



DRAFT
 Waste Management
 Activity Analysis – Part 1







Table of Contents

Introduction & Purpose and Key Findings	1
Solid Waste Management Hierarchy	1
Methodology	2
Program Gaps & Metrics	2
Gap Analysis Model.....	3
Current Program Inventory	3
Options Identification	3
1.0 Source Reduction	4
1.1 Existing City Programs and Results	4
Grasscycling.....	4
Green Building Resource Center	5
1.2 Existing State and Local Policies and Regulations	5
State of Texas Plastic Bag Bans	5
Extended Producer Responsibility (EPR).....	6
City of Houston.....	6
1.3 Existing Public Information Programs	6
1.4 Needs and Gaps Assessment.....	6
Metrics Related to Source Reduction.....	6
1.5 Potential Future Actions	7
2.0 Reuse	9
2.1 Existing City Programs and Results	9
Building Materials Reuse Warehouse	9
Chemical Swap Shop & ReStore	10
2.2 Existing Regional Private and Nonprofit Programs.....	11
Repurpose Depot	11
Houston Habitat for Humanity ReStore	11
State of Texas Alliance for Recycling (STAR) Reuse Council.....	11
2.3 Existing Policies and Regulations	12
State Regulations.....	12
2.4 Existing Public Information Programs	12
2.5 Needs and Gaps Assessment.....	12
2.6 Potential Future Actions	13
Recycling & Reuse.....	13
3.0 Recycling	14
3.1 Existing City Programs and Results	14
Residential Curbside Collection	14
Multifamily Recycling Collection.....	16
Neighborhood Depository/Recycling Centers	16
Business Recycling Collection	18
Environmental Service Centers.....	18
Electronics Donation and Recycling.....	18
Overall Diversion Rate	19
3.2 Existing Public Information Programs	19
Houston-Galveston Area Council (H-GAC)	20
3.3 Existing Markets	21
Market Conditions for Traditional Recyclables	22
3.4 Existing Policies and Regulations.....	25
State Regulations.....	25



	Used Oil Recycling Program	25
3.5	Needs and Gaps Assessment.....	26
	Contamination	26
3.6	Potential Future Actions	27
	Recycling & Reuse.....	27
4.0	Organics.....	29
4.1	Existing City Programs and Results	29
	Residential Yard Waste and Tree Waste Collection.....	29
	Neighborhood Depository Green Waste Drop-Off.....	29
	Backyard Composting and Grasscycling.....	29
	Food Residual Recovery	30
	Biosolids Diversion	30
4.2	Existing Markets.....	30
	Feedstock Markets.....	30
	Product Markets	31
4.3	Existing Policies and Regulations	31
	Grasscycling.....	31
	Back Yard Composting	31
	Mulch Promotion	31
4.4	Existing Public Information Programs	32
4.5	Needs and Gaps Assessment.....	32
	Residential	32
	Non-Residential.....	32
4.6	Potential Future Actions	34
5.0	Construction and Demolition Debris	36
5.1	Existing City Programs and Results	36
5.2	Existing Markets.....	36
5.3	Existing Policies and Regulations	37
	City Policies Related to C&D.....	37
5.4	Existing Public Information Programs	37
5.5	Needs and Gaps Assessment.....	37
	Metrics Related to C&D.....	38
5.6	Potential Future Actions	38



Introduction & Purpose and Key Findings

The Vision Statement for the Integrated Resource Recovery Management Plan (“Plan”) is as follows.

“The Vision of Houston’s solid waste management program is to provide a financially sustainable solid waste management program that enhances Houston’s environment, encourages reduced per-capita disposal, and ensures long-term disposal capacity to serve the community in an equitable manner.”

The Citizens Advisory Task Force (“Task Force”) has established a number of goals and objectives for the City’s solid waste management program. The overall goals include the following:

- Increase Reuse, Recycling and Organics Diversion and decrease environmental risks of waste disposal in landfills
- Continue to Provide Quality Solid Waste Services to the residents and businesses of Houston
- Ensure Long-term Disposal Capacity and Sustainable Solid Waste Infrastructure
- Provide solid waste management services in a safe, equitable, responsive, and environmentally responsible manner.
- Achieve Financial Sustainability for Solid Waste Services

The purpose of this report is to provide the Citizens Advisory Task Force with an assessment of the City’s current solid waste management program. This assessment takes into consideration the recently adopted draft goals and objectives established by the Task Force. The City currently provides a range of services to the community to protect the City’s environment and meet the health needs of the community. **Moving forward, the City intends to make Houston’s Resource Management Program a first class service, which will require a number of changes and long-term investments.** This report identifies potential options for the long-term solid waste plan. The Consulting Team will evaluate these options and present a DRAFT PLAN to the Task Force. Once the Task Force has approved, it will be presented to Houston residents and businesses for comment. Based on this input as well as input from City Council, a FINAL PLAN will be prepared.

