



Report to the City of Boston

Tasks 2 and 3:

Current And Projected Materials Generation And Diversion
Disposal And Diversion Practices
Zero Waste-Related Programs, Policies, And Facilities
Current And Projected Markets Status For Key Commodities
Analysis Of The Quantity And Composition Of Discarded Materials
Analysis Of Potential Commodity Revenue

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Perlmutter Associates

with

Zero Waste Associates

and

The Center for EcoTechnology

Table of Contents

| | |
|---|-----------|
| I. Executive Summary | 1 |
| II. Introduction | 2 |
| III. Definition of Zero Waste | 3 |
| III. Current and Projected Materials Generation, Disposal, and Diversion | 3 |
| A. Materials Data Issues | 3 |
| A. Residential | 4 |
| B. Institutional, Commercial, Industrial | 5 |
| C. Total Materials Generation, Disposal, and Diversion | 7 |
| III. Boston Policies, Programs, Facilities | 8 |
| A. Overview | 8 |
| 1. Residential and City Government Recycling..... | 9 |
| 2. Commercial Trash Hauler Ordinance | 10 |
| 3. Organics | 10 |
| 4. Bag Ban | 10 |
| 5. Education | 10 |
| 6. Trash | 10 |
| 7. Enforcement..... | 11 |
| IV. State Policies and Programs | 11 |
| A. Waste Bans | 11 |
| B. Programs | 11 |
| V. Existing and Projected Population and Business growth | 13 |
| VI. Facilities Serving Boston | 14 |
| A. Materials Recovery Facilities | 14 |
| 1. Description | 14 |
| 2. Issues Raised..... | 14 |
| B. Food Rescue and Donation Services | 15 |
| 1. Description | 15 |
| 2. Issues Raised..... | 15 |
| C. Reuse and Repair Facilities | 16 |
| 1. Description | 16 |
| 2. Issues Raised..... | 17 |
| D. Construction, Demolition and Deconstruction Recycling Facilities | 17 |
| 1. Description | 17 |
| 2. Issues Raised..... | 18 |
| E. Composting Facilities | 18 |
| 1. Description | 18 |
| 2. Issues Raised..... | 19 |
| F. Anaerobic Digesters and Food Scrap Processing Facilities | 19 |
| 1. Description | 19 |
| 2. Issues Raised..... | 20 |
| G. Facilities and Services for Special Materials | 20 |
| 1. Description | 20 |
| 2. Issues Raised..... | 21 |
| VII. International and Local Commodity Markets Impacting Boston | 21 |

| | |
|---|-----------|
| Appendix A- Boston Zero Waste Guiding Principles | 24 |
| Appendix B, Boston NAICs Codes, Employees and Wages..... | 26 |

I. Executive Summary

The City of Boston's Climate Action Plan update of 2014¹ called for the City to implement a Zero Waste planning process. Following that, the City, in partnership with the Zero Waste Boston Coalition (formerly Boston Recycling Coalition), held a Zero Waste Summit and follow-up meetings in 2016 that led to the adoption of four guiding principles for Zero Waste. These are to:

1. Make Zero Waste a key priority.
2. Focus first on using less and diverting more.
3. Support this work through local business.
4. Sustain this work through culture change.

In 2018, Mayor Walsh named a Zero Waste Advisory Committee to give him Zero Waste recommendations. The team of Perlmutter Associates, along with Zero Waste Associates and the Center for EcoTechnology was chosen to support the Advisory Committee.

This report fulfills Task 2 and part of Task 3 in the team's scope of work:

1. Gather and Analyze Solid Waste Data and Information on Existing Policies and Programs
2. Conduct Waste Reduction and Diversion Opportunity Assessments for Residential and Institutional, Commercial and Industrial (ICI) Sectors

The City of Boston recognizes the internationally accepted definition of Zero Waste that has been developed by the Zero Waste International Alliance²: The definition, in short, is: no burn, no bury, no toxic emissions.

Boston's residential sector generated 240,283 tons of materials (recycled + disposed) in FY 2017; the recycling rate was 21%. Seventy-seven percent of Boston's disposed trash is recyclable or potentially recyclable. Its Institutional, Commercial, and Industrial (ICI) sectors generated 915,732 tons of materials in FY 2017, with a recycling rate of 25%. Eighty-one percent of Boston's ICI waste is recyclable, compostable, and potentially recyclable. The majority of ICI trash is generated in the Professional, Technical, & Financial sector.

The City has a number of trash and waste reduction-related policies, programs, and services that cover residential as well as ICI sectors. The City's Waste Reduction Division of the Public Works Department (PWD) is responsible for the implementation of contracts for the collection, disposal and processing of residential recyclables, trash (disposed materials), and leaf and yard trimmings, and for implementation of the City's Commercial Trash Hauler and other related ordinances.

The City is divided into five collection districts. Haulers bid— through an Invitation for Bids issued every five years—to provide residential curbside recycling and trash collection services to one or more of these districts. Currently, two companies hold the contracts: Capitol Waste collects in four of the five districts, serving nearly 80% of the housing units in the City, and Sunrise Scavenger collects in the remaining district. Casella holds the contract for processing of residential recyclables, and most of the remaining residential trash goes to the Covanta waste-to-energy facility in Saugus. The City's current residential trash and recycling contracts expire in June 30, 2019.

The City contracts with a private vendor, City Soil, for operation of a facility to compost leaf and yard trimmings.

All costs associated with residential trash collection and curbside recycling (including leaf and yard trimmings collection and composting) are paid for primarily by the General Fund, from tax revenue.

¹ <https://www.boston.gov/departments/environment/climate-action-plan>

² Source: www.zwia.org/standards

ICI materials are collected by haulers who receive operating permits under the City's Commercial Trash Hauler Ordinance from the Public Works Department. These haulers charge customers directly for the services provided.

The Commonwealth bans certain recyclable materials, supports ICI Zero Waste technical assistance programs that have helped Boston businesses, and has various grant and incentive programs, through the Department of Environmental Protection, which could support Boston's waste reduction programs.

Boston has a large number of facilities that manage its recycling, reuse, organics, and special materials. These include materials recovery facilities (MRFs); food rescue and donation; reuse and repair facilities; construction, demolition, and deconstruction recycling facilities; and composting facilities. Some of the issues raised during a series of interviews with facility operators include:

- Contamination of recyclables is a bigger problem than ever due to new material specifications from China, a primary end market; education and enforcement is needed.
- There is a shortage of workers, especially drivers and manual labor; workforce development is needed.
- More edible food could be rescued from restaurants and institutions; assistance and education is needed from City health inspectors.
- Existing businesses diverting usable materials (building materials, clothing, etc) from the disposal have the capacity to divert more; more awareness is needed among businesses and residents about these opportunities to waste less while supporting local businesses and not-for-profit organizations.
- Waste reduction companies are operating on small footprints; City assistance would be helpful in safeguarding existing space and obtaining additional space.

Prices and the value of secondary materials rise and fall with demand. In 2018, market lows are higher than the highs of 20 years ago. Currently, the market demand from China and increasingly more countries have called for better sorting of the feedstock. Some materials, such as mixed paper, are not accepted in China and are more expensive to ship to other countries.

II. Introduction

The City of Boston's Climate Action Plan update of 2014³ called for the City to implement a Zero Waste planning process. Following that, the City, in partnership with the Zero Waste Boston Coalition (formerly Boston Recycling Coalition) held a Zero Waste Summit and follow-up meetings in 2016 that led to the adoption of four guiding principles for Zero Waste. These are to:

- Make Zero Waste a key priority.
- Focus first on using less and diverting more.
- Support this work through local business.
- Sustain this work through culture change.

The full text of the Guiding Principles is in Appendix A.

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³ <https://www.boston.gov/departments/environment/climate-action-plan>

This report reflects an understanding of the City's:

- current and projected materials generation, diversion, and disposal from all sectors (residential, institutional, commercial, and industrial),
- disposal and diversion practices,
- waste reduction-related programs, policies, and facilities, and
- current and projected markets status for key commodities.

It also provides:

- an analysis of the quantity and composition of discarded materials,
- an analysis of potential commodity revenue.

This information will enable the City, its Zero Waste Advisory Committee, and consultants to identify Zero Waste services and opportunity gaps and recommend ways to fill them.

III. Definition of Zero Waste

The City of Boston recognizes the definition of Zero Waste developed by the Zero Waste International Alliance⁴:

“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.”

In short: no burn, no bury, no toxic emissions.

III. Current and Projected Materials Generation, Disposal, and Diversion

A. Materials Data Issues

Data on materials generation, disposal, diversion and composition in Massachusetts is not perfect. Contracted haulers of the City's residential trash and recycling are required to report the tonnage of materials they collect. However, the City does not get reports from its recycling processor about contamination out-throws, so recycling figures show only the tons collected at the curb, not actually recycled, while disposal figures do not reflect the out-throws. Many large apartment buildings subscribe to additional private collection services and these tonnages are not typically reported by the permitted haulers. The Commonwealth requires composition studies of materials disposed at the permitted disposal facilities in the state, but these studies do not differentiate materials by municipality or business sector, nor do these facilities accept all kinds of trash, such as construction materials or that from some types of industrial businesses. Haulers of ICI materials in Boston must obtain a permit to collect materials under the City's Commercial Trash Ordinance and report tonnages of materials disposed and recycled under their permit requirements. However, the Ordinance only covers haulers that collect materials from buildings that use roll off containers or compactors. Haulers collecting from businesses using wheeled carts do not report tonnages, and there is no requirement for independent recyclers that do not collect trash to report tons recycled.

⁴ Source: www.zwia.org/standards

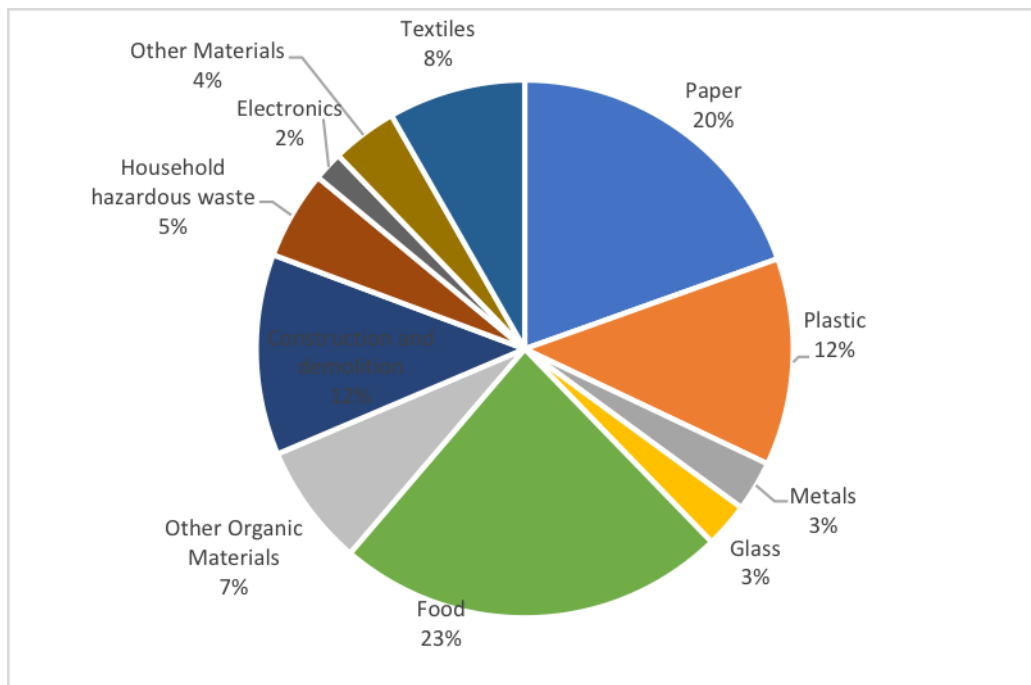
Finally, the City collects some materials from government buildings under its residential collection contracts, but that tonnage is not broken out separately and is included in the residential figures, below. The City estimates that government operations account for about one percent of all materials generated, and three-quarters of that is from public schools.

A. Residential

In the residential sector, the most recent data from FY2017 show that 189,809 tons of materials were disposed and 50,474 tons were collected for recycling from residents,⁵ for a total of 240,283 tons of materials generated and a 21% residential recycling rate. An estimate of the composition of the materials that are disposed, based on the state composition studies, can be found in Figure 1. Figure 2 shows the percentage of the disposed materials that are potentially recyclable. Seventy-seven percent of Boston’s disposed residential trash is recyclable, compostable, or potentially recyclable. Examples of “potentially recyclable” materials include expanded polystyrene and plastic bags. These materials are technically recyclable, but not targeted for collection.

According to City records, materials disposed by the residential sector (from both single-family residences and multi-family residences) decreased by 14% from 2008 to 2015, this decrease follows a trend throughout the state.

