and quality of local streets however, environmental factors are generally responsible for the majority of pavement wear and deterioration for Arden Hills streets and therefore significant extensions of pavement life are unlikely."

University of Minnesota / Department of Civil Engineering, in a report dated March 2005, commenting on a study in the City of Crystal, stated, "Spring Load Restriction policy produces no benefit to the road owners in the City of Crystal, as it does not extend the life of the pavement within its normal lifetime. The roads would fail for other reasons before they would fail due to excessive loadings in the springtime."

Street Maintenance Costs:

CA Communities:

<https://www.pressdemocrat.com/news/2299353-181/garbage-trucks-weigh-heavily-on>

MN Communities:

<https://www.lrrb.org/pdf/201432.pdf>

CO Communities:

https://www.fcgov.com/recycling/pdf/Trash_Services_Study_Final_Report_2008.pdf?1436548083

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Appendix K

Metro Funding Approach

K.1 Implementation Approach

Based upon the assessment of High Performance and Zero Waste programs in Appendix F and G, three implementation approaches were identified to align with the adoption of required policies and authorities.

- Aggressive
- Moderate
- Conservative

These three approaches towards the adoption of recommended policies and programs are not mutually exclusive and are three distinct paths forward. Regardless of which direction is chosen, expanding existing recycling and waste diversion programs can be implemented; however, the moderate and conservative approaches will not achieve the goal of 90+% waste diversion within 30 years. The total costs and cost per ton of diversion will vary depending upon whether the aggressive, moderate, or conservative program portfolios are implemented. Once a direction on which policy recommendation is most appropriate for Metro, several funding strategies can be investigated further.

K.2 Current Available Funding Sources

The MPW Solid Waste Operations are primarily funded through general fund distributions, special revenue funds, and special purpose funds. The solid waste program revenues are classified as either special revenue or special purpose funds. Actual program revenues are generated from waste generation fees charged to haulers, waste disposal fees, convenience center fees, grants, and the sale of recyclable materials. Metro also has several miscellaneous fees including fess for: extra carts, extra garbage service, and commercial vehicle inspections.

The solid waste fees are set by ordinance; and, any adjustments to the fee amounts must pass council with a majority (21 members) vote. Special purpose funds cover the solid waste grants and tire waste grants provided by TDEC. These program revenues are minimal compared to ongoing operational expenses; therefore, Metro General Fund contributions are the primary source of revenues for Solid Waste Operations.

The fiscal year (FY) 2018 Solid Waste Operations operating revenue source distribution was 78% from General Fund transfers and 22% from program revenues. The General Fund revenues were primarily provided from the USD compared to the GSD (71% vs. 29%) given that MPW's operating expenses are heavily derived from services offered to USD residents and businesses. The combination of delivering enhanced service levels, beyond Metro Charter requirements, to MPW customers and the inability to charge for additional waste collection or disposal services within the USD has created a funding strain for MPW.

K.3 Funding and Management Structure

As Metro moves towards a solid waste management model that focuses on increased waste diversion throughout Davidson County, the main challenge to implementing the Plan under the current funding structure is the heavy reliance upon General Fund revenues to support the programs. With recurring and changing public service priorities for General Fund revenues, MPW will be unable to providing the level of consistent and sustainable resources required to successfully achieve interim diversion goals and the ultimate goal of 90+% diversion.

The development of this Solid Waste Master Plan is a huge step in the right direction towards reducing waste, increasing diversion, and moving away from landfill disposal as the primary means of waste management. The hard work that remains is implementing the recommended policies and programs; developing the management structure; and identifying sustainable funding sources. These key components will be a part of the short-term steps necessary to get the Plan off the ground.

- Metro re-aligns the funding structure for solid waste management services to transition from the tax-base General Fund to a proprietary fund (accounting structure for business-type activities) such as an Enterprise Fund. A key issue to be addressed is the provision and enforcement of base-level services and fees for USD residents and businesses. A discussion on alternative funding structure policies is provided in Section 12/Appendix L.
- Develop a staggered approach to decreasing funding for waste collection and management services (in both the USD and GSD) from the General Fund. The approach shall allow for increasing fees, over several years, to residents and commercial customers to ease the reliance on General Fund revenues. The new funding approach will also need to consider new billing mechanisms, such as existing utility (i.e. water/sewer) bills or non-ad valorem solid waste fee on property taxes.
- Develop public and private/public partnership funding options for the array of new facilities needed to handle diverted and disposed materials
- Develop new fee structure to be assessed to haulers, residents, and commercial entities to support the implementation of High-Performance programs.

K.3.1 Enterprise Fund Structure

The creation of an enterprise fund for solid waste operations will allow Metro to equitably shift payment of collection, processing, and disposal costs to specific users of the services based on the actual levels of services utilized. An enterprise fund will provide Metro the flexibility to account separately for all financial activities associated with the full range of residential and commercial solid waste services to be provided, under the Plan, throughout both the USD and GSD.

Similar to general funds, enterprise funds are typically required to have a balanced budget meaning that revenues must be sufficient to cover all operational expenditures and capital investments. The primary revenue source for solid waste enterprise funds are typically fees for collection and disposal services. Any user fees developed must be established to reflect the actual cost of providing the services rendered including ongoing maintenance and capital investment

costs. The enterprise fund will also benefit from revenues associated with grants, private facility revenue-sharing agreements, and other user charges.

In Tennessee, solid waste collection fees are considered “restricted revenues” that can only be spent on authorized expenses. Restricted revenues can’t be transferred from one fund to another to cover expenses associated with non-authorized uses. Therefore, MPW will need to determine if solid waste collection fees captured in the General Fund can be transferred to an enterprise fund as long as the revenue is utilized for the provision of solid waste services.