Solid Waste Management Hierarchy

This report focuses on the solid waste management hierarchy. The hierarchy as presented in Figure 0-1 illustrates focuses on reducing waste generated through source reduction and reuse, then recovery of materials through recycling and composting. Whatever cannot be reduced or recovered, is either treated through energy recovery systems or disposed properly in a permitted municipal solid waste or construction / demolition landfill. The first part of the report deals with source reduction, reuse, recycling and organics management. The second part of the report will deal with solid waste collection, energy recovery, landfill disposal and illegal dumping.





Methodology

The City currently provides residents and businesses with a range of solid waste management services that in many ways focus on the above goals. Moving forward, the City will need to adopt a Plan that realistic and implementable. In order for the Plan to meet these criteria, the City has requested that the Plan address SMART Planning concepts.

Specific. Projects and Programs developed for the Plan should have specific recommendations that can lead to actionable policies or programs.

Measurable. In order to assess the success of programs and policies, there should be a measurable component. We refer to these measurable components as metrics. Metrics are based on city targets or industry standards. The Task Force will have an opportunity to discuss these metrics and make modifications as the Plan is developed.

Attainable. The proposed policies and programs must be realistic. Establishing unattainable goals or objectives will only result in program failure.

Relevant. The plan is intended to focus specifically on issues related to integrated resource management. Specifically, this plan focuses on ways to reduce waste generation, increase recycling, provide efficient collection of waste and recyclables, assure disposal capacity and establish a financially sustainable program.

Time-bound. The planning period is for a twenty year timeframe. The Plan will further be divided into short-term, mid-term and long-term programs and policies.

The focus of this report is to evaluate the City's current resource management program with respect to the Task Force's goals and objectives using the SMART criteria.

Program Gaps & Metrics

The Task Force goals and objectives defines the type of resource management program it believes is necessary to meet the Vision Statement. In certain ways, the City's current program may achieve some of these goals and objectives. In other ways, there are definite "program gaps." To determine if program gaps exist, the Project Team has established "primary metrics" for the goals and objectives. These metrics are based on the City's current program goals and the Project Team's knowledge of the solid waste industry, benchmarking studies and best practices.

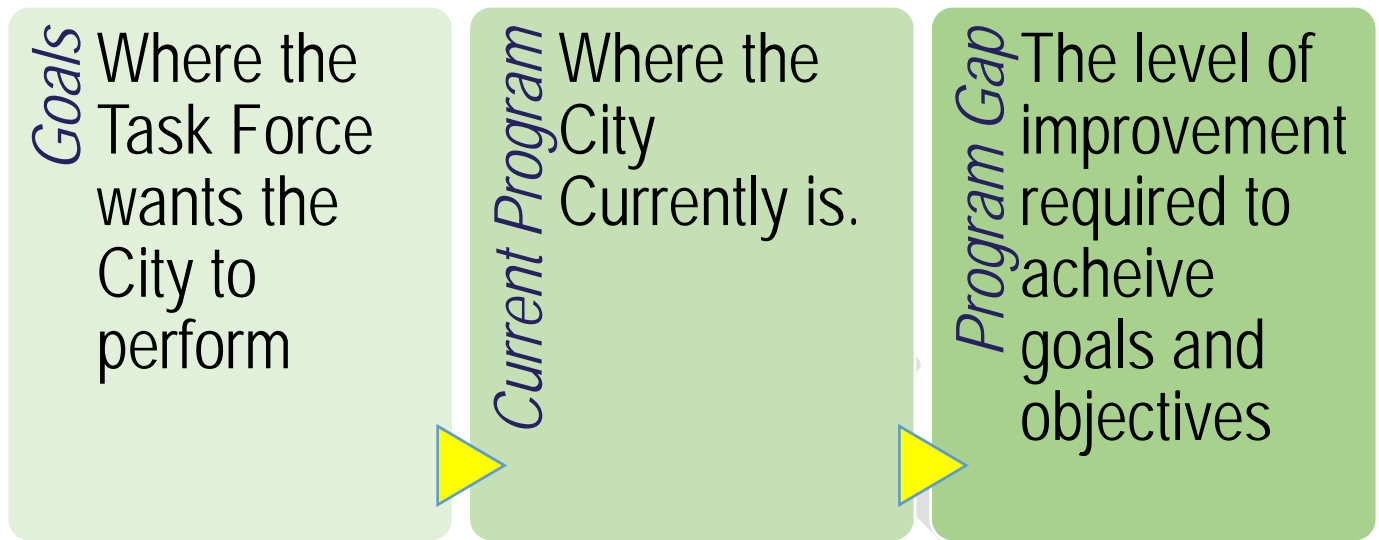
SMART Planning Concepts

- ✓ Specific
- ✓ Measurable
- ✓ Attainable
- ✓ Relevant
- ✓ Time-bound

Program Gaps are defined to identify where the current solid waste program does not achieve the Task Force's newly developed goals and objectives.



Gap Analysis Model



For example, one of the Task Force's objective is to increase participation of single family homes in recycling programs, to increase amounts and types of materials and decrease contamination. Based on the performance of other communities with similar size the metrics would be for the City to participation rates are 75%, recovery rate of 25% of single family material, with a contamination level below 20%. Currently, the City's program participation rate is 65%, it recovers approximately 16% of the residential waste stream and has a contamination level of 25%. The program gap is 10% for participation; 9% for recovery; and 5% for contamination levels. The strategic plan will be designed to identify programs and policies to eliminate these gaps.