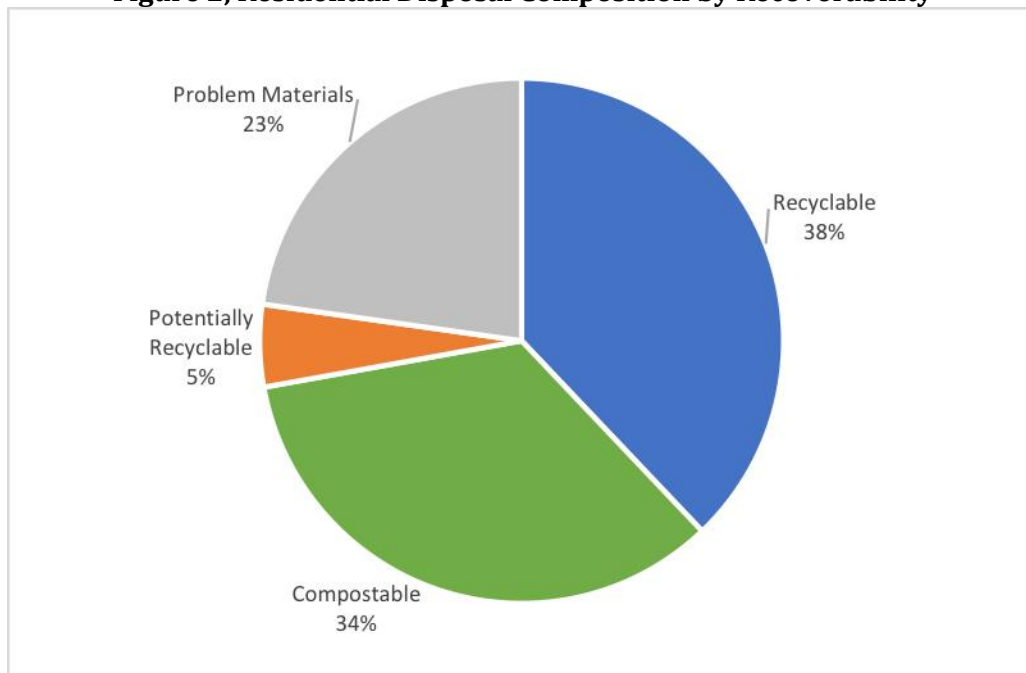
Figure 1, Residential Disposal Composition by Material Category⁶



⁵ Source: FY17 actual tonnages and tip fee by district

⁶ Source: 2016 Waste Characterization Study in Support of Class II Recycling Program (Saugus, SEMASS, Havervill)

Figure 2, Residential Disposal Composition by Recoverability



B. Institutional, Commercial, Industrial

Massachusetts' overall disposal was approximately 5.5 million tons in 2015⁷. Of this, approximately, 3.7 million was attributable to the ICI sector. Since Boston's ICI sector is about 18% of total employment statewide,⁸ it is estimated that Boston's ICI sector is responsible for 18% of the total ICI tons disposed statewide. This comes out to approximately 683,891 tons in 2015.

To yield an estimate of ICI recycling, a tons-per-employee per year methodology⁹ was applied to the Boston NAICS (North American Industry Classification) codes by number of employees (see Appendix B). This yields 231,841 tons recycled. Adding the two numbers together provides an annual total generation of discarded materials of 915,732 and a 25% recycling rate.

Figures 3 and 4 estimate the composition of disposed materials from the commercial sector (based on statewide composition studies) and the potentially recoverable materials that are currently disposed (based on what is currently marketable or potentially marketable in the region). Eighty-one percent of Boston's commercial trash is recyclable, compostable, or potentially recyclable (such as expanded polystyrene or plastic bags).¹⁰

⁷ Source: Massachusetts Department of Environmental Protection, 2015 Solid Waste Data Update, includes commercial disposal, construction and demolition disposal and non-municipal solid waste disposal.
<http://www.mass.gov/eea/docs/dep/recycle/priorities/15swdata.pdf>

⁸ Source: Massachusetts Executive Office of Labor and Workforce Development, Employment and Wages Report (ES-202)
http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION

⁹ <http://www.calrecycle.ca.gov/Publications/Documents/1543/20151543.pdf>
<https://www2.calrecycle.ca.gov/WasteCharacterization/BusinessGroupCalculator>

¹⁰ Totals may not sum due to rounding.

Figure 3, Commercial Disposal Composition by Material Category¹¹

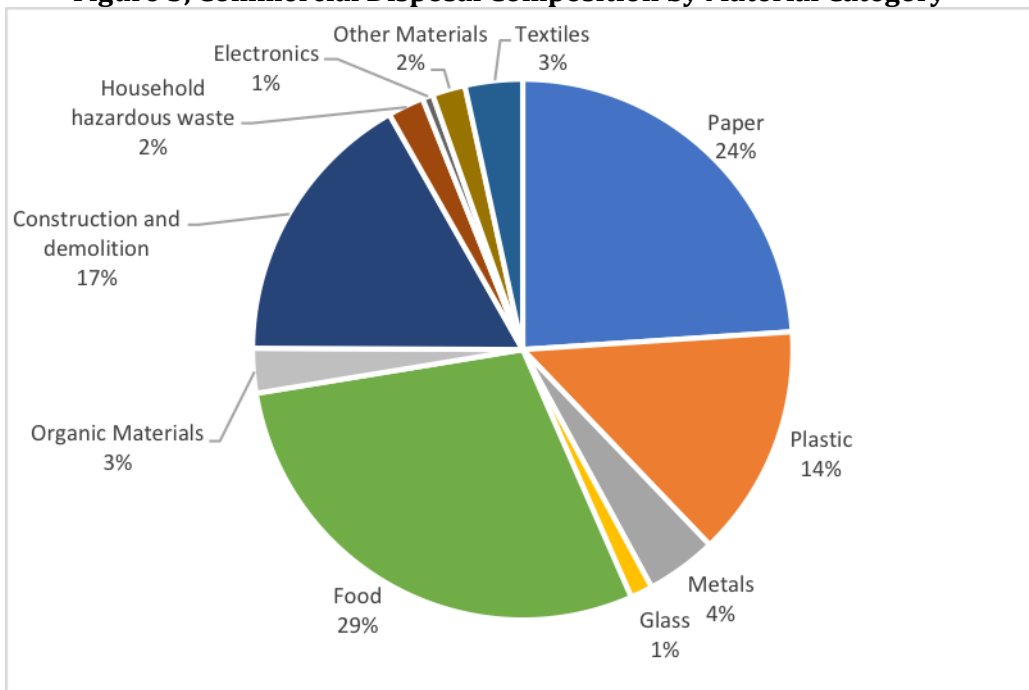
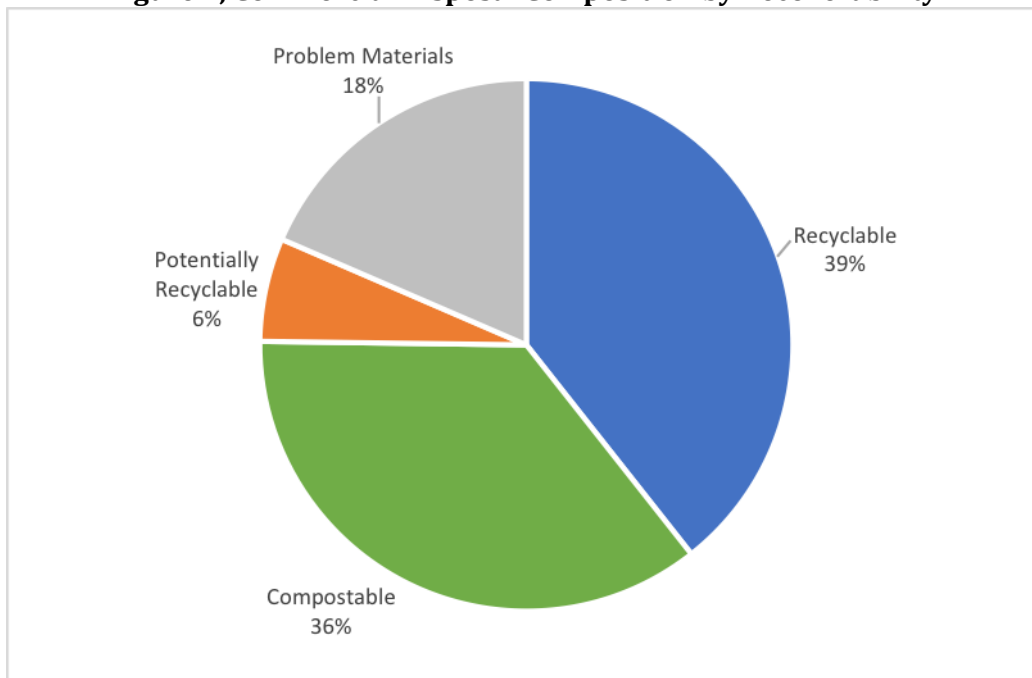


Figure 4, Commercial Disposal Composition by Recoverability

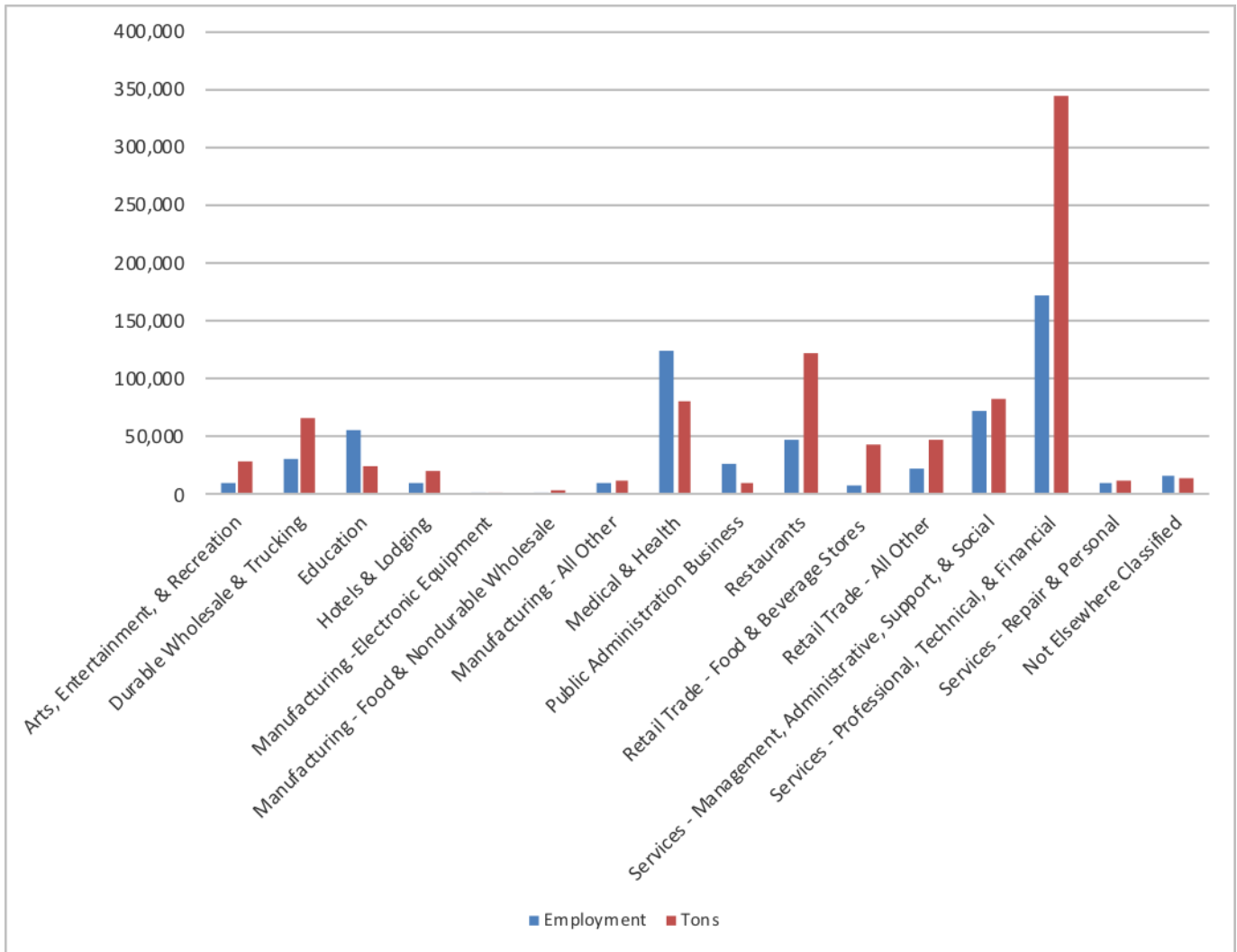


The following chart uses national statistics for tons of material generated (including both disposed and diverted materials) per employee per year and projects generation by sector for Boston based on Boston's employment figures (see Appendix B).¹² The majority of Boston's trash is generated in the Professional, Technical, & Financial sector.

¹¹ Source: 2016 Waste Characterization Study in Support of Class II Recycling Program (Saugus, SEMASS, Haverhill)

¹² Source: 2014 California Commercial Generator Waste Study, page 10 TPEPY
<http://www.calrecycle.ca.gov/Publications/Documents/1543/20151543.pdf>

Figure 5, Boston's Estimated Commercial Generation by Employment



C. Total Materials Generation, Disposal, and Diversion

The total estimated annual generation (diversion plus disposal) of discarded materials by the residential and ICI sectors in Boston is 1,156,015 tons. The total material diverted from disposal (through recycling and composting) is 24%, or 282,315 tons, while 76% is disposed at permitted solid waste facilities. Twenty-one percent of the total is from the residential sector and 79% ICI.

Table 1, Boston Disposal, Diversion and Generation Tonnage Estimates, 2017

| Sector | Disposal | Diversion | Generation |
|--------------|----------------------|----------------------|----------------------|
| Residential | 189,809 | 50,474 | 240,283 ¹ |
| ICI | 683,891 ² | 231,841 ³ | 915,732 |
| Total | 873,700 | 282,315 | 1,156,015 |

¹City Hauler Data

²Boston's Portion of Statewide Data

³Based on Tons Per Employee Per Year

The City of Boston population in 2017 was 673,000 and is projected to increase to 724,000 by 2030 and 800,000 by 2050¹³. There are 273,000 households¹⁴ and 27,000 businesses¹⁵ in Boston. Current estimated disposal per person is 9.4 pounds per day or 1.7 tons per year.

III. Boston Policies, Programs, Facilities

A. Overview

The City has a number of trash and waste reduction policies, programs, and services that cover residential as well as ICI sectors.