K.3.2 Management Structure

Effective funding and implementation of the Plan across the entire county, with two distinct taxing districts, will require a management structure that can conduct operations, generate user fee revenues, and enforce program requirements. MPW is currently limited in its ability to provide the services and generate sufficient revenues to support the Plan. The Metro Charter currently doesn’t allow charges for additional waste collection or disposal services within the USD because residential curbside and some commercial waste services are part of the tax base.

One option proposed for this Plan is the creation of a solid waste authority to guide the planning, implementation, and funding of programs associated with the Plan. The idea behind establishing an authority is to treat the delivery of solid waste management services as a utility similar to the water, wastewater and stormwater provided by Metro Water Services. The authority would serve as the lead entity responsible for implementation of the Plan including policies, programs, services and funding.

One key power of a solid waste authority is the ability to impose and collect solid waste disposal fees. The ability to establish fees sufficient to cover the cost of providing the programs and services under the authority is paramount to establishing a long-term, sustainable source of funding that is separate from the General Fund.

The authority’s jurisdictional boundaries would initially be the entire Davidson County area with the potential to expand into a regional Authority, if determined to be beneficial to Metro and the other regional communities. Establishment of an Authority provides the opportunity to address revenues (through residential and commercial fees and charges) without the concerns and discussions around the limitations associated with crossing the GSD and USD boundaries.

Appendix L of the Plan provides more detailed information on the policies, powers, and structure of a potential Authority within Davidson County.

K.4 Incremental Program Costs

The program costs associated with the High-Performance and zero waste strategies are outlined in Appendix F and G of the Plan. The estimated costs are considered incremental (and not inclusive) to the existing solid waste operation costs.

The Plan High-Performance strategy costs borne by Metro are: tracking, enforcement of bans, administration of C&D deposit system, incentive surcharges, new convenience centers, public space recycling, small business and school programs, multi-family programs. Zero Waste programs add additional responsibility and costs to Metro such as “green” procurement

procedures; diversion at special events and festivals; enforcement activities; public education; and economic development tools to support zero waste diversion. Based upon full implementation of 90% diversion programs (aggressive scenario), estimated annual incremental costs for Metro are approximately \$9.5 million.

Metro’s costs under the moderate diversion scenario are about \$8.4 million, and are approximately \$6.5 million for the conservative scenario. Both the moderate and conservative approaches yield lower incremental annual costs for Metro; however, the lower diversion tons result in higher per ton costs compared to the aggressive scenario. The moderate and conservative costs per ton are \$13 and \$22, respectively, compared to \$8 for the aggressive strategies.

Tip fees are also expected to increase at local and regional disposal facilities. Total annual costs associated with all programs for all generators and Metro is approximately \$88 M.

Table K-1 Costs for High Performing and ZW Strategies for the Three Scenarios

| | Program Costs, All Phases-Year Shown → Year 9 | | |
|--|---|--------------------|------------------------|
| | Aggressive Portfolio | Moderate Portfolio | Conservative Portfolio |
| Total Percent Diverted (incl. Existing 18-19%) | 85% ¹ | 55% | 35% |
| Total New Tons Diverted from Landfill | 1,148,300 | 638,950 | 296,000 |
| Metro Cost: Avg. Annual Cost | \$9,499,000 | \$8,447,000 | \$6,517,000 |
| Generator Costs | \$46,881,000 | \$21,463,000 | \$22,003,000 |
| Marginal Tip Fee Cost - (LF savings minus new tip fee) | \$31,540,000 | \$23,030,000 | \$6,010,000 |
| Total Costs | \$87,920,000 | \$52,940,000 | \$34,530,000 |
| Metro \$/Ton (new) | \$8 | \$13 | \$22 |
| Total Cost per Ton | \$80 | \$89 | \$127 |

Note: The term LF savings minus new tip fee computes the difference in costs between the cost of landfilling waste and delivering the waste to a series of other destinations. A blend of current costs and costs of future facilities was utilized in the calculation.

The additional funding levels required by Metro to implement the Plan will be used to provide:

- Additional staff for program development and rollout, monitoring, enforcement, and contract oversight.
- Staff vehicles
- New containers
- Education, social marketing, and outreach materials

Capital costs associated with development of metro-owned facilities such as convenience centers and anaerobic digestion.

¹ Note one program is not projected to be fully rolled out by 2027, so the portfolio numbers don’t quite reach 90% in the table.

K.5 Specific Funding Sources

Getting to High Performance and to Zero Waste goals involves an array of changes in responsibilities and behaviors – and costs – by actors and stakeholders around the region. The new integrated system will cost more in infrastructure development, services, and outreach.² For the most part, the costs for the array of programs and policies are funded in the following ways. The principles underlying the funding sources are for users to pay, provide integrated incentives, provide stable / on-going funding sources, and diversify funding sources. Our specific plan for Metro’s High Performing and Zero Waste Plan funding sources includes the following.