The City's Waste Reduction Division of the Public Works Department (PWD) is responsible for the implementation of separate contracts for:

- collection of residential recyclables and trash
- disposal of trash
- processing of residential recyclables
- composting of leaf and yard trimmings
- four household hazardous waste (HHW) collection days/year

as well as for implementation of the City's Commercial Trash Hauler and other related ordinances.

The City is divided into five collection districts and haulers can bid— through an Invitation for Bids issued every five years—to provide residential curbside recycling and trash collection services to one or more of these districts. Currently, two companies hold the bids: Capitol Waste collects in four of the five districts, serving nearly 80% of the housing units in the City, and Sunrise Scavenger collects in the remaining district. The City awards separate bids for residential trash disposal and for processing of curbside recyclables. The selected recycling and trash collectors are required to bring materials to these designated facilities. Current contracts expire in June 2019. The collection services are:

- *Trash*, which includes unlimited quantities of discarded materials, except for certain prohibited items (service is provided weekly except for on Beacon Hill and downtown, where it is provided 2 times per week, and in the Back Bay where it is offered twice per week).
- *Single stream recycling* (provided weekly everywhere in the City on the same day as trash collection);
- *Cathode Ray Tubes (CRT)* including proper end-of-life management (offered any week on the same day as trash collection by pre-arrangement).
- *Freon-containing appliances*, including proper end-of-life management (same arrangement as for CRTs) and includes the proper management of appliances collected.
- *Leaf and yard trimmings* (previously provided in the spring and fall, but expanded in 2018 to 18 weeks, spring through fall).
- *Bulky items*, except for construction and demolition debris, bricks, automotive components, dirt, rocks, stones, fences, oil drums, plumbing fixtures, and tires.
- *Christmas trees*, (provided for two weeks after Christmas).

Casella holds the contract for processing of all of the City's residential recyclables. Casella charges a fee of \$70/ton, which covers the cost of processing. Any revenue received from the sale of recyclables over this amount is split between the City and Casella, 40% and 60% respectively. This market share is calculated against the processing fee to determine the price the City pays to Casella or that Casella pays to the City, depending on market prices. However, the price the City pays Casella cannot go above \$5/ton. These terms will likely change given recent extreme changes in recycling markets.

¹³ Source: Projected Growth in Boston, Imagine Boston 2030, page 21

¹⁴ Source: U.S. Census, July 2016.

¹⁵ Source: Boston industry NAICS: Employment and Wages Report (ES-202), March 2017. See Appendix B

Most residential trash collected in Boston is sent to one of the following waste-to-energy facilities: Wheelabrator Saugus, Covanta SEMASS, or Covanta Haverhill (via the Lynn transfer station).

The costs associated with residential trash collection and curbside recycling (including the composting of leaf and yard trimmings) are primarily paid for by the general fund, from tax revenues. The current cost of the City's residential recycling and trash contracts is about \$40 million/year. This is about 2 percent of the City's operating budget, and comes out to \$57/person and \$148/household.¹⁶ These costs exclude the costs of City employees involved in recycling and trash.

ICI materials are collected by haulers that receive operating permits under the City's Commercial Trash Hauler Ordinance from the Public Works Department. These haulers charge customers directly for the services provided.

There are currently 14 permitted ICI haulers in the City. To receive a permit, haulers must offer recycling services to customers (either directly or through a separate recycling company).

More details of these and other programs are below.

1. Residential and City Government Recycling

The City converted from dual stream (paper and containers collected separately) to single stream recycling in 2009. City contractors collect recycling weekly from all residential buildings (single family through large apartments and public housing), as well as some government departments, including public schools, libraries, and fire houses. The City provides 64-gallon wheeled recycling carts to all buildings of six units or less (58% of units), with one cart/unit for buildings with 3 units or less and shared carts for buildings with 4-6 units. In a few dense neighborhoods where it is difficult to store carts, recyclables are placed by residents in clear plastic bags on the sidewalks for collection. Residents must buy official City bags or use their own clear bags. Larger buildings use their own containers and carts. The City works with the owner or property manager to ensure proper container use and placement both inside and outside of the building.

In 2003, the City enacted an ordinance for residential buildings of over 6 units. This ordinance requires that the owners of residential buildings from which the City collects trash provide an adequate number of recycling carts in a common area, close to trash removal dumpsters. The ordinance offers exemptions for building owners that cannot comply. Building owners are also required to post the City's recycling guide in a visible location and deliver a guide to each resident in the building. The Department of Public Works and the Department of Inspectional Services have the authority to inspect, enforce, and impose penalties relating to the ordinance. The ordinance was initially enforced through the issuance of fines of between \$150-\$300, which was not found to be effective in driving recycling compliance. Now, if big buildings don't recycle properly (e.g., recyclables in the trash or trash in recycling), PWD allows the materials to be left behind. This has improved compliance, although some large buildings (e.g., 200-400 units) put out only a small number of recycling carts to be technically in compliance, while not providing adequate service.

In addition to the services provided in the residential recycling contracts, the City holds household hazardous waste drop-off days four times per year, currently under contract with Clean Harbors. These events accept both hazardous and non-hazardous items, including electronics, textiles, tires, batteries, propane tanks, and oil-based paints. Confidential paper shredding is also provided at the events.

The Code Enforcement Division of Public Works can tag waste that has been put out improperly. Once this has happened, it is up to the generator to arrange for private disposal. The City has 14 code enforcement inspectors.

¹⁶ source: City of Boston

Where there are both residential and commercial customers in a building, the property manager must show that the building is paying residential taxes to receive City residential trash and recycling services. If the City finds that there is contamination to the residential containers from commercial accounts, it can stop providing these services.

Since FY2008, when the City launched its “Recycle More, Trash Less” campaign, Boston residents have increased their recycling rate from 12 percent to 21 percent in FY2016. Over 29,700 tons of materials were recycled in 2016. During this same time, there has been a decrease in the density of the materials collected due to the “evolving ton:” fewer newspapers are being read and recycled and many packages have migrated from metals and glass to plastics, which are lighter weight.

2. Commercial Trash Hauler Ordinance

Boston’s 2008 Commercial Trash Hauler Ordinance requires that all commercial haulers, as a precondition to receiving a permit to collect trash in the City, offer recycling services to their customers. Customers can opt to not use the service or to recycle with a different company. Under the ordinance, haulers must also provide their customers with educational materials detailing the services. The ordinance also requires haulers to provide the Commissioner of Public Works with an annual report for the previous year that lists the total number of commercial customers, the number and percentage of commercial customers that utilize the hauler’s recycling service, the total tonnage of materials collected, and a description of the recycling education materials the hauler uses. Failure to comply can result in a fine of \$150 for the first violation and \$300 for the second violation, and revocation of the hauler’s permit on a third violation. The ordinance only covers haulers that provide service using large containers, such as dumpsters, 1-5 cubic yard containers, and compactors—not wheeled carts, which are used by smaller generators.

3. Organics

Yard trimmings and leaves are collected from residents for 18 weeks in late April through early December. A total of 9,200 tons of yard trimmings and leaves were collected in FY2015. A special collection for Christmas trees is also offered after the holidays. The material is delivered to the City’s contracted organics processor, City Soil. The City, through the Department of Public Works, issues an Invitation for Bids for a contractor to run a compost operation on American Legion Highway for yard trimmings and leaves. In 2017, residents could also take their Halloween pumpkins to the site for a Pumpkin Smash. The contractor is required to deliver some of the finished compost to community gardens. It can sell remaining compost to private customers.

The City runs Project Oscar, a program where bins are placed in public locations in six neighborhoods of the City and the City contracts for maintaining the sites. Some of Boston’s residential food scraps go to the MWRA through in-sink garbage disposers, where the solids are incorporated into fertilizer. The City sponsored a pilot program to increase the amount of food scraps handled in this way.

The City also subsidizes the sale of backyard compost bins by the non-profit Boston Building Resources.

4. Bag Ban

In late 2017, the Boston City Council passed a ban on lightweight plastic bags given out at retail establishments and required retailers to charge a fee for the use of paper bags and thicker plastic bags. Retailers can keep the money from the fees. This policy has not yet been implemented.

5. Education

The City has a Trash Day app with information about recycling and trash collection in Boston. The City also has several places on its web site where residents can get information about where and how to recycle—Zero Waste Boston, Greenovate, and PWD. Greenovate also has a blog about Zero Waste.

6. Trash

Each residential collection contractor collects trash in bags, barrels or 6 cubic yard (cy) containers. About 13% of the trash is collected from 6 cy containers provided by large building owners and approved by the City prior to use. Trash is collected weekly in most areas of the City but is collected two times per week in

some of the densest and oldest City neighborhoods where there is limited space for trash storage inside and outside. Building owners or property managers may contract privately for additional collection. Roughly 5-10% of apartment complexes may have supplemental service to meet about 50% of their trash collection needs. It costs the City \$86/ton to dispose of materials.

7. Enforcement

In addition to enforcement of the commercial trash hauling and large residential building ordinances, the Inspectional Services Department has the authority to enforce ordinances relating to litter, illegal dumping, overflowing bins, improper storage of trash, maintaining a dumpster without a permit, and other violations mostly related to trash and litter.

IV. State Policies and Programs

The Massachusetts Department of Environmental Protection (MassDEP) has a number of policies and programs to increase waste diversion in Massachusetts.

A. Waste Bans

The MassDEP bans a number of easy-to-recycle and toxic materials from disposal at landfills and combustion facilities. The earliest bans were put in place in 1990. Other materials have been added to the list over time. The list of [materials currently banned from disposal](#)¹⁷ include:

- Asphalt pavement, brick and concrete
- Cathode ray tubes
- Clean gypsum wallboard
- Commercial food material
- Ferrous and non-ferrous metals
- Glass and metal containers
- Lead acid batteries
- Leaves and yard trimmings
- Recyclable paper, cardboard and paperboard
- Single-resin narrow-necked plastic containers
- Treated and untreated wood and wood scraps (banned from landfills only)
- White goods (large appliances)
- Whole tires (banned from landfills only; shredded tires acceptable)

The ban on disposal of [commercial food material](#), which went into effect in October of 2014, is the most recent addition to this list. This ban requires that any commercial entity that disposes of one ton or more of food scraps per week must divert that material from disposal. Commercial generators can use the [Food Waste Estimation Tool](#) on the RecyclingWorks website to calculate whether they likely are subject to the ban.

Generators, trash haulers, and solid waste facilities are all responsible for complying with waste ban requirements. MassDEP conducts inspections at all solid waste facilities and issues enforcement actions when necessary. Solid waste facilities are also responsible for creating and following their individual waste ban compliance plan which outlines how they will handle failed loads and provide follow up information to haulers and generators.

B. Programs

The MassDEP offers a number of programs and funding opportunities that support waste diversion efforts. The City has received grant funding from the State in the past, when there were different grant programs in place. Those grants helped fund recycling staff in City Hall, the Boston Housing Authority, and the public school. The City has received small target grants from the Sustainable Materials Recovery Program, but not

¹⁷ <https://www.mass.gov/guides/massdep-waste-disposal-bans>

larger grants. It does not qualify for the Recycling Dividends Program because it does not have the minimum required programs in place. However, the City could qualify for funding if it had more Zero Waste programs in place.

- [Sustainable Materials Recovery Program \(SMRP\) Municipal Grants](#) provide funding to cities, regional authorities, and non-profit organizations that provide solid-waste related services to improve local recycling, composting, reuse, and household hazardous waste diversion programs. These grants fund a number of activities, such as purchasing recycling and composting equipment, mattress recycling, initiating a Pay-As-You-Throw program, waste reduction enforcement, school recycling, and organics capacity development. In addition to SMRP Municipal Grants, cities that implement specific waste diversion programs and policies may qualify for payments to cover solid waste and recycling expenses from MassDEP under the [SMRP Recycling Dividends Program](#). Funds for communities who qualify for this program are determined based upon a point system indexed for various waste diversion categories and the number of households served by the municipal program, and range from \$2,100 to \$230,000. Examples of qualifying activities include: a PAYT program, trash limits, organics and yard trimmings pickup, HHW access, hauler regulations, and having a location that handles difficult to manage recycling items.
- [The Green Team](#) is an environmental education program for K-12 schools in Massachusetts. This program is funded by the MassDEP and administered by Center for EcoTechnology (CET). Public, private, and charter schools in Massachusetts are all welcome to participate in this program by filling out an [on-line form](#) to register for the school year. Green Team participants can access a number of free resources to assist with waste diversion efforts at their school: they can [request free recycling and composting equipment](#), access [Slash Trash](#) and [Composting Lesson Plans](#), and receive help over the phone and email with recycling questions. A number of schools in Boston already regularly participate in The Green Team; visit the [Participating Schools](#) page for a full list of registrants for this school year. The Green Team is currently also producing an instructional video on cafeteria source separation that will soon be available on the Green Team website.
- [RecyclingWorks in Massachusetts](#) is a program that helps businesses and institutions maximize recycling, reuse, and food recovery opportunities. This program is funded by the MassDEP and administered by CET. RecyclingWorks offers a number of resources to help institutional, commercial, and industrial entities with waste diversion activities. These include:
 - o A searchable database of haulers and processors of recyclable materials.
 - o A free hotline that businesses can call or email with recycling questions: (888) 254-5525, info@recyclingworksma.com.
 - o Free on-site technical assistance with starting or improving a waste diversion program.
 - o Several Best Management Practices guidance documents that were developed through engagement with stakeholders.
 - o Various other online resources, such as guidance organized by [business sector](#) and by [material](#), video and written case studies, and information on [waste ban compliance](#).

RecyclingWorks organizes regular events on waste diversion topics, such as WasteWise Forums and annual College & University Forums. RecyclingWorks is also available for association events, and has previously presented to groups in the Boston area, such as A Better City, Boston Green Tourism, and the Boston Society of Architects.

RecyclingWorks has worked with many entities in Boston, representing a variety of sectors. Technical assistance with the following Boston entities has been featured in case studies:

- o [Boston Public Market](#)

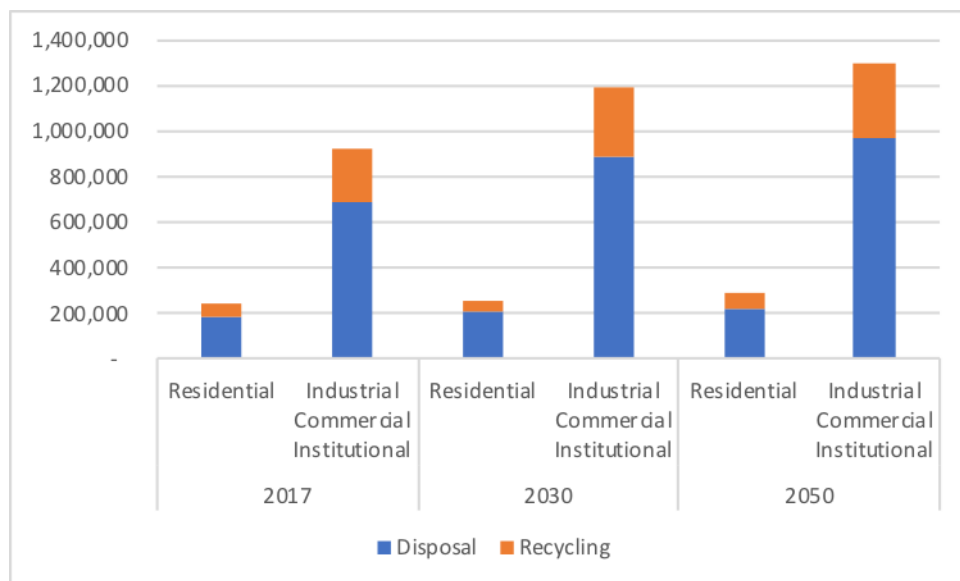
- [Lenox Hotel](#)
 - [Massachusetts College of Art and Design](#)
 - [America's Food Basket Supermarkets](#)
- [Recycling Business Development Grants](#) help Massachusetts recycling processors and manufacturers create sustainable markets for eligible materials. These \$50,000 to \$400,000 grants are awarded once each year by MassDEP and MassDEP updates the list of eligible materials annually. Previous materials have included container glass, contamination in single-stream recycling, contaminated food materials, construction and demolition wood, and post-consumer bulky rigid plastics.
 - [The Boston Foundation](#) and [The Barr Foundation](#) are examples of Boston-based private entities that engage in public-private partnerships addressing needs in the City.

In addition to the many programs listed above, MassDEP offers guidance to help municipalities [Implement Mandatory Recycling & Private Hauler Regulations](#). The Best Practices for [Municipalities Developing Private Hauler Regulations](#), developed MassDEP in 2017, includes templates for ordinance language, a permit application, and reporting forms.

V. Existing and Projected Population and Business growth

Imagine Boston¹⁸ has projected that the population in the City will grow by eight percent by 2030 and another 10 percent by 2050. Commercial activity is expected to grow at a higher rate. Imagine Boston projects that jobs will grow by 30 percent by 2030 and an additional 10 percent by 2050. Applying these growth rates to discarded materials generation shows that the City will need to handle over 285,000 tons of residential materials and nearly 1.3 million tons of commercial materials in 2050.

Figure 6, Boston Generation Projections



¹⁸ Projected Growth in Boston (From Imagine Boston, see p 21) <https://imagine.boston.gov>

VI. Facilities Serving Boston

Descriptions of the different types of facilities handling recyclable and reusable products and materials from Boston is below. The consultants visited a sampling of facilities in each category. Some of the issues raised during a series of interviews with facility operators include:

- Contamination of recyclables is a bigger problem than ever due to new material specifications from China, a primary end market; education and enforcement is needed.
- There is a shortage of workers, especially drivers and manual labor; workforce development is needed.
- More edible food could be rescued from restaurants and institutions; assistance and education is needed from City health inspectors.
- Existing businesses diverting usable materials (building materials, clothing, etc) from the disposal have the capacity to divert more; more awareness is needed among businesses and residents about these opportunities to waste less while supporting local businesses and not-for-profit organizations.

Waste reduction companies are operating on small footprints; City assistance would be helpful in safeguarding existing space and obtaining additional space.

A. Materials Recovery Facilities

1. Description

Recyclables collected from Boston residents are sent to Casella's Materials Recovery Facility (MRF) in Charlestown. This facility processes recyclable materials using an initial negative sort process where contaminants are picked out by hand. The sorting line also uses magnets and eddy currents to sort for metals, an optical sorter for several types of plastics, and various screens for other specific materials such as cardboard (OCC) and glass. The facility collects cartons and aseptic packaging with other mixed paper.

Casella's Charlestown MRF also processes materials from commercial generators. These materials are processed separately from residential materials in a building a few doors away. Some haulers deliver dual stream recyclables (containers separated from paper) to the facility, but they are processed the same way as single stream materials because of the way the equipment is set up. The facility also accepts clean corrugated cardboard.

Recyclables collected from Boston's ICI generators are taken to a number of facilities in the Boston area. The MassDEP maintains a map of all [Materials Recovery Facilities in Massachusetts](#). All MRFs in the Boston area accept single stream material. In addition to Casella's Charlestown facility, facilities taking materials from Boston include:

- E.L Harvey & Sons in Westborough
- GreenWorks in Peabody
- Republic Services in Brockton
- Waste Management in Avon and Billerica

In addition, there are facilities that handle other types of recyclable materials in the region, including specialty papers, film plastics and Styrofoam:

- Save That Stuff in Charlestown
- Conigliaro Industries in Framingham
- CSI Plastics in Millbury
- Capital Paper in Weymouth

2. Issues Raised

- Changes in acceptable contamination rates from China's new National Sword policy are presenting challenges for MRFs. Many facilities are slowing down their sorting lines or running material through

the process twice in order to lower contamination, both lowering their capacity and causing more materials to be discarded.

- Small plastics, like K-cups, are hard to sort and frequently end up mixed with the wrong material, such as glass.
- Some forms of packaging lack a recycling market. For example, orange PET (which is used for some Tide detergent bottles) cannot be mixed with other detergent bottles, which are HDPE, but also cannot be mixed with PET bottles because those markets only want clear or green PET.
- A number of common contaminants in recycling cause major issues when they arrive at MRFs because they become tangled in the sorting machinery. Plastic bags tend to be the most common contaminant but other materials, such as textiles, hoses, and extension cords cause similar issues.
- Workers at MRFs usually are not paid according to municipal living wage standards and if they were, fees for recycling would need to be increased. In addition, because the Casella, the City's contracted MRF operator, handles materials from several communities all with different living wage ordinances, requiring the raising of wages to comply with living wage ordinances will likely need to be dealt with on a regional basis.
- Some MRFs rely on temp workers because they can't find sorters. Workforce development is needed.

B. Food Rescue and Donation Services

1. Description

A network of organizations in and near Boston help connect surplus food from businesses and institutions with those in need. These include:

- Greater Boston Food Bank, the central food bank for the Boston area
- Lovin' Spoonfuls, a food rescue organization based in Boston which recovers perishable foods
- Food For Free, a food rescue organization based in Cambridge, which recovers fresh produce and prepared food
- Daily Table, a non-profit grocery store in Dorchester, which sells discounted groceries and healthy prepared foods made on site.
- Rescuing Leftover Cuisine, a food rescue organization based in New York that recently started operating in the Boston area.
- Fair Foods, a food rescue organization based in Dorchester
- Spoiler Alert, a platform for managing unsold inventory based in Boston
- Food For All, an app that helps restaurants sell discounted meals at the end of the day

The Harvard Food Law and Policy Clinic (Harvard FLPC) in Cambridge is a national leader in food recovery policy. Harvard FLPC created legal fact sheets about [Liability Protection](#), [Tax Incentives](#), and [Date Labeling](#) that describe both Massachusetts and Federal policies. These fact sheets are part of the [Food Donation Guidance for Massachusetts Businesses](#) available on the RecyclingWorks in Massachusetts website; this guidance was developed through a stakeholder process including state and local health officials, food rescue organizations, food banks, and organizations with established food donation programs.

2. Issues Raised

- Many potential food donors cite fear of liability as a reason for not donating food, despite fact sheet from Harvard about Liability Protection.
- The City of Boston food inspectors are reported by food rescue organizations to be more restrictive than other municipalities about food donation. For example, the Whole Foods in Boston had to stop donating prepared foods, yet the one in Cambridge is able to because of different health inspection standards.

C. Reuse and Repair Facilities

1. Description

There are a wide variety of entities in and near Boston that help facilitate reuse of various materials from both residents and businesses. Some of these entities are for-profit companies, others are non-profits that primarily serve a social mission. In general, these non-profits see their contribution to waste diversion as secondary to their mission to provide jobs and resources to those in need. Reuse facilities accept items such as household goods, textiles, building materials, and furniture from residents and institutions.

Household Goods and Textiles: The following entities accept household materials and textiles, most frequently from residents, although in some cases also from institutions such as colleges. For the most part, these entities sell or donate materials that are in good shape. Materials that are not useable are usually baled and connected with a recycling outlet. While they try to recycle materials that cannot be used, many of these organizations prefer to only receive materials that are in good condition.

- Morgan Memorial Goodwill Industries in Boston
- Cradles to Crayons in Boston
- Bay State Textiles in Pembroke
- Anton's Cleaners Coats for Kids in Tewksbury
- Savers
- Salvation Army
- Boomerangs
- Recycle That
- Planet Aid

There are also consignment stores throughout Boston that resell, on behalf of individuals, used clothing in good shape.

Residential Building Materials and Furniture: Three non-profit organizations accept donated building materials from the Boston area and operate retail outlets to sell these materials to the general public. These outlets will usually pick up materials for free or a nominal charge. Because most of the customers at their stores are homeowners and landlords, these facilities are interested in materials that are useful in residences, such as kitchen cabinets and sinks, bathroom vanities, tubs, toilets, residential doors, newer appliances, etc. Each entity specializes in slightly different materials. For instance, the Greater Boston ReStore accepts a wide variety of furniture, while the other entities do not accept much furniture. These facilities include:

- Boston Building Resources Reuse Center in Boston
- Habitat for Humanity ReStore: Greater Boston (one of 9 ReStores in Massachusetts)
- EcoBuilding Bargains in Springfield

There are also for-profit businesses that provide an outlet for some of the building materials that the non-profit reuse stores are less interested in, such as:

- Restoration Resources in Boston (Materials that are of architectural interest)
- LongLeaf Lumber in Cambridge (Reclaimed wood, usually from older buildings containing a large volume of wood)

RecyclingWorks in Massachusetts [Construction & Demolition Materials Guidance](#) (also referenced in the Construction, Demolition and Deconstruction Recycling Facilities Existing Initiative Summary) includes more information on capturing building materials for reuse.

Institutional Building Furniture and Building Materials: Material brokers provide an outlet for materials removed during pre-construction clean-outs and commercial/institutional remodeling projects, such as

desks from a decommissioned school, or conference tables and chairs from remodeling an office building. The volume of materials removed from these projects often do not have a use within the local market, so materials brokers connect these materials to outlets across the country, or even internationally. Entities specializing in institutional furniture reuse include:

- The Furniture Trust in Boston
- IRN: The Reuse Network in Concord, NH
- Green Reuse and Recycling Organization International (GRRRO) in Manchester, NH
- Re-Stream in Waltham

Repair: An on-line search of “repair” in Boston shows that Boston is home to businesses that repair cell phones, shoes, TVs, watches, jewelry, computers, appliances, furniture, and luggage. In addition, Fixit Clinics have become popular. These events pair people who need things fixed with people who know how to fix them.

2. Issues Raised

- Many reuse entities are short on space to receive, sort, store, and display items.
- Repair can often be more expensive than buying something new.

D. Construction, Demolition and Deconstruction Recycling Facilities

1. Description

A number of facilities that process and transfer construction, demolition and deconstruction (CD&D) materials from contractors and individuals operate in the Boston area. These materials include

- Clean wood*
- Clean gypsum wallboard*
- Metals*
- Asphalt, Brick and Concrete (ABC)*
- Asphalt shingles
- Carpet, carpet padding, and vinyl composite tile (VCT)
- Cardboard*
- Ceiling tiles
- Rigid and film plastics
- Expanded polystyrene packaging

*Materials banned from disposal 310 CMR 19.017

CD&D processors use various mechanical and manual processes to separate recyclable material from the loads they receive, and send the recovered recyclable materials to end markets. CD&D transfer stations generally do not comprehensively sort material; while they may separate some materials from the incoming materials stream, they transfer a majority of materials to either a CD&D processor or to an end disposal site. CD&D processing facilities are effective at sorting a variety of materials, such as metal, clean wood, and concrete. Some CD&D facilities also accept loads of source-separated materials that are difficult or impossible to sort, such as clean gypsum. There are several CD&D processors that serve projects in Boston, in addition to those listed in the reuse section, above, including:

- ReEnergy Roxbury in Boston
- E.L. Harvey & Sons in Westborough
- A.K.S. Recycling in Fitchburg
- Devens Recycling Center in Ayer
- New Bedford Waste Services in New Bedford
- Stoughton Recycling Technology in Stoughton

- TBI Recycling in Raynham
- Wood Waste of Boston

CD&D transfer stations in the area include:

- Champion City Recovery in Brockton
- James G. Grant Co in Boston
- Mich-Lin Transfer Station in Cambridge
- Trojan Recycling in Brockton

There are also several facilities that accept specific, source-separated, CD&D materials. These include:

- The Paint Exchange in Rockland, for latex paint
- Rooftop Recycling in Boxboro, for asphalt shingles
- Agretech in Dracut, for asphalt pavement, brick and concrete
- AEI: Abby Enterprises in Marshfield, for asphalt pavement, brick and concrete
- Cambridge Gypsum Recycling in North Grafton, for gypsum wallboard

The MassDEP maintains a [report](#) that shows the recycling rate for each CD&D facility in Massachusetts. In 2016, RecyclingWorks in Massachusetts engaged stakeholders, such as contractors, architects, CD&D processors and haulers, and reuse outlets to develop [Construction & Demolition Materials Guidance](#). This guidance includes information to increase recycling of these materials, including sending materials to CD&D processing facilities, and what materials to consider collecting separately on-site.