- **Residential Rates / User Fees:** New residential collection revenue sources will be needed to support equipment (trucks and carts) and services (labor and processing) for integrated trash, recycling and organics collection, whether by Metro, authority, or the independent haulers, or in the longer-term, by contract. These funds come directly from user fees assessed directly to the households, with rates designed to cover the sector’s cost of service, including the portion needed for facility use. Rates will be in the form of an integrated/combined bill, billed by Metro and the haulers in the short run, and by the contracted hauler(s) and/or solid waste authority in the longer run. In the short run, haulers operating in the area will be assessed a fee to cover the costs of the high performing and zero waste residential programs, including potentially the multifamily grants program (or shared residential / commercial haulers) and outreach. In the longer run, a small fee may be assessed to the contracts to cover the cost of Agency monitoring / oversight.
- **Commercial Rates / User Fees:** New commercial collection equipment (trucks and containers) and services (labor and processing) for integrated trash, recycling and organics collection, whether by Metro, authority, or the independent haulers, or in the longer-term, by contract. Again, these funds come directly from user fees assessed directly to the businesses, with rates designed to cover the total cost of service (in an integrated / combined bill). Rates will be in the form of an integrated / combined bill, billed by Metro and the haulers in the short run, and by the contracted hauler(s) and/or authority in the longer run. A small fee may be assessed to the contracts to cover the cost of monitoring / oversight. In the short run, haulers operating in the area will be assessed a fee to cover the costs of the high performing and zero waste commercial programs, including small business programs, deconstruction, food, and recycling outreach. In the longer run, a small fee may be assessed to the contracts to cover these costs and the cost of monitoring / oversight.
- **Hauler Costs:** Hauler costs will increase, as they are requested to provide containers, new services, and develop combined SAYT rates, etc. The costs of doing business under the new system – including extra fees assessed by Metro -- are expected to be directly passed on to

² Traditional sources of funding for local / regional programs are most commonly user fees, but also include: single purpose taxes, hauler registration / licensing / franchise fees; new authorized planning funds; litter fees / Advance Disposal Fees / Bottle bills; generator fees / environmental fees; tax on first sale of toxic items; and grants. In addition, economies / savings and efficiencies can become sources of avoided funds, helping fund “next step” efforts. Source: Burns and McDonnell and Skumatz Economic Research Associates, “Colorado CDPHE Integrated Materials Management Plan”, 6/2016.

their customers. Hauler efforts will be funded through rates they charge, including additional efforts to allow for the addition of glass and other mandated materials to programs over time, implementation of SAYT, and other services. Enforcement will be key to maintain a level playing field and assure no one undercuts program service requirements.

- **Sources for Metro Costs:** Metro expenditures of staff time for policies, program design and implementation, regulation-crafting, negotiation and cooperation-building, enforcement, RFPs, and tracking / monitoring and other Metro staff expenses outside service is covered by hauler fee that Metro charges for the hauler to operate within Metro's jurisdiction. Substantial outlays include public space recycling and convenience centers. Additional funds may come from taxes and fees, budgeted through the capital improvement project (CIP) planning and budgeting processes. The overarching Metro department or solid waste authority may have access to even more funding sources. In California and other locations, a new funding authority was authorized, allowing for planning and enforcement. In some cases, the fee was assessed on a per-ton basis, a per-household or per-business basis.
- **Tippling Fees / Rates for facilities:** Incentive-based subsidies and premiums on landfill disposal fees or the subsidies for lower fees for organics and recycling tons may come from one of several places. The best source is a joint rate study conducted to cover landfill / organics / recycling, with policy-based assumptions placed on top of the cost allocations to accomplish the incentive variations from true cost of service (e.g. recover all costs but require a 25% lower rate for organics and recycling, or similar). If the facilities are a mix of public and private facilities, the rates will need to be constructed as a system of subsidies and discount "funds" that pay out to achieve the rate differentials desired, with periodic re-forecasts and rate studies.
- **Tippling Fees for surcharges / discounts:** New facilities will recover the cost of construction and operations through rates charged for use of the facilities. This includes new MRFs, organics facilities, C&D processing sites, etc. Capital is ordinarily obtained through bonds, which will likely be best obtained only after a strong local / regional commitment to a new integrated system, goals, etc. is obtained.
- **Construction and Demolition Programs through Program Fees:** This program is self-funding. A deposit is assessed as part of the program, and the program is funded through two pieces: the fees that are not returned because some builders will not reach goals and will not have full funds returned, and a small percentage may be assessed to run and monitor the program (e.g. meeting goals returns 95% of the fee or similar). This program's policy goal is that funds from non-compliant builders shall be used by Metro or an Authority to support diversion programs.
- **Zero Waste Economic Development Strategies:** The five economic development strategies included in the zero-waste plan are assumed to be covered by the budgeting process for the Economic Development Department, which also has the ability to apply for grants, etc.

K.6 Grants and Other Funding Sources

Government grants and funding sources – whether at the federal, state or local levels – can potentially provide financial benefits for a variety of solid waste and recycling projects. These funding sources are often provided on a competitive basis, and sometimes are not specific to the solid waste and recycling industry. Securing additional funding can help reduce capital and/or operating costs. An overview of potential grant and funding sources that have been used for solid waste management or recycling projects follows.³

Tennessee Grant/Funding Programs

TDEC has developed an Online Grants Management System that offers applicants a more streamlined approach to submitting grant applications and managing projects that have received grant funding. The Grants Management System will allow MPW staff to research grant funding opportunities, application deadlines, apply for grants, and manage all applications. Cities, counties, and solid waste authorities are eligible to apply for TDEC grants.

Priorities for waste reduction grants are: Applicants located in distressed counties; applicants located with the top 5 counties which includes Davidson County; applicants that develop public-private partnerships that contribute resources. MPW, as an applicant, could meet 2 of the three priorities for grants that will be helpful in implementing the Plan.

Each grant program has specific eligibility, priority, and funding requirements for projects.

Grant funding will not be provided for projects that are considered normal, recurring operating expenses.