City building codes require that projects meet a minimum level of green building credits using the Leadership in Energy and Environmental Design (LEED) protocols created by the U.S. Green Building Council.¹⁹ LEED credits include points for recycling CD&D materials and many builders in Boston are motivated to work with CD&D processors in order to receive LEED credits and because doing so is cost effective. C&DD recycling and reuse is becoming more common.

2. Issues Raised

- LEED version 4 no longer allows materials used for Alternative Daily Cover at landfills to “count” as diversion. Under this provision, the diversion rate for CD&D facilities is now lower than previously.
- The majority of the sorting staff are temps due to the lack of ability to find and retain permanent workers.
- Lack of disposal infrastructure in MA is an issue. Landfills are closing and incinerators can’t handle the residual material from CD&D sites.
- Transportation is a concern as trucks transporting CD&D materials compete with regular Boston vehicular traffic.

E. Composting Facilities

1. Description

A number of compost sites process materials generated from Boston. All compost sites accept yard trimmings/brush and many also accept food scraps. Some of the sites that accept food scraps can also process compostable utensils and bags, but the type and volume accepted varies widely by facility. All sites below accept leaf and yard trimmings. Others take additional materials as noted. These sites accept brush and yard trimmings from municipal curbside recycling programs (including Boston’s), from landscapers, and from private collectors such as CERO and Bootstrap Compost that collect food scraps from grocery stores and institutions, residents and/or small businesses.

- City of Boston Compost Site in Boston, operated by City Soil
- Landscape Express in Boston

¹⁹ Green Building Guidelines <http://www.bostonplans.org/planning/planning-initiatives/article-37-green-building-guidelines>

- We Care Environmental in Marlborough (food scraps and all compostableware)
- Needham Department of Public Works in Needham (food scraps)
- Agresource in Ipswich (food scraps)
- Black Earth Compost in Hamilton (food scraps)
- Brick Ends Farm in Hamilton (food scraps)
- Groundscapes Express in Wrentham (food scraps)
- Hidden Acres Farm / Cassidy Farm in Medway (food scraps)
- Krochamal Farm in Tewksbury (food scraps. It is also an animal feed operation)
- Mass Natural in Tewksbury (food scraps)
- Newland Farms in Norton (food scraps)
- Rocky Hill Farm in Saugus (food scraps)

The RecyclingWorks in Massachusetts program provides no-cost [technical assistance to compost sites](#) that currently or are considering accepting food scraps to help support food scraps composting infrastructure in Massachusetts to optimize operations. Best Management Practices are provided, but not necessarily regulatory advice.

In addition to compost sites, there are several anaerobic digesters in the area that accept food scraps. The MassDEP maintains a map of all [Sites Accepting Diverted Food Material](#) in Massachusetts, which includes anaerobic digesters, animal feed operations, compost sites, and organics processors. See Anaerobic Digesters and Food Scrap Processing Facility Existing Initiative description for more information.

2. Issues Raised

- Compost sites within the City of Boston do not accept food scraps. Real or perceived concerns about odor and pests in this dense urban environment may limit the potential for composting food scraps at these sites in the future.
- While there are many compost sites in the Boston area that accept food scraps, most of these sites limit the quantity and volume of compostable foodware and bags. This limits the number of outlets for collection programs, such as front-of-house collection, that are likely to have high rates of these materials and some contamination.
- The WeCare Environmental site in Marlborough will likely close after its current contract ends in 2020. This may cause an infrastructure gap for processing food scraps with high rates of contamination and compostable foodware as WeCare can process a wider range of materials than other compost sites in the area.

F. Anaerobic Digesters and Food Scrap Processing Facilities

1. Description

In addition to compost sites, depackaging facilities and anaerobic digesters (AD) play a large role in diverting Boston's food scraps from disposal. Depackaging facilities separate packaged food from its packaging using a variety of techniques. Some depackagers are also used to process loads of source separated food scraps that have a high level of contamination.

Two depackaging facilities handle materials from Boston in different ways:

- Waste Management Boston Centralized Organic Recycling (CORE) in Boston. This facility converts both source separated and packaged food scraps into an organic slurry that is sent to the Greater Lawrence Sanitary District where it is co-digested with sludge from the wastewater treatment plant to produce methane gas and then electricity. Packaging and contaminants are sent to a waste-to-energy facility.
- E.L. Harvey & Sons in Westborough. The organic byproduct from this site is sent to anaerobic digesters, compost sites, and animal feed operations, depending on the composition of the off-spec

product being processed. They do not process loads of source-separated organics from residential or commercial generators.

There are two other depackaging facilities in the Boston area that manage only packaged liquids. Liquids from these facilities have been processed as wastewater; however, both facilities are considering sending some of their depackaged liquids for anaerobic digestion. In addition, when streams of material are kept separate, the depackaged containers can be recycled.

- Parallel Products in New Bedford
- RecyclingWorks Inc in East Weymouth

Vanguard Renewables operates several AD facilities in Massachusetts. The closest to the Boston area is their AD facility at Jordan Farm in Rutland. Depending upon the feedstock needs of each facility, food scraps from the Boston area may sometimes be sent to the Vanguard sites at Barstow's Longview Farm in Hadley or at Bar-Way Farm in Deerfield.

Exeter Agri-Energy in Exeter, Maine also operates a depackager and anaerobic digester. While this facility is further from Boston, because it is the longest operating depackager in New England, it also accepts food scraps from generators in Boston.

2. Issues Raised

- Food soiled paper, compostable foodware, and compostable bags are generally not accepted by anaerobic digestion facilities. At depackaging facilities, these materials are separated from the food scraps and discarded with other residual materials. This removal of compostable products may cause a reporting issue for Zero Waste facilities as a potentially large portion of the projected compostable materials are ending up disposed.

G. Facilities and Services for Special Materials

1. Description

A number of facilities in the Boston area focus on diverting difficult to recycle and hazardous materials from disposal. These entities are organized below based upon the primary materials they accept.

Rigid and Film Plastics: Several entities focus on collecting and finding recycling outlets for a range of hard-to-recycle materials. These entities are particularly relevant in providing an outlet for rigid and film plastics (including boat shrink wrap). They also provide another market for more frequently recycled items, such as paper, scrap metal, and specific source-separated CD&D materials. These facilities include:

- Conigliaro in Framingham
- 77 Recycling in Clinton
- Capital Paper Recycling in East Weymouth
- Save That Stuff in Charlestown
- AAA Recycling in New Bedford
- New England Shrink Wrap, Taunton

Hazardous Materials: Several entities specialize in managing hazardous materials such as household hazardous waste, mercury-containing items (fluorescent lamps, thermostats, thermometers, barometers, blood pressure cuffs, etc), and elemental mercury. These facilities include:

- Complete Recycling Solutions in Fall River
- Clean Harbors in Braintree
- New England Disposal in Sutton
- Veolia North America in West Bridgewater
- Thermostat Recycling Corporation
- Stericycle in Haverhill

Most materials disposed in Boston are sent to one of the following waste-to-energy facilities: Wheelabrator Saugus, Covanta SEMASS, or Covanta Haverhill. These facilities have a [Material Separation Plan](#) filed with the MassDEP to prevent mercury-containing materials from entering the trash and, therefore, the thermal process. The plans vary slightly, but they provide community assistance in the form of educational materials (tool kits for Boards of Health, fire departments, educational videos, advertisements, digital resources) to help residents and businesses identify mercury items and cover costs for recycling mercury containing items in contracted communities.

Electronics: A number of entities in the Boston area specialize in refurbishing and recycling computers, cell phones, CRTs, and other electronic devices. In general, these entities refurbish electronics that can be reused and recycle the remaining material. These facilities include:

- PCS of Massachusetts in Hanover [RIOS R2 Standard ISRI]
- Electronic Recyclers International (ERI) in Holliston R2
- Electronics Redux in Norfolk
- CNE Direct in Middleton
- JSM Technology in Manchester
- Mainstream Global in Lawrence
- BoxQ in Georgetown
- American Retroworks in Brockton

Most of these facilities are certified under the Sustainable Electronics Recycling International R2 Standard for electronic recycling. ERI also has e-Stewards certification.

Some entities that accept household goods for reuse, such as Morgan Memorial Goodwill Industries, also refurbish electronics. And some of the stores that sell electronics will also repair them.

Mattresses: Two facilities in Massachusetts accept mattresses for recycling:

- United Teen Equality Center (UTEC) in Lowell
- Raw Material Recovery Corp in Gardner

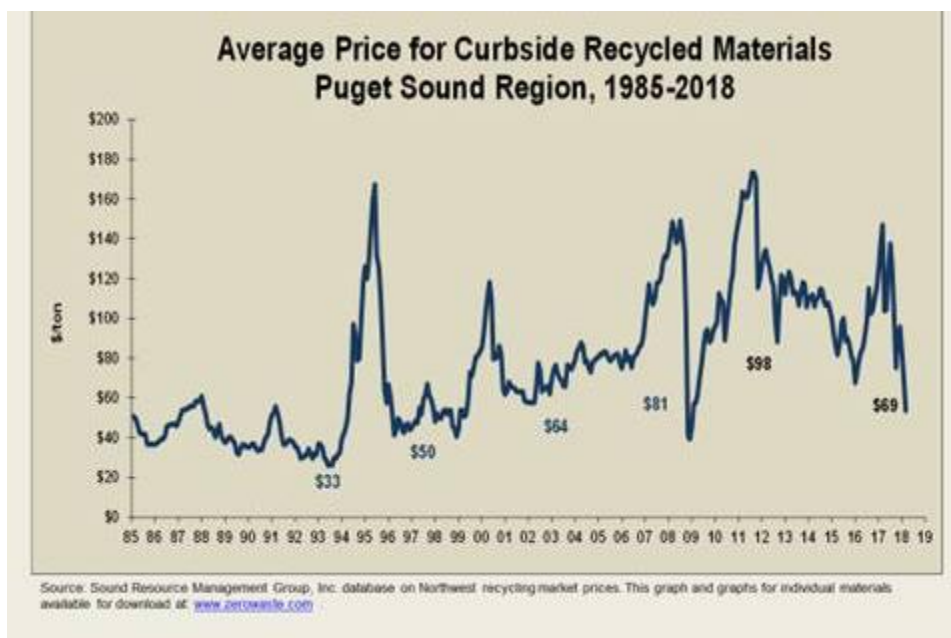
2. Issues Raised

- Logistics are challenging in the City. The Public Works Department does not have space or staff to run year-round household hazardous waste drop off centers.
- Markets for hard-to-recycle plastics can shift or go away.

VII. International and Local Commodity Markets Impacting Boston

Prices and the value of secondary materials rise and fall with demand. 2018 market lows are higher than the highs of 20 years ago, as shown in Figure 6, Recycling Market Price Fluctuations in the Puget Sound Region. While prices on the East Coast differ from the Pacific Northwest, the trends would be similar. The demand for clean secondary materials has increased from 20 years ago, as well.

Figure 6: Recycling Market Price Fluctuations



Currently the market demand from China, and increasingly more countries, has called for better sorting of the feedstock to reduce contamination. This is increasing processing costs and causing municipalities to spend more money on education of residents and enforcement of recycling rules. In a global sense, the new call for a circular economy will create a high demand for secondary feedstock and cause producers to redesign products and packages for reuse, recycling and composting. Whether or not this leads to a raising of commodity prices remains to be seen.

Current standards for mixed paper and mixed rigid plastics being enforced by China require a cleaner sort than in the past. The proliferation of MRFs with single stream in the U.S. produced a lower grade of mixed paper and mixed plastics that the Chinese were willing to accept for many years. But this low quality is no longer allowed in China, and materials are more expensive to ship to other countries for recycling. Future efforts should focus on better education of residents and recycling haulers, and better sorting to ensure higher quality feedstocks. High quality feedstocks always have a larger number of end-market options and fetch better prices than low value ones, even during times of market downturns.

Clean (mill spec) high-grade ledger paper still commands a high price as does clean Corrugated Cardboard and clean PETE and HDPE. Mixed loads of high and low fiber (ledger and cardboard) are no longer accepted in China.

Today, China will buy sorted grades of plastic resin like polyethylene (PETE) and high density polyethylene (HDPE). Mixed rigid plastics are watched closely for contaminants. Brokers are exploring and finding new sorting facilities and users in other Asian countries, although there is still not sufficient capacity elsewhere to use all the materials that China was importing.

This stronger enforcement effort on recyclables is part of a larger crackdown in China against pollution and corruption, partly a response to the recent stressed political relationship between the US and China, as well as a desire for the country to build its own recycling collection infrastructure.

The estimated value of key Boston discards currently burned or buried in landfills today if sorted and baled to international specifications is shown in Table 2, below.

Table 2, Estimated Value of Key Baled Boston Discards Internationally

| Categories | Annual Tons ¹ | \$/ton ² | Annual Revenues Lost |
|-----------------------|--------------------------|---------------------|----------------------|
| 1. Textiles | 39,144 | 340 | 13,308,962 |
| 2. Polymers (plastic) | 38,817 | 300 | 11,645,120 |
| 3. Metals | 21,327 | 300 | 6,398,055 |
| 4. Glass | 9,201 | 40 | 368,025 |
| 5. Paper | 144,636 | 70 | 10,124,499 |
| Total | 253,124 | | \$41,844,662 |

¹Based on state waste characterizations study estimated for Boston

²Sources: Resource Recycling magazine, industry interviews and Zero Waste Associates analysis.

These export revenues are higher than prices for baled and delivered materials for the Northeast market, as listed in RecyclingMarkets.net for April 2018 and shown in Table 3.

Table 3, Estimated Value of Key Boston Discards in the Northeast USA

| Categories | Annual Tons | \$/ton | Annual Revenue Lost |
|--|----------------|--------|---------------------|
| 1. Textiles ¹ | 39,144 | 340 | \$13,308,962 |
| 2. Mixed Polymers (plastic) ² | 38,817 | 3 | \$116,451 |
| 3. Mixed Metals ² | 21,327 | 40 | \$853,074 |
| 4. Mixed Glass ² | 9,201 | 0 | 0 |
| 5. Mixed Paper ² | 144,636 | 5 | \$723,179 |
| Total | 253,124 | | \$15,001,666 |

¹Boston market price

²Recycling markets.net

Even low value materials, such as plastic and glass, are less expensive to recycle than burning or burying these resources.

Additional Findings:

- Textiles have a steady market although few brokers. Estimated volume of textiles in Boston's disposed materials (based on statewide materials composition studies) at 37,000 tons is higher than both metals or plastic. Recovery of reusables and textiles is a growing industry and enhances the local economy.
- Metal markets are flat and on the high side. Iron and steel is the most recycled of all material. The nonferrous metal prices are at the level of semiprecious metals.
- Paper sorted by grades are selling and in demand. 60% of the consuming market is in North America. The mills are asking for the brown (low-grade corrugated and Kraft) fiber to be separated from the ledger (high-grade) fibers. This can be accomplished through strong source separation programs and good sorting processes.
- There is an opportunity to strengthen the market for glass, due to recent closure of a major glass manufacturer in Massachusetts. This could be through an upgrade of the bottle bill to call for refillables and include container glass or through developing new local markets for low or high grade uses. The export market for just flint (clear) glass is very high.
- Plastics sorted by resin types have a high selling value. New MRFS are successfully using laser sorting for PETE and HDPE. Most of the consumer plastics are PETE and HDPE. Other resins have local markets. Procter and Gamble is promising an increase in packages using more recycled polypropylene (PP) content. This will assist Boston MRFs as the facilities are domestic.
- Finished compost in Boston can be sold for as much as \$40 per cubic yard (cy)

Appendix A- Boston Zero Waste Guiding Principles

1. Make Zero Waste a Key Priority

Boston will create a waste policy that mitigates climate change, reduces climate emissions and other environmental and public health impacts, saves money, supports economic mobility and creates good jobs for Boston residents. As part of this work, the City will:

- **Define the Goal**
Boston will build from the Zero Waste International Alliance's definition of zero waste to define the goal.
- **Develop a Strategy**
Boston will establish a plan to advance zero waste in all sectors of the Boston community. Implementation of this plan would start in Fiscal Year 2018. The plan will include specific metrics, milestones, and timelines.
- **Expand Resources For Change**
Whether through partnerships, policies or direct funding, Boston will expand support for zero waste engagement, education and enforcement.
- **Work Collaboratively**
Recognizing that this is a shared challenge, Boston will work collaboratively with other communities in the region and other major U.S. cities in this work.

2. Focus First on Wasting Less, Diverting More

Through this plan, Boston will develop and adopt policies that will support waste reduction; significantly increase repair, reuse, recycling, composting, and remanufacturing; and enable the City to meet its zero-waste milestones. As part of this work, the City will:

- **Lead by Example**
While accounting for roughly only 1% of the City's total waste, the City of Boston recognizes it has an opportunity and responsibility to lead by example. Consequently, the City will examine and implement policies to reduce, reuse and recycle more. This may include - among other actions - using municipal procurement to support zero-waste goals; evaluating city contracts for waste reduction opportunities; creating model waste reduction and recycling programs at all City properties and facilities, including schools and housing; and engaging all City departments in zero-waste planning and implementation.
- **Facilitate Residential Waste Reduction**
Residential waste accounts for about 40 percent of the city's waste stream, and the City manages contracts that provide waste and recycling services to all Boston residents. The City will work with service providers, Boston residents, and large residential building owners and property managers to identify changes that support zero waste goals. It will also continue discussions with regional stakeholders to develop regional zero-waste solutions.
- **Engage Large Generators of Waste**
60% of waste comes from commercial, industrial and institutional partners. The City will work with the largest waste generators, such as colleges, universities, hospitals, and commercial businesses to waste less and divert more. The City will explore incorporating zero-waste requirements into major permitting, planning, and project reviews.

3. Support This Work Through Local Business

Recognizing that the successful implementation of a zero waste system requires not just local policies but a local industry, the City will work with workers and businesses to ensure that they are prepared to support these new policies.

This may include working with job training programs to include needed zero-waste skills; supporting new and emerging zero-waste jobs for Boston residents, including youth; and drawing on Boston's leadership in technological innovation and research to put discarded materials to their highest and best use.

Throughout this work, the City will encourage measures to improve the safety, health, and jobs of workers.

4. Sustain This Work Through Culture Change

Acknowledging that achieving and sustaining zero waste will be a collective accomplishment, the City of Boston will focus on how to build a culture of zero waste, citywide. This will include engaging meaningfully with all stakeholders in a Zero Waste planning process; embracing industry workers, communities of color, low-income communities, and youth as critical Zero Waste partners; conducting large-scale, linguistically and culturally appropriate public education; and growing the next generation of zero-waste leaders by developing youth-specific programs.

Appendix B, Boston NAICs Codes, Employees and Wages²⁰

| NAICS | Description | No. of Establishments | Number of Employees | | | Total Wages |
|--------|--|-----------------------|---------------------|---------|---------|------------------|
| | | | Jan-17 | Feb-17 | Mar-17 | |
| | Total, all industries | 27,003 | 630,898 | 634,269 | 636,323 | \$17,039,126,933 |
| | Natural Resources and Mining | 5 | 48 | 50 | 55 | \$610,485 |
| 11 | Agriculture, Forestry, Fishing and Hunting | 4 | 34 | 36 | 41 | \$257,500 |
| | Construction | 840 | 12,975 | 12,672 | 12,877 | \$386,805,364 |
| 23 | Construction | 840 | 12,975 | 12,672 | 12,877 | \$386,805,364 |
| 236 | Construction of buildings | 273 | 4,288 | 4,277 | 4,311 | \$117,361,980 |
| 2361 | Residential building construction | 178 | 948 | 953 | 974 | \$16,425,931 |
| 2362 | Nonresidential building construction | 95 | 3,340 | 3,324 | 3,337 | \$100,936,049 |
| 237 | Heavy and civil engineering construction | 49 | 2,153 | 2,124 | 2,170 | \$133,255,295 |
| 2371 | Utility system construction | 20 | 1,239 | 1,203 | 1,226 | \$108,290,471 |
| 2372 | Land subdivision | 12 | 113 | 118 | 117 | \$5,492,151 |
| 2373 | Highway, street, and bridge construction | 9 | 677 | 665 | 680 | \$17,062,939 |
| 2379 | Other heavy construction | 8 | 124 | 138 | 147 | \$2,409,734 |
| 238 | Specialty trade contractors | 518 | 6,534 | 6,271 | 6,396 | \$136,188,089 |
| 2381 | Building foundation and exterior contractors | 72 | 822 | 733 | 786 | \$15,289,160 |
| 2382 | Building equipment contractors | 197 | 2,969 | 2,708 | 2,708 | \$66,421,804 |
| 2383 | Building finishing contractors | 159 | 1,468 | 1,589 | 1,655 | \$30,891,768 |
| 2389 | Other specialty trade contractors | 90 | 1,275 | 1,241 | 1,247 | \$23,585,357 |
| | Manufacturing | 310 | 7,350 | 7,253 | 7,282 | \$161,960,713 |
| 31-33 | Manufacturing | 310 | 7,350 | 7,253 | 7,282 | \$161,960,713 |
| DUR | Durable Goods Manufacturing | 107 | 3,217 | 3,162 | 3,188 | \$84,530,944 |
| NONDUR | Non-Durable Goods Manufacturing | 203 | 4,133 | 4,091 | 4,094 | \$77,429,769 |
| 311 | Food manufacturing | 99 | 1,868 | 1,830 | 1,819 | \$18,237,249 |
| 3113 | Sugar & confectionery product manufacturing | 3 | 51 | 56 | 56 | \$368,001 |
| 3114 | Fruit and vegetable preserving and specialty | 3 | 19 | 20 | 20 | \$128,339 |
| 3115 | Dairy product manufacturing | 3 | 30 | 29 | 30 | \$254,494 |
| 3116 | Animal slaughtering and processing | 6 | 85 | 84 | 86 | \$852,633 |
| 3117 | Seafood product preparation and packaging | 10 | 332 | 333 | 330 | \$3,875,645 |
| 3118 | Bakeries and tortilla manufacturing | 67 | 1,168 | 1,129 | 1,119 | \$10,879,084 |
| 3119 | Other food manufacturing | 5 | 132 | 128 | 127 | \$1,321,899 |
| 312 | Beverage and tobacco product manufacturing | 11 | 557 | 558 | 561 | \$25,218,737 |
| 3121 | Beverage manufacturing | 10 | 551 | 547 | 548 | \$25,161,989 |
| 314 | Textile product mills | 13 | 98 | 99 | 96 | \$1,839,630 |
| 3141 | Textile furnishings mills | 4 | 31 | 32 | 30 | \$420,310 |
| 3149 | Other textile product mills | 9 | 67 | 67 | 66 | \$1,419,320 |
| 315 | Apparel manufacturing | 9 | 414 | 405 | 417 | \$3,966,693 |
| 3152 | Cut and sew apparel manufacturing | 4 | 379 | 370 | 382 | \$2,866,135 |
| 322 | Paper manufacturing | 4 | 61 | 45 | 39 | \$886,485 |

²⁰ Source: Labor and Work Force Development Mass.gov <http://lmi2.detma.org/lmi/lmi_es_a.asp#IND_LOCATION>

| | | | | | | |
|------|--|-------|--------|--------|--------|-----------------|
| 3222 | Converted paper product manufacturing | 4 | 61 | 45 | 39 | \$886,485 |
| 323 | Printing and related support activities | 49 | 666 | 683 | 678 | \$13,453,429 |
| 3231 | Printing and related support activities | 49 | 666 | 683 | 678 | \$13,453,429 |
| 325 | Chemical manufacturing | 11 | 233 | 237 | 246 | \$10,443,970 |
| 3254 | Pharmaceutical and medicine manufacturing | 6 | 209 | 213 | 222 | \$10,197,343 |
| 327 | Nonmetallic mineral product manufacturing | 11 | 160 | 164 | 169 | \$2,600,911 |
| 3272 | Glass and glass product manufacturing | 3 | 11 | 11 | 12 | \$115,162 |
| 3279 | Other nonmetallic mineral products | 4 | 24 | 24 | 24 | \$266,190 |
| 3323 | Architectural and structural metals mfg. | 12 | 205 | 166 | 197 | \$3,489,098 |
| 3327 | Machine shops and threaded product mfg. | 3 | 23 | 22 | 22 | \$282,637 |
| 3328 | Coating, engraving, and heat treating metals | 3 | 125 | 124 | 127 | \$2,158,424 |
| 334 | Computer & electronic product manufacturing | 14 | 333 | 328 | 330 | \$6,506,920 |
| 3344 | Semiconductor & electronic component mfg. | 5 | 136 | 132 | 134 | \$1,804,226 |
| 3345 | Electronic instrument manufacturing | 5 | 152 | 151 | 153 | \$3,953,140 |
| 335 | Electrical equipment and appliance mfg. | 9 | 110 | 108 | 111 | \$1,999,068 |
| 3359 | Other electrical equipment & component mfg. | 5 | 44 | 42 | 42 | \$904,295 |
| 337 | Furniture and related product manufacturing | 14 | 77 | 74 | 74 | \$1,578,197 |
| 3371 | Household and institutional furniture mfg. | 9 | 35 | 33 | 33 | \$379,398 |
| 3372 | Office furniture and fixtures manufacturing | 5 | 42 | 41 | 41 | \$1,198,799 |
| 339 | Miscellaneous manufacturing | 27 | 510 | 522 | 510 | \$11,264,830 |
| 3391 | Medical equipment & supplies manufacturing | 8 | 44 | 48 | 47 | \$653,403 |
| 3399 | Other miscellaneous manufacturing | 19 | 466 | 474 | 463 | \$10,611,427 |
| | Trade, Transportation and Utilities | 3,538 | 68,521 | 68,052 | 68,007 | \$1,093,815,265 |
| 22 | Utilities | 35 | 2,029 | 2,024 | 2,017 | \$61,117,919 |
| 221 | Utilities | 35 | 2,029 | 2,024 | 2,017 | \$61,117,919 |
| 2211 | Power generation and supply | 16 | 1,109 | 1,103 | 1,097 | \$37,387,787 |
| 2212 | Natural gas distribution | 6 | 344 | 345 | 345 | \$10,957,162 |
| 42 | Wholesale Trade | 833 | 7,886 | 7,949 | 7,963 | \$186,606,083 |
| 423 | Merchant wholesalers, durable goods | 243 | 2,393 | 2,385 | 2,364 | \$58,078,043 |
| 4231 | Motor vehicle and parts merchant wholesalers | 8 | 87 | 86 | 86 | \$690,525 |
| 4232 | Furniture & furnishing merchant wholesalers | 27 | 304 | 311 | 309 | \$8,229,152 |
| 4233 | Lumber & const. supply merchant wholesalers | 16 | 233 | 221 | 216 | \$6,698,042 |
| 4234 | Commercial equip. merchant wholesalers | 73 | 963 | 962 | 942 | \$22,016,606 |
| 4235 | Metal and mineral merchant wholesalers | 4 | 9 | 11 | 11 | \$224,132 |
| 4236 | Appliance and electric goods merchant whls. | 27 | 183 | 184 | 183 | \$5,444,120 |
| 4237 | Hardware and plumbing merchant wholesalers | 20 | 228 | 228 | 228 | \$3,635,325 |
| 4238 | Machinery and supply merchant wholesalers | 14 | 117 | 118 | 117 | \$1,889,815 |
| 4239 | Misc. durable goods merchant wholesalers | 54 | 269 | 264 | 272 | \$9,250,326 |
| 424 | Merchant wholesalers, nondurable goods | 232 | 3,755 | 3,805 | 3,821 | \$73,991,470 |
| 4242 | Druggists' goods merchant wholesalers | 25 | 277 | 280 | 290 | \$14,328,817 |
| 4243 | Apparel & piece goods merchant wholesalers | 22 | 207 | 212 | 213 | \$6,590,306 |
| 4244 | Grocery and related product wholesalers | 105 | 2,444 | 2,497 | 2,506 | \$37,111,901 |
| 4246 | Chemical merchant wholesalers | 9 | 65 | 66 | 63 | \$1,415,616 |
| 4248 | Alcoholic beverage merchant wholesalers | 14 | 74 | 73 | 78 | \$1,960,135 |