- Materials Management Grant Current Grant Listing⁴. TDEC offers an extensive portfolio of grants designed to promote materials management throughout the waste management system. TDEC keeps an 18-month window with these funding options - The grants applicable to supporting programs and policies associated with the Plan are:
 - Waste Reduction – Grants for waste reduction equipment required to establish new collection or processing capacity, improve existing collection or processing operations, or prepare materials for transport and marketing. The FY18-19 budget for waste reduction grants is \$3,000,000. MPW or a solid waste authority would compete against other “Suburban and urban counties with populations of 50,001 or greater and the cities, solid waste authorities, or non-profit organizations within those counties.” Total grant offering is \$2,000,000. Funding maximum per applicant is \$500,000. A local match of 10-50% is required based upon certain economic criteria.

³ The major source for this discussion of grants and funding is Burns and McDonnell and Skumatz Economic Research Associates, “Colorado CDPHE Integrated Solid Waste Management Plan”, 6/21/2016.

⁴ - <https://www.tn.gov/environment/program-areas/solid-waste/materials-management-program/grants-administration.html>

- Education and Outreach – Grant support for projects that are needed to expand education and outreach in communities that have met the minimal requirements of informing residents about the basics of recycling.
- Convenience Centers – grants are provided in support of projects that replace or eliminate unstaffed sites; or develop new centers in underserved areas or applicants that do not meet the minimum level of service for the number of convenience centers under Rule 0400-11-01-.10 (2).
- Recycling Rebate – Rebates are eligible for use in establishing new programs or collection sites; preparing recovered materials for transport and marketing; identifying markets for recovered materials; and developing educational programs for adults and children to help them understand solid waste issues, management options, costs and the value of waste reduction and recycling efforts.
- Recycling Equipment – Davidson County is not eligible for this grant in FY17-18 because the county received a recycling rebate.
- HHW Collection Facility – competitive grants for collection of household hazardous waste at a permanent site
- Measurement Equipment – Grants are provided for measurement equipment includes, scales, software and software subscriptions (RFID readers, route optimization, accounting, material tracking, etc.), computers including tablets used for measurement activities, and metering/monitoring devices (RFID tags, car counters, automation systems, GPS, sensors, moisture readers, etc.).
- Organics Management – Grant funds can be used to provide new or expanded organics management services to residents. In addition, funding can be used to address wasted food and food waste through education, feeding people, feeding animals, industrial uses, anaerobic digestion, and composting.

US Department of Agriculture (USDA)

Community Facilities Direct Loan and Grant Program

Through the Community Facilities Direct Loan and Grant Program, the USDA provides affordable funding to develop essential community facilities in rural areas. An essential community facility is defined as a facility that provides an essential service to the local community, such as solid waste or recycling services, for the orderly development of the community in a primarily rural area. Private, commercial or business undertakings are excluded. Public bodies, community-based nonprofits, and federally-recognized Tribes serving rural areas including cities, villages, townships and towns as well as Federally Recognized Tribal Lands with no more than 20,000 residents according to the latest U.S. Census Data are eligible for this program.

Rural Utilities Services Program

Through Rural Utilities Service Water and Environmental Programs (WEP), rural communities can obtain the technical assistance and financing, typically through long-term, low-interest loans, necessary to develop drinking water and waste disposal systems. WEP provides funding for the

construction of waste facilities in rural communities and is the only Federal program exclusively focused on rural waste infrastructure needs of rural communities with populations of 10,000 or less. The funds may also be used for collections and landfill closure. Grants within WEP include:

- Solid Waste Management Grant
- Water & Waste Disposal Grants to Alleviate Health Risks on Tribal Lands and Colonials
- Water & Waste Disposal Loans and Grants
- Water & Waste Disposal Loan Guarantees
- Water & Waste Disposal Predevelopment Planning Grants
- Water & Waste Disposal Revolving Loan Funds
- Water & Waste Disposal Technical Assistance and Training Grants

Websites: <http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program>; and <http://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs>

Private Funding Sources

While there are various potential private funding sources, this appendix describes the Recycling Partnership, Closed Loop Fund and Bloomberg Philanthropies.

The Recycling Partnership

The Recycling Partnership (Partnership), formerly the Curbside Value Partnership, is an industry-funded national recycling nonprofit with the goal to improve curbside residential recycling in the United States. The Partnership provides resources for communities (4,000 or more households) starting programs with recycling carts or switching from bins to carts. To accelerate the local level adoption of recycling best management practices, the Partnership uses highly leveraged grants coupled with technical assistance.

For 2016, the Partnership grants offered were for:

- Cart procurement: \$7.00 per cart delivered up to \$500,000
- Education and outreach implementation: \$1.00 per household up to \$50,000
- Access to technical assistance and the CARTs campaign materials valued at \$139,000

The Closed Loop Fund

The Closed Loop Fund (CLF) was created to increase recycling rates and is funded by consumer goods companies and retailers. The CLF provides zero interest loans to municipalities and low interest loans to private companies. The goal for CLF is to invest \$100 million in recycling infrastructure from 2015 to 2019.

Bloomberg Philanthropies

Bloomberg Philanthropies focuses on environment, public health, education, government innovation and the arts. Bloomberg also has an initiative dubbed the “Mayors Challenge” where cities submit innovative ideas to improve city life and have a chance at winning a \$5 million grand prize or one of four additional \$1 million grants.

Websites: <http://recyclingpartnership.org/>; <http://www.closedloopfund.com/>;
<http://www.bloomberg.org/>

Tax-Exempt Private Activity Bonds

Private activity bonds provide tax-exempt financing for the furtherance of governmental and qualified purposes, which may include the construction of solid waste disposal (which could include various types of recycling activities) facilities. Qualified private activity bonds are issued by a state or local government, the proceeds of which are used for a defined qualified purpose by an entity other than the government issuing the bonds.

Qualified private activity bonds must be approved by the governmental entity issuing the bonds and, in some cases, each governmental entity having jurisdiction over the area in which the bond-financed facility is to be located. Public approval can be accomplished by either voter referendum or by an applicable elected representative of the governmental entity after a public hearing following reasonable notice to the public.

Website: <http://www.irs.gov/pub/irs-pdf/p4078.pdf>

Appendix L

Importance of Supportive Policies

L.1 Solid Waste Management Public Policy

The US Environmental Protection Agency's (USEPA) hierarchy for waste management systems focuses on the following activities (in order of preference): source reduction and reuse; recycling and composting; energy recovery, and treatment and disposal. Legislative, regulatory, and policy goals at both the federal and state levels have been encouraging local governments to develop solid waste management plans that focus more on waste reduction, material recovery, and reuse. The Tennessee Solid Waste Management Act of 1991 establishes a part of the state's public policy to be:

"...educate and encourage generators and handlers of solid waste to reduce and minimize to the greatest extent possible the amount of solid waste which requires collection, treatment, incineration or disposal through source reduction, reuse, composting, recycling and other methods."

The policies described in this appendix; and throughout this Plan, meet the spirit and intent of the state's public policy regarding the management of solid waste. Recent data from the Tennessee Department of Environment and Conservation (TDEC) Annual Progress Reports indicate Metro disposes approximately 1.8 tons per person annually, or about 9.9 lbs. of waste/pp/day. This rate of disposal is significantly higher than similar-sized communities actively pursuing waste reduction/diversion policies. For comparison, the following data is provided.

- North Carolina has a statewide goal of maintaining a rate of less than 1.0 tons per person annually. For FY16-17, the actual rate was 1.0 (excluding excavated coal ash)
- CalRecycle's 2017 disposal data indicate that California achieved an annual per capita disposal rate of 0.49 tons per person
- Larger cities are often under 1.0 tons per person per year.
- The City of Fort Collins, CO. has adopted a goal of zero waste by 2030. As a complimentary goal, the City wants to achieve a per capita disposal goal of 0.51 tons per person by 2025.
- According to the Seattle Public Utilities 2017 Recycling Rate Report, Seattle's citywide per capita disposal rate is approximately 0.48 tons per person
- FY 2016-2017 – Mecklenburg County (Charlotte, NC) had a rate of 1.32 tons per person per year.

One of the driving philosophies of this Solid Waste Master Plan (Plan) is to shift the opinions and behaviors of residents and businesses regarding waste management away from "disposal-centric" to material and resource management (recovery and reuse). The limited amount of waste

disposal airspace remaining at the Middlepoint Landfill is a big driver for why waste reduction, recycling, and diversion are critical to Davidson County and surrounding counties.

Effective management of any business or operational system requires timely and accurate data – managing a solid waste system is no different. In order to ensure that adequate services are provided, and waste and recyclable materials are being handled properly, Metro will need to improve data reporting and metrics relative to waste and recycling collection activities within the USD, GSD, and potentially satellite city areas. Therefore, ordinances and policies will be an important component of increasing education and public awareness regarding available services and infrastructure, requirements for recycling and disposing of materials banned from landfills and reinforcing the appropriate behaviors and desired outcomes.

One of the fundamental policy challenges to implementing a county-wide Plan is the current consolidated city-county form of government that has established two distinct tax districts: the Urban Services District (USD) and the General Services District (GSD). The Metro Charter has created separate levels of responsibility and authority for the Public Works Department (Department) relative to managing, implementing, funding and monitoring solid waste management activities across both the USD and GSD.

As noted in previous appendices of the Plan, communities across the country that are successfully diverting large portions of the waste stream have one common theme: a myriad of program strategies supported by the adoption and enforcement of key coordinated public policies. The high-performance and zero waste strategies, discussed throughout this Plan, have been recommended for Metro based upon an evaluation of the current programs, analysis of the current waste composition, public input and experience with programs in similar communities.

Even with the technical, financial, and environmental consideration given in developing the Plan, success will ultimately be dependent upon the “policy foundation” established during the initial phases of implementation and throughout the program to support the Plan.

L.2 Policies Critical to Solid Waste Master Plan Success

In general, the primary policy goals will be to establish service and program expectations for reducing, reusing, recycling and recovering waste materials; create incentives for private-sector infrastructure investment; and provide clear metrics for monitoring progress within the residential, commercial, industrial and institutional sectors.

The strategies, funding and implementation activities discussed in this Plan require Metro to strive to create consistency throughout the USD and GSD regarding policies on management and funding of the waste management system, material disposal bans, mandates, residential and commercial recycling, curbside collection services and enforcement. The critical policy tools and concepts essential to successfully implementing this Plan are:

- Create a Solid Waste Authority with geographical boundaries that include USD and GSD.
 - Provide consistency in policy, programs, service levels, goals and metrics across Davidson County.

- Establish uniform program implementation to drive participation levels.
- Establish a data tracking system for tons diverted and tons disposed.
- Grant authority to implement household and hauler license fees across Davidson County.
 - Provide long-term sustainable funding sources.
 - Switch from special revenue fund to enterprise fund accounting.
 - Address USD/GSD funding dichotomy (tax base vs. subscription).
- Adopt disposal bans for organics and targeted recyclable materials.
 - Provide a guaranteed “feedstock” for public and private processing facilities.
 - Limit material to be disposed in landfills.
- Implement residential and commercial collection ordinances.
 - Service delivery programs i.e. Save-as-you-throw.
 - Hauler contracting and franchises.
- Develop incentives for private-sector investment and partnerships.
 - Allow regional expansion of programs.
 - Create incentives for increased public and private partnerships.