| | | | | | | |
|-------|--|-------|--------|--------|--------|---------------|
| 4249 | Misc. nondurable goods merchant wholesalers | 41 | 245 | 238 | 237 | \$4,796,780 |
| 425 | Electronic markets and agents and brokers | 358 | 1,738 | 1,759 | 1,778 | \$54,536,570 |
| 4251 | Electronic markets and agents and brokers | 358 | 1,738 | 1,759 | 1,778 | \$54,536,570 |
| 44-45 | Retail Trade | 2,211 | 31,695 | 31,298 | 31,211 | \$346,443,444 |
| 441 | Motor vehicle and parts dealers | 69 | 1,430 | 1,444 | 1,454 | \$20,782,499 |
| 4411 | Automobile dealers | 27 | 1,031 | 1,051 | 1,053 | \$17,016,215 |
| 4412 | Other motor vehicle dealers | 6 | 41 | 45 | 48 | \$665,610 |
| 4413 | Auto parts, accessories, and tire stores | 36 | 358 | 348 | 353 | \$3,100,675 |
| 442 | Furniture and home furnishings stores | 81 | 807 | 786 | 780 | \$13,388,218 |
| 4421 | Furniture stores | 37 | 359 | 357 | 362 | \$9,765,932 |
| 4422 | Home furnishings stores | 44 | 448 | 429 | 418 | \$3,622,287 |
| 443 | Electronics and appliance stores | 54 | 652 | 651 | 640 | \$7,443,794 |
| 4431 | Electronics and appliance stores | 54 | 652 | 651 | 640 | \$7,443,794 |
| 444 | Building material and garden supply stores | 70 | 969 | 946 | 970 | \$10,650,778 |
| 4441 | Building material and supplies dealers | 67 | 950 | 928 | 947 | \$10,552,162 |
| 4442 | Lawn & garden equipment and supplies stores | 3 | 19 | 18 | 23 | \$98,617 |
| 445 | Food and beverage stores | 644 | 8,554 | 8,576 | 8,619 | \$56,622,994 |
| 4451 | Grocery stores | 400 | 6,782 | 6,804 | 6,836 | \$42,783,608 |
| 4452 | Specialty food stores | 99 | 742 | 752 | 762 | \$4,835,699 |
| 4453 | Beer, wine, and liquor stores | 145 | 1,030 | 1,020 | 1,021 | \$9,003,688 |
| 446 | Health and personal care stores | 260 | 3,291 | 3,349 | 3,308 | \$35,779,363 |
| 4461 | Health and personal care stores | 260 | 3,291 | 3,349 | 3,308 | \$35,779,363 |
| 447 | Gasoline stations | 84 | 497 | 502 | 498 | \$3,326,842 |
| 4471 | Gasoline stations | 84 | 497 | 502 | 498 | \$3,326,842 |
| 448 | Clothing and clothing accessories stores | 451 | 5,443 | 5,289 | 5,337 | \$41,259,146 |
| 4481 | Clothing stores | 285 | 4,038 | 3,922 | 3,961 | \$29,100,931 |
| 4482 | Shoe stores | 57 | 869 | 843 | 852 | \$5,492,418 |
| 4483 | Jewelry, luggage, and leather goods stores | 109 | 536 | 524 | 524 | \$6,665,797 |
| 451 | Sports, hobby, music instrument, book stores | 96 | 1,507 | 1,433 | 1,380 | \$11,059,424 |
| 4511 | Sporting goods and musical instrument stores | 62 | 744 | 720 | 706 | \$6,634,075 |
| 4512 | Book stores and news dealers | 34 | 763 | 713 | 674 | \$4,425,349 |
| 452 | General merchandise stores | 56 | 2,693 | 2,414 | 2,340 | \$15,054,729 |
| 4522 | Department Stores | 17 | 2,363 | 2,067 | 1,995 | \$13,465,502 |
| 4523 | General Merch Stores, incl Warehouse | 39 | 330 | 347 | 345 | \$1,589,227 |
| 453 | Miscellaneous store retailers | 266 | 1,905 | 2,003 | 1,920 | \$16,442,692 |
| 4531 | Florists | 42 | 416 | 515 | 418 | \$4,665,433 |
| 4532 | Office supplies, stationery, and gift stores | 71 | 761 | 750 | 767 | \$4,966,773 |
| 4533 | Used merchandise stores | 43 | 253 | 254 | 258 | \$2,443,934 |
| 4539 | Other miscellaneous store retailers | 110 | 475 | 484 | 477 | \$4,366,552 |
| 454 | Nonstore retailers | 80 | 3,947 | 3,905 | 3,965 | \$114,632,964 |
| 4541 | Electronic shopping and mail-order houses | 59 | 3,857 | 3,817 | 3,876 | \$113,606,979 |
| 4542 | Vending machine operators | 6 | 33 | 34 | 33 | \$306,925 |
| 4543 | Direct selling establishments | 15 | 57 | 54 | 56 | \$719,060 |
| 48-49 | Transportation and Warehousing | 459 | 26,911 | 26,781 | 26,816 | \$499,647,819 |

| | | | | | | |
|------|---|-------|--------|--------|--------|-----------------|
| 481 | Air transportation | 43 | 7,152 | 7,191 | 7,188 | \$168,277,544 |
| 4811 | Scheduled air transportation | 35 | 7,001 | 7,039 | 7,030 | \$166,577,523 |
| 4812 | Nonscheduled air transportation | 8 | 151 | 152 | 158 | \$1,700,021 |
| 484 | Truck transportation | 77 | 740 | 709 | 719 | \$9,984,448 |
| 4841 | General freight trucking | 47 | 307 | 294 | 294 | \$3,847,924 |
| 4842 | Specialized freight trucking | 30 | 433 | 415 | 425 | \$6,136,524 |
| 485 | Transit and ground passenger transportation | 90 | 9,534 | 9,425 | 9,442 | \$169,094,176 |
| 4852 | Interurban and rural bus transportation | 4 | 131 | 132 | 135 | \$1,518,240 |
| 4853 | Taxi and limousine service | 43 | 454 | 453 | 474 | \$6,790,667 |
| 4854 | School and employee bus transportation | 13 | 1,529 | 1,455 | 1,448 | \$16,372,737 |
| 4855 | Charter bus industry | 9 | 133 | 122 | 127 | \$1,570,031 |
| 487 | Scenic and sightseeing transportation | 26 | 632 | 648 | 700 | \$6,590,024 |
| 4871 | Scenic and sightseeing transportation, land | 12 | 267 | 276 | 292 | \$2,617,925 |
| 4872 | Scenic and sightseeing transportation, water | 14 | 365 | 372 | 408 | \$3,972,099 |
| 488 | Support activities for transportation | 133 | 3,695 | 3,624 | 3,578 | \$35,956,923 |
| 4881 | Support activities for air transportation | 26 | 2,349 | 2,269 | 2,209 | \$15,641,317 |
| 4882 | Support activities for rail transportation | 3 | 32 | 29 | 22 | \$493,937 |
| 4883 | Support activities for water transportation | 15 | 170 | 169 | 178 | \$2,536,871 |
| 4884 | Support activities for road transportation | 26 | 547 | 551 | 561 | \$6,485,072 |
| 4885 | Freight transportation arrangement | 59 | 563 | 560 | 558 | \$10,616,682 |
| 492 | Couriers and messengers | 39 | 1,465 | 1,467 | 1,457 | \$16,972,962 |
| 4921 | Couriers and express delivery services | 25 | 1,286 | 1,272 | 1,263 | \$15,506,546 |
| 4922 | Local messengers and local delivery | 14 | 179 | 195 | 194 | \$1,466,416 |
| 493 | Warehousing and storage | 12 | 669 | 673 | 674 | \$42,939,917 |
| 4931 | Warehousing and storage | 12 | 669 | 673 | 674 | \$42,939,917 |
| | Information | 762 | 17,119 | 17,282 | 17,350 | \$493,508,298 |
| 51 | Information | 762 | 17,119 | 17,282 | 17,350 | \$493,508,298 |
| 511 | Publishing industries, except Internet | 259 | 8,057 | 8,072 | 8,067 | \$242,250,650 |
| 5111 | Newspaper, book, and directory publishers | 100 | 4,416 | 4,412 | 4,385 | \$111,010,798 |
| 5112 | Software publishers | 159 | 3,641 | 3,660 | 3,682 | \$131,239,852 |
| 512 | Motion picture and sound recording industries | 86 | 1,043 | 1,093 | 1,184 | \$16,162,663 |
| 5121 | Motion picture and video industries | 70 | 956 | 1,001 | 1,096 | \$15,083,268 |
| 5122 | Sound recording industries | 16 | 87 | 92 | 88 | \$1,079,395 |
| 515 | Broadcasting, except Internet | 29 | 2,381 | 2,411 | 2,427 | \$51,692,358 |
| 5151 | Radio and television broadcasting | 27 | 2,379 | 2,409 | 2,425 | \$51,520,762 |
| 517 | Telecommunications | 153 | 1,701 | 1,744 | 1,712 | \$62,711,559 |
| 5173 | Wired & Wireless Telecom Carriers | 119 | 1,563 | 1,611 | 1,575 | \$59,186,975 |
| 5179 | Other telecommunications | 33 | 131 | 126 | 130 | \$3,461,317 |
| 518 | Data processing, hosting and related services | 76 | 1,101 | 1,110 | 1,119 | \$46,743,790 |
| 5182 | Data processing, hosting and related services | 76 | 1,101 | 1,110 | 1,119 | \$46,743,790 |
| 519 | Other information services | 159 | 2,836 | 2,852 | 2,841 | \$73,947,279 |
| 5191 | Other information services | 159 | 2,836 | 2,852 | 2,841 | \$73,947,279 |
| | Financial Activities | 3,000 | 82,054 | 82,381 | 81,991 | \$5,880,166,194 |
| 52 | Finance and Insurance | 1,839 | 68,740 | 69,032 | 68,660 | \$5,458,303,765 |