L.3 Establishment of Solid Waste Authority

The Charter of the Metropolitan Government of Nashville and Davidson County (Charter) establishes the powers and functions of government services that are provided to residents and businesses of the Metro area. The Charter establishes different waste management functions and service delivery requirements for the USD and GSD. For the USD, government services include refuse collection and disposal; while, the GSD only receives refuse disposal services. The Department has been granted, via the Charter, the power to:

- Collect and dispose of garbage and other refuse within the urban services district, and to regulate the collection and provide for disposal of garbage and other refuse within the general services district.
- In addition, the Department can collect service charges to defray installation and operation costs for furnishing services beyond the limits of the urban services district when such services are a function of the urban services district.

However, the Metro Charter currently doesn’t allow charges for additional waste collection or disposal services within the USD because residential curbside and some commercial waste services are part of the tax base.

Given these legislative requirements, the Department, under the current Charter structure, will not have direct responsibility and authority over implementation of the entire Plan. The primary directive of the Plan is to divert 90%+ of the waste stream from disposal in a landfill. The ability to reach this goal will require the uniform delivery of collection and disposal services and programs throughout the County. The Charter requirements will significantly reduce the Department's ability to implement waste collection and disposal changes within the GSD area. The inability to fully implement components of the Plan in the GSD will limit the effectiveness of the Plan and require the Department to lower the diversion goal from 90% to below 50%.

Given the challenges associated with amending the Charter to address these solid waste challenges, Metro should consider the development of a Solid Waste Authority (Authority) as a mechanism that would allow unification and uniformity of service delivery and program implementation across Davidson County. A Solid Waste Authority would allow the Plan to be implemented across both the USD and GSD: **One Metro One Plan**. Just as music, food, and outdoor activities transcend across Nashville/Davidson County so can waste reduction, diversion and recycling as we move towards Zero Waste.

The idea behind establishing an Authority is to treat the delivery of solid waste management services as a utility similar to the water, wastewater and stormwater provided by Metro Water Services. The Authority would serve as the lead entity responsible for implementation of the Plan including policies, programs, services and funding. The Authority's jurisdictional boundaries would initially be the entire Davidson County area with the potential to expand into a regional Authority, if determined to be beneficial to Metro and the other regional communities. Establishment of an Authority provides the opportunity to create all-inclusive programs, goals, service levels, and metrics without the concerns and discussions around the limitations associated with crossing the GSD and USD boundaries.

L.3.1 Authority Structure

The Solid Waste Authority Act of 1991 (2010 Tennessee Code Title 68, Chapter 211) allows counties in a "municipal solid waste region" to create and participate in a solid waste authority that has been established by resolution of the county governing body. The organizational structure requirements and rights for a solid waste authority consists of the following components:

- Establishment of a board of directors with at least 1 member from each representative jurisdiction.
- Participants in the authority can be added or deleted by amendment of resolution.
- Authority has legal rights and powers as a "Public Instrument" of the county(s).

Metro Legal Department (Legal) has conducted a preliminary review of any legal issues associated with Metro's participation in a solid waste authority. Legal's initial assessment based on our conversations is that there are no legal issues that prohibit the creation or participation of Metro government within an authority. Legal also indicated that the Metropolitan Sports Authority could serve as an example regarding the process for establishing an authority. The Authority will need to enter an intergovernmental agreement with Metro regarding the delivery

of solid waste management services and allocation of existing assets and funding sources. The participation of satellite cities (Belle Meade, Oak Hill, Berry Hill, and Forest Hills) will need to be evaluated further, and may need to be initially exempted from the Authority.

L.3.2 Key Powers of an Authority

In accordance with the Solid Waste Authority Act of 1991, Section 68-211-906, a solid waste authority has certain powers as a “public instrument” of the county and municipalities participating in the authority. Several of the key powers that will be beneficial in implementing the Plan are:

- Ability to control collection of solid waste for disposal or processing.
- Establish constant delivery of solid waste services and contracting across USD and GSD.
- Develop projects within the Authority jurisdiction boundaries.
- Acquire property.
- Operate, maintain, and manage projects either by self-performing or entering into contracts with private vendors.
- Issue debt to finance projects.
- Enter into negotiated contracts or agreements with local governments, the State of Tennessee, or “any person”.

The powers identified above are all critical to the successful implementation of the Plan and the goal of achieving 90%+ diversion. However, one overarching power that provides the foundation for the Authority is the authorization to impose and collect a solid waste disposal fee. Tennessee Code Ann. § 68-211-835(g)(1) (1996) indicates that “funds generated from such fees may only be used to establish and maintain solid waste collection and disposal services; including, but not limited to, convenience centers.” The ability to establish fees sufficient to cover the cost of providing the programs and services under the Authority is paramount to establishing a long-term, sustainable source of funding that is separate from the General Fund.

L.3.3 Regional Authority

The Authority structure can be expanded to include regional communities that establish and approve their participation by resolution. Discussions regarding the potential expansion of the Authority into a regional authority did not pose any concerns with Legal during their initial evaluation. One of the convincing arguments toward establishing a regional authority is the ability to share resources to eliminate duplication and provide maximum utilization of funds and resources. The Authority’s regional board can be a mechanism to bridge any resource gaps among their local governments since they represent the entire region and can provide a

consistent vision across the region. Solid waste regions that exercise resource sharing have benefited economically by not duplicating resources.¹

An additional benefit is that regional solid waste planning at the Authority level can be done from a materials management approach leveraging the integrated solid waste management systems of the region. The long-term goal is to remove as much material from the waste stream as possible to lengthen the life spans of landfills and to leverage more sustainable methods of using the material collected.² The long-term plan is also to remove potential toxic materials by diverting them to other programs. If effective, the region can have more of its “waste” diverted from landfills through a systems approach that includes reduction, reuse, composting and recycling.³

When solid waste planning is done from a regional level, the region will benefit from economies of scale. More cost efficient and service attractive contracts may be obtained due to the combined, larger population of a region. The increased knowledge base of a varied solid waste planning board helps to solve problems in favor of the solid waste planning region.⁴

Regional solid waste authorities are not unknown entities within Tennessee. The Interlocal Solid Waste Authority, which was established in 1991, is comprised of Franklin, Bedford, Lincoln, and Moore Counties; and the City of Tullahoma. Each community adopted a resolution to participate in the authority and the provision of services associated with the transportation and disposal of solid waste. A second regional authority is the Bi-County Solid Waste Management authority which was formed in 1974 between Montgomery and Stewart Counties. The Bi-County authority operates one Class I and two Class III landfills along with a system of convenience centers. Recently, Rutherford County has been discussing options for how they will manage solid waste once the Middlepoint Landfill closes. One of the recommendations under consideration is the creation of a solid waste authority to guide the planning, management, and implementation of future programs that address waste reduction, reuse, recycling and disposal.

L.4 Implementation of Household and License Fees

The Department accounts for the activities related to the management of solid waste as special revenue and special purpose funds. Currently, the special revenue fund is not generating enough revenues to cover all expenses; therefore, significant financial contributions are required from the General Fund. The Department was previously self-sustaining when Metro owned revenue-producing disposal facilities; such as the old Bordeaux Landfill which closed in 1996 and the Nashville Thermal Transfer Corporation (NTTC) which ceased waste-burning operations in 2002.

Without a dedicated source of program revenues, the Department has been heavily dependent on General Funds to meet operating budgets. Based on fiscal year 2018 budget revenues, the solid waste program revenues account for approximately 22% of operating revenues while the General Fund transfers account for 78% of the operating revenues. The level of General Fund support is

¹ Bob Gedert email discussion on regional authorities, March 13, 2018

² Bob Gedert email discussion on regional authorities, March 13, 2018

³ Bob Gedert email discussion on regional authorities, March 13, 2018

⁴ Bob Gedert email discussion on regional authorities, March 13, 2018

subject to the annual budget process and yearly fluctuations due to the programmatic needs of other critical departments such as schools, police, fire, and transportation.

Most program revenues are provided by waste generating fees such as the disposal charges of \$6/ton for municipal solid waste (MSW) and \$1/CY for construction and demolition (C&D) waste. The MSW fee has not been raised for decades, and the C&D fee was recently raised from \$0.50 to \$1. Since the revenues are under the Special Revenue Fund, their use is limited to brush collection, dead animal collection, and convenience centers which are services available to all residents. State guidelines for the use of existing and new fees charged under a Special Revenue Fund require that the services provided must benefit the entire fee base.

The Department's existing revenue structure is not considered a long-term sustainable source of funding to support the implementation and continuation of the myriad of programs aimed at reaching 90%+ waste diversion. In addition to the funding instability, the Department also faces the challenge of providing solid waste services to customers who are not fully aware of the true costs to provide those services. Under the current Charter requirements, waste collection and disposal costs for the USD are embedded in the property tax bill so no direct connection exists between service level and cost of service. The ability to raise revenues through household and license fees is a key foundational policy that will be the cornerstone that allows the continuity and momentum of the Plan to be maintained well into the future.

Implementation of the myriad strategies described in Appendix F and G of this Plan will require the Department to implement household and hauler license fees that generate adequate revenues which can be utilized to support all programs. The key to supporting all programs is the ability to utilize funds generated through the collection of fees across the entire county jurisdiction. This flexibility is often found in solid waste operations that are established as enterprise funds.

Enterprise Funds

In lieu of providing solid waste services under the overall umbrella of the general fund, many cities and counties operate their solid waste operations as a separate enterprise fund. Across the country, the aggregate number of service/utility enterprise funds has increased; with the largest increases occurring in the solid waste and stormwater sectors. One of the reasons for shifts to enterprise fund accounting was that user fees and charges established in enterprise funds promoted efficiency by equitably shifting payment of costs to specific users of services based on the types and levels of services received while avoid the needs for an increased general taxation.

An enterprise fund would provide the Department the flexibility to account separately for all financial activities associated with the full range of solid waste services provided throughout both the USD and GSD by Metro.

Solid waste enterprise funds establish a separate accounting and financial reporting mechanism for solid waste services provided for which a fee is charged to the users in exchange for the services. Under an enterprise fund, solid waste service revenues and expenses would be segregated into a fund with financial statements separate from all other city governmental activities. It allows Metro to demonstrate to the public the portion of total costs of solid waste service that is recovered from user charges and any portion that is subsidized by the general fund

(taxes), if necessary. With an enterprise fund, all costs of service delivery: direct, indirect and capital costs are fully identified in public financial documents.