| | | | | | | |
|------|--|-------|---------|---------|---------|-----------------|
| 522 | Credit intermediation and related activities | 381 | 17,428 | 17,502 | 17,223 | \$969,190,375 |
| 5221 | Depository credit intermediation | 244 | 14,259 | 14,296 | 13,997 | \$798,617,782 |
| 5222 | Nondepository credit intermediation | 76 | 1,749 | 1,785 | 1,790 | \$121,111,364 |
| 5223 | Activities related to credit intermediation | 61 | 1,420 | 1,421 | 1,436 | \$49,461,229 |
| 523 | Securities, commodity contracts, investments | 1,047 | 31,689 | 31,845 | 31,703 | \$3,600,025,824 |
| 5231 | Securities and commodity contracts brokerage | 243 | 8,752 | 8,840 | 8,724 | \$962,555,864 |
| 5239 | Other financial investment activities | 800 | 22,914 | 22,983 | 22,958 | \$2,636,402,253 |
| 524 | Insurance carriers and related activities | 393 | 18,540 | 18,606 | 18,649 | \$856,171,539 |
| 5241 | Insurance carriers | 115 | 14,820 | 14,884 | 14,901 | \$704,652,730 |
| 5242 | Insurance agencies and brokerages | 278 | 3,720 | 3,722 | 3,748 | \$151,518,809 |
| 525 | Funds, trusts, and other financial vehicles | 15 | 10 | 10 | 10 | \$654,670 |
| 5259 | Other investment pools and funds | 14 | 9 | 9 | 9 | \$646,030 |
| 53 | Real Estate and Rental and Leasing | 1,161 | 13,314 | 13,349 | 13,331 | \$421,862,429 |
| 531 | Real estate | 1,016 | 10,885 | 10,953 | 10,932 | \$385,022,894 |
| 5311 | Lessors of real estate | 223 | 2,877 | 2,899 | 2,902 | \$94,958,425 |
| 5312 | Offices of real estate agents and brokers | 313 | 2,012 | 2,005 | 2,000 | \$69,269,006 |
| 5313 | Activities related to real estate | 480 | 5,996 | 6,049 | 6,030 | \$220,795,464 |
| 532 | Rental and leasing services | 138 | 2,370 | 2,332 | 2,337 | \$35,608,871 |
| 5321 | Automotive equipment rental and leasing | 49 | 1,467 | 1,456 | 1,442 | \$16,943,411 |
| 5322 | Consumer goods rental | 51 | 361 | 351 | 361 | \$3,827,200 |
| 5323 | General rental centers | 8 | 175 | 162 | 161 | \$2,839,970 |
| 5324 | Machinery and equipment rental and leasing | 30 | 367 | 363 | 373 | \$11,998,290 |
| | Professional and Business Services | 5,920 | 122,154 | 122,843 | 123,036 | \$3,717,030,832 |
| 54 | Professional and Technical Services | 4,570 | 81,642 | 82,257 | 82,228 | \$2,841,048,633 |
| 541 | Professional and technical services | 4,570 | 81,642 | 82,257 | 82,228 | \$2,841,048,633 |
| 5411 | Legal services | 987 | 14,642 | 14,607 | 14,530 | \$511,689,464 |
| 5412 | Accounting and bookkeeping services | 240 | 9,566 | 9,738 | 9,707 | \$258,715,401 |
| 5413 | Architectural and engineering services | 424 | 8,779 | 8,764 | 8,743 | \$220,338,959 |
| 5414 | Specialized design services | 176 | 799 | 814 | 815 | \$17,603,175 |
| 5415 | Computer systems design and related services | 958 | 15,479 | 15,653 | 15,707 | \$573,821,123 |
| 5416 | Management and technical consulting services | 911 | 15,664 | 15,745 | 15,731 | \$677,335,632 |
| 5417 | Scientific research and development services | 248 | 9,542 | 9,629 | 9,702 | \$372,618,953 |
| 5418 | Advertising, PR, and related services | 319 | 5,391 | 5,518 | 5,480 | \$166,990,055 |
| 5419 | Other professional and technical services | 307 | 1,780 | 1,789 | 1,813 | \$41,935,873 |
| 55 | Management of Companies and Enterprises | 188 | 8,367 | 8,375 | 8,369 | \$443,203,410 |
| 551 | Management of companies and enterprises | 188 | 8,367 | 8,375 | 8,369 | \$443,203,410 |
| 5511 | Management of companies and enterprises | 188 | 8,367 | 8,375 | 8,369 | \$443,203,410 |
| 56 | Administrative and Waste Services | 1,162 | 32,145 | 32,211 | 32,439 | \$432,778,788 |
| 561 | Administrative and support services | 1,120 | 31,370 | 31,440 | 31,666 | \$420,094,657 |
| 5611 | Office administrative services | 106 | 1,029 | 1,066 | 1,067 | \$33,418,401 |
| 5612 | Facilities support services | 21 | 461 | 471 | 478 | \$6,977,178 |
| 5613 | Employment services | 338 | 12,742 | 12,579 | 12,703 | \$191,723,375 |
| 5614 | Business support services | 116 | 813 | 872 | 850 | \$10,530,194 |
| 5615 | Travel arrangement and reservation services | 118 | 2,099 | 2,088 | 2,127 | \$46,158,436 |

| | | | | | | |
|------|---|-------|---------|---------|---------|-----------------|
| 5616 | Investigation and security services | 82 | 6,783 | 6,820 | 6,788 | \$58,650,541 |
| 5617 | Services to buildings and dwellings | 279 | 6,379 | 6,492 | 6,531 | \$50,566,213 |
| 5619 | Other support services | 60 | 1,064 | 1,052 | 1,122 | \$22,070,319 |
| 562 | Waste management and remediation services | 42 | 775 | 771 | 773 | \$12,684,131 |
| 5621 | Waste collection | 16 | 380 | 377 | 389 | \$5,505,470 |
| 5622 | Waste treatment and disposal | 4 | 16 | 16 | 17 | \$281,839 |
| 5629 | Remediation and other waste services | 22 | 379 | 378 | 367 | \$6,896,822 |
| | Education and Health Services | 6,602 | 196,288 | 198,662 | 198,955 | \$3,680,817,266 |
| 61 | Educational Services | 507 | 53,643 | 56,023 | 55,689 | \$966,842,871 |
| 611 | Educational services | 507 | 53,643 | 56,023 | 55,689 | \$966,842,871 |
| 6111 | Elementary and secondary schools | 59 | 12,561 | 12,525 | 12,549 | \$228,256,810 |
| 6113 | Colleges and universities | 44 | 34,289 | 35,975 | 35,531 | \$655,938,545 |
| 6114 | Business, computer and management training | 41 | 392 | 585 | 601 | \$7,212,415 |
| 6115 | Technical and trade schools | 26 | 285 | 309 | 328 | \$4,126,164 |
| 6116 | Other schools and instruction | 180 | 2,711 | 2,803 | 2,847 | \$24,007,200 |
| 6117 | Educational support services | 152 | 1,589 | 1,660 | 1,661 | \$27,474,594 |
| 62 | Health Care and Social Assistance | 6,095 | 142,645 | 142,639 | 143,266 | \$2,713,974,395 |
| 621 | Ambulatory health care services | 817 | 22,688 | 22,631 | 22,623 | \$539,207,265 |
| 6211 | Offices of physicians | 237 | 10,713 | 10,662 | 10,645 | \$376,972,187 |
| 6212 | Offices of dentists | 229 | 1,766 | 1,747 | 1,716 | \$25,248,813 |
| 6213 | Offices of other health practitioners | 196 | 1,144 | 1,144 | 1,149 | \$14,172,593 |
| 6214 | Outpatient care centers | 53 | 3,985 | 3,992 | 4,022 | \$66,009,254 |
| 6215 | Medical and diagnostic laboratories | 22 | 208 | 205 | 203 | \$3,830,360 |
| 6216 | Home health care services | 62 | 3,350 | 3,379 | 3,361 | \$28,355,612 |
| 6219 | Other ambulatory health care services | 18 | 1,522 | 1,502 | 1,527 | \$24,618,446 |
| 622 | Hospitals | 36 | 94,630 | 94,749 | 94,857 | \$1,944,486,067 |
| 6221 | General medical and surgical hospitals | 20 | 77,583 | 77,738 | 77,907 | \$1,667,395,104 |
| 6222 | Psychiatric and substance abuse hospitals | 6 | 714 | 714 | 736 | \$9,980,579 |
| 6223 | Other hospitals | 10 | 16,333 | 16,297 | 16,214 | \$267,110,384 |
| 623 | Nursing and residential care facilities | 133 | 5,942 | 5,949 | 5,968 | \$57,866,919 |
| 6231 | Nursing care facilities, skilled nursing | 28 | 3,183 | 3,191 | 3,186 | \$33,358,938 |
| 6232 | Residential mental health facilities | 60 | 1,423 | 1,410 | 1,436 | \$12,921,916 |
| 6233 | Continuing care, assisted living facilities | 28 | 782 | 791 | 789 | \$5,876,020 |
| 6239 | Other residential care facilities | 17 | 554 | 557 | 557 | \$5,710,045 |
| 624 | Social assistance | 5,109 | 19,385 | 19,310 | 19,818 | \$172,414,144 |
| 6241 | Individual and family services | 4,819 | 13,218 | 13,112 | 13,585 | \$108,953,664 |
| 6242 | Emergency and other relief services | 89 | 2,356 | 2,363 | 2,390 | \$29,517,710 |
| 6243 | Vocational rehabilitation services | 21 | 1,288 | 1,295 | 1,300 | \$13,197,260 |
| 6244 | Child day care services | 180 | 2,523 | 2,540 | 2,543 | \$20,745,510 |
| | Leisure and Hospitality | 2,767 | 67,993 | 68,661 | 70,169 | \$622,126,287 |
| 71 | Arts, Entertainment, and Recreation | 367 | 9,979 | 9,822 | 10,498 | \$169,436,327 |
| 711 | Performing arts and spectator sports | 165 | 4,218 | 3,933 | 4,596 | \$119,632,080 |
| 7111 | Performing arts companies | 52 | 1,477 | 1,531 | 1,754 | \$22,908,076 |
| 7112 | Spectator sports | 14 | 1,398 | 1,076 | 1,561 | \$77,381,122 |

| | | | | | | |
|------|---|-------|--------|--------|--------|---------------|
| 7113 | Promoters of performing arts and sports | 37 | 1,146 | 1,144 | 1,094 | \$13,732,979 |
| 7114 | Agents and managers for public figures | 21 | 77 | 67 | 64 | \$2,790,053 |
| 7115 | Independent artists, writers, and performers | 41 | 120 | 115 | 123 | \$2,819,850 |
| 712 | Museums, historical sites, zoos, and parks | 35 | 2,461 | 2,529 | 2,574 | \$29,730,376 |
| 7121 | Museums, historical sites, zoos, and parks | 35 | 2,461 | 2,529 | 2,574 | \$29,730,376 |
| 713 | Amusements, gambling, and recreation | 167 | 3,300 | 3,360 | 3,328 | \$20,073,871 |
| 7139 | Other amusement and recreation industries | 167 | 3,300 | 3,360 | 3,328 | \$20,073,871 |
| 72 | Accommodation and Food Services | 2,400 | 58,014 | 58,839 | 59,671 | \$452,689,960 |
| 721 | Accommodation | 115 | 10,954 | 11,007 | 11,183 | \$138,464,450 |
| 7211 | Traveler accommodation | 104 | 10,915 | 10,962 | 11,138 | \$138,233,901 |
| 722 | Food services and drinking places | 2,285 | 47,060 | 47,832 | 48,488 | \$314,225,510 |
| 7223 | Special food services | 222 | 6,676 | 7,317 | 7,245 | \$55,714,111 |
| 7224 | Drinking places, alcoholic beverages | 113 | 2,119 | 2,116 | 2,216 | \$12,359,072 |
| 7225 | Restaurants and other eating places | 1,950 | 38,265 | 38,399 | 39,027 | \$246,152,328 |
| | Other Services | 2,789 | 21,385 | 21,532 | 21,746 | \$244,441,961 |
| 81 | Other Services, Except Public Administration | 2,789 | 21,385 | 21,532 | 21,746 | \$244,441,961 |
| 811 | Repair and maintenance | 330 | 1,697 | 1,673 | 1,684 | \$19,875,629 |
| 8111 | Automotive repair and maintenance | 249 | 1,349 | 1,317 | 1,325 | \$13,882,262 |
| 8112 | Electronic equipment repair and maintenance | 25 | 90 | 92 | 91 | \$1,652,981 |
| 8113 | Commercial machinery repair & maintenance | 16 | 128 | 131 | 132 | \$2,846,158 |
| 8114 | Household goods repair and maintenance | 40 | 130 | 133 | 136 | \$1,494,228 |
| 812 | Personal and laundry services | 790 | 8,527 | 8,589 | 8,710 | \$65,214,987 |
| 8121 | Personal care services | 449 | 3,476 | 3,466 | 3,509 | \$25,073,472 |
| 8122 | Death care services | 34 | 288 | 287 | 286 | \$3,594,388 |
| 8123 | Drycleaning and laundry services | 129 | 819 | 897 | 899 | \$5,628,032 |
| 8129 | Other personal services | 178 | 3,944 | 3,939 | 4,016 | \$30,919,094 |
| 813 | Membership associations and organizations | 765 | 10,227 | 10,354 | 10,409 | \$150,414,570 |
| 8131 | Religious organizations | 15 | 38 | 40 | 40 | \$417,126 |
| 8132 | Grantmaking and giving services | 135 | 1,373 | 1,369 | 1,370 | \$23,984,756 |
| 8133 | Social advocacy organizations | 249 | 3,141 | 3,179 | 3,245 | \$47,990,060 |
| 8134 | Civic and social organizations | 127 | 3,093 | 3,111 | 3,138 | \$26,255,269 |
| 8139 | Professional and similar organizations | 239 | 2,582 | 2,655 | 2,616 | \$51,767,359 |
| 814 | Private households | 904 | 934 | 916 | 943 | \$8,936,775 |
| 8141 | Private households | 904 | 934 | 916 | 943 | \$8,936,775 |
| | Public Administration | 470 | 35,011 | 34,881 | 34,855 | \$757,844,269 |
| 92 | Public Administration | 470 | 35,011 | 34,881 | 34,855 | \$757,844,269 |
| 921 | Executive, legislative and general government | 89 | 5,246 | 5,202 | 5,202 | \$96,750,727 |
| 9211 | Executive, legislative and general government | 89 | 5,246 | 5,202 | 5,202 | \$96,750,727 |
| 922 | Justice, public order, and safety activities | 147 | 11,808 | 11,810 | 11,778 | \$293,032,773 |
| 9221 | Justice, public order, and safety activities | 147 | 11,808 | 11,810 | 11,778 | \$293,032,773 |
| 924 | Administration of environmental programs | 37 | 2,595 | 2,585 | 2,565 | \$58,288,440 |
| 9241 | Administration of environmental programs | 37 | 2,595 | 2,585 | 2,565 | \$58,288,440 |
| 925 | Community & housing program admin | 12 | 1,633 | 1,635 | 1,631 | \$28,942,197 |
| 9251 | Community & housing program admin | 12 | 1,633 | 1,635 | 1,631 | \$28,942,197 |

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|------|---|----|-------|-------|-------|---------------|
| 926 | Administration of economic programs | 61 | 5,795 | 5,792 | 5,811 | \$128,528,388 |
| 9261 | Administration of economic programs | 61 | 5,795 | 5,792 | 5,811 | \$128,528,388 |
| 928 | National security and international affairs | 6 | 677 | 675 | 671 | \$15,014,951 |
| 9281 | National security and international affairs | 6 | 677 | 675 | 671 | \$15,014,951 |