L.5 Bans for Organics and Targeted Recyclable Materials

The use of material disposal bans is an effective, low-cost tool that is commonly used to target specific materials for diversion from landfills. Metro has implemented bans on yard waste, corrugated cardboard and corrugated cardboard boxes and electronic wastes previously. The waste and recycling characterization study (Appendix C of this Plan) conducted as a part of developing this Plan offers insightful information on identifying valuable recyclable materials and current banned materials that are being placed in the residential and commercial waste streams.

Organics (including food scraps), paper and plastics are the top three categories of materials found in landfilled waste from the residential and commercial sectors. A third of residential waste is comprised of organics (i.e. compostable material), while a third of commercial waste is food scraps, cardboard and C&D. This Metro-specific data, along with state data, will help frame the development of new ordinances and policies that target organics (particularly food scraps) and other recyclable materials.

Expanding the types of material banned from landfill disposal is an important step in starting the cultural and behavioral changes required for Metro to push towards zero waste. However, bans without effective and continual enforcement of the bans will reduce the overall effectiveness of the strategy. The Charter allows Metro to enforce policies and bans; however, currently the Department only has one inspector with the ability to write citations, which are limited to a maximum \$50 fine. One of the recommendations outlined in the Plan is to significantly increase Department staff levels to allow for adequate enforcement of current and future material bans and programs.

Enforcement must be taken as seriously as development of policy, implementation of programs and sustainable funding. Material disposal bans with effective enforcement provide incentive for public and private investment in infrastructure and processing facilities because the marketplace is essentially guaranteed a “feedstock” for the facilities. For example, bans on organic materials will drive the development of food recovery systems, compost facilities, and anaerobic digestion plants to manage the availability of these materials.

L.6 Franchising

Solid waste collection franchising can be defined as: “The right or license granted to one or more companies or organizations to provide waste collection services to specified waste generators – such as residences or businesses - in a defined geographic area.” There are three types of waste collection franchises:

- Exclusive franchises
- Semi-exclusive franchises
- Non-exclusive franchises

In an exclusive franchise, the right to provide waste collection services to a specified type of generator in a designated area is granted to a single company or organization. For semi-exclusive franchises, the collection service area is divided into a small number of districts with the right to service accounts in a given district granted to a single entity. In a non-exclusive franchise, the right to provide services in a franchise district is granted to more than one company or organization. A non-exclusive solid waste collection franchise approach is similar to the free market approach, except that levels of service and fees are defined in the franchise license agreement. The establishment of a franchise system throughout Davidson County wouldn't preclude the Department from competing to deliver services for specific residential or commercial/downtown "districts". This approach is often referred to as managed competition.

Significant cost reductions and efficiency improvements are typically achieved when a community converts from a free market solid waste collection approach to solid waste collection provided through an exclusive franchise. In the U.S., the majority of incorporated areas are provided with residential waste collection services through one or more exclusive franchise agreements.

The Metro GSD area is currently provided with residential waste collection services through subscription services. By dividing up the GSD, and potentially the USD, into a small number of exclusive franchise service areas, it is possible that three curbside collection services - residential waste, every-other week recycling, and organics collection - could be provided for a similar or reasonable price compared to what residents are paying for weekly waste collection service alone. The provision of a regularly scheduled curbside collection services for recyclables and organics to the residents in the GSD and USD areas will significantly increase the quantities of these materials that are diverted from landfill disposal due to the increase in the convenience associated with participating in these programs.

Benefits

- Increase in waste collection customer service levels.
- Significant increase in customer convenience regarding participation in recycling and organics diversion.
- Utilization of a mechanism to implement or enforce other waste programs (e.g. recycling, waste bans, SAYT).
- Potential reduced service costs.
- Reduced vehicular emissions.
- Reduced traffic and "wear and tear" on roads.
- Establishment of uniform levels of services (including recyclables and organics collection services).
- Establishment of numerical tracking of material flows to measure progress toward diversion goals.

- Provides a means through which a local government can exercise control over the collected waste.

Drawbacks

- Reduced market share for some haulers (could especially hurt small haulers).
- Possible reduction in number of waste collection service choices.
- Transition from a non-exclusive franchise approach can be contentious.

L.7 Develop Environment Private Sector Investment and Partnerships

One of the critical steps associated with comprehensive waste diversion strategies is to identify and understand the secondary materials markets that exist for the materials that will be recycled, composted, or otherwise diverted from landfills. As a rule, the secondary materials markets follow the fluctuations of their corresponding primary materials markets with respect to demand and pricing. These fluctuations are created by changes in the global, national, regional and local manufacturing conditions which, in turn, are influenced by a variety of factors that determine the demand for the manufactured products. The recent recycling market impacts associated with China's material restrictions or the recently imposed tariffs are examples of the importance of local end use markets that can provide some buffer against abrupt changes in global market conditions

Partnerships with the private sector should become an important part of the conversation regarding the future of solid waste management. From a policy perspective, Metro should establish policies, guidelines, or ordinances that encourage the development of local recycling, composting, and material reuse markets. Local and regional private partnerships can be useful because of the potential benefits associated with greater coordination; an increase in efficiency and cost-effectiveness; and a shared commitment towards increasing waste diversion and maximizing the value of resources currently being landfilled.

Appendix G of the Plan discusses several strategies for expanding waste diversion from 75% to greater than 90%. Several of the strategies are developed around the idea of increased cooperation and support of the private sector. Several of the key strategies are the use of local economic development tools for support of Zero Waste diversion goals; support of local zero waste businesses; support of the Tennessee Materials Marketplace; and development and support of an eco-industrial park. In support of these recommended strategies, the Metro Chamber of Commerce should create business "focus groups" to help support the Plan's implementation efforts towards recruitment of end-use companies for recycled or reclaimed products.