It should be noted that metrics may change over time. For example, the short-term recovery rate may be 25%, with a longer term objective of 40%.

The Project Team also recognizes that for certain program metrics, it is necessary to evaluate specific operational conditions that have a bearing on the overall performance of the program. For example, collection efficiency may be measured by number of households served per route as a primary metric. To accomplish this objective, the City must have sufficient operating trucks, sufficient labor, and an adequate preventive maintenance program. The Project Team will evaluate these "secondary metrics" which are essential to meeting the primary metrics.

Current Program Inventory

The Project Team has spent a considerable amount of time interviewing City staff to identify specific projects and performance measures. Other steps taken to evaluate the City's current program have been to review city budgets and existing contracts.

Options Identification

As part of this analysis, the Project Team will also identify specific options that may be adopted by the City to achieve the goals and objectives. A more thorough analysis of these options will be presented in the Strategic Analysis Phase of the Plan.



1.0 Source Reduction

In the full lifecycle of any product, there are three main segments: up-stream, mid-stream and down-stream. The up-stream segment of a product's lifecycle involves the manufacturing process itself, where manufacturers determine which materials and how much material will be used to manufacture and package the product. The mid-stream segment of a product's lifecycle focuses on the longevity of the product, including reuse and repurposing of products. The down-stream segment of a product's lifecycle focuses on recovery, including recycling or energy recovery. By nature of the role of local government, the down-stream segment of a product's lifecycle is the point of greatest direct impact. However, local governments can, to some degree, influence the up-stream and mid-stream segments of a product's lifecycle, before the materials arrive at a local government facility, by promoting waste prevention, reduction, and reuse. A local government can also lead by example with its own purchasing policies.

The Environmental Protection Agency (EPA) defines source reduction as activities designed to reduce the volume or toxicity of waste generated, including the design and manufacture of products with minimum toxic content, minimum volume of material, and/or longer useful life.¹ Source reduction is fundamentally different from the other elements of the solid waste hierarchy insofar as source reduction occurs before materials have been identified as waste.

A variety of practices exist to promote source reduction in local communities, which affect the residential, commercial, industrial, and institutional sectors. The EPA focuses on the following six source reduction options in the residential, commercial, industrial, and institutional sectors:

- Residential Sector Options
 - Grasscycling
 - Home Composting
 - Clothing and footwear reuse
- Commercial, Industrial, Institutional (CII) Sector Options
 - Office paper reduction
 - Converting to multi-use pallets
 - Paper towel reduction

Source reduction in practice has environmental benefits through reduced energy consumption and pollution, conservation, and the extension of landfill space. It also has the potential to impact financial obligations through reduced transportation and disposal costs.

1.1 Existing City Programs and Results

Grasscycling

Grasscycling programs are one of the simplest ways to divert organic materials from the municipal solid waste (MSW) stream. Grasscycling programs encourage residents to leave grass clippings on their lawns instead of bagging and disposing of them. Grasscycling diverts a portion of the waste stream and provides an excellent source of nutrients for the lawn; yard trimmings make up more than 30% of the total residential waste stream in Houston. Research has shown that lawns generate approximately 300 pounds of grass clippings per 1,000 square feet annually, which amounts to 6.5 tons per acre each year.²

1

<https://nepis.epa.gov/Exe/ZyNET.exe/10000ZYP.txt?ZyActionD=ZyDocument&Client=EPA&Index=1995%20Thru%201999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C95THRU99%5CTXT%5C00000007%5C10000ZYP.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=6>

² <https://www.calrecycle.ca.gov/organics/grasscycling>



On April 5, 2010, the City of Houston implemented a compostable bag program, requiring residents to use compostable bags for City collection of green organic material. If green waste is not bagged in the city-approved compostable bags, it will not be collected. As a free alternative to purchasing the compostable bags for City collection, the City recommends grasscycling.

Green Building Resource Center

The Green Building Resource Center (GRBC) is assisting residents in conservation efforts by offering 50-gallon rain barrels and 65-gallon compost bins at discounted prices of \$69.00 and \$65.00. The Green Building Resource Center, located on the first floor of the Houston Permitting Center, is a project of Houston Public Works offering economical and sustainable building solutions for the public.³ Information is also made available about zero waste initiatives that promote how to cut down on waste, especially packaging, and the importance of changing consumption habits.

Leading by example, the GRBC was constructed to green building standards to reach LEED for New Construction to the Gold level and features water efficient plumbing fixtures, recycled artwork, and recycled acoustical insulation. Additionally, the GRBC maintains a vegetated roof, watered with harvested rainwater, a rooftop array of 387 solar panels, and turf-covered bio filtration. The GRBC offers over 50 educational displays, a library of information, samples of recycled materials for green building and in-home energy conservation, and also highlights the impacts of recycling.

1.2 Existing State and Local Policies and Regulations

State of Texas Plastic Bag Bans

The State of Texas Health and Safety, Chapter 361, known as the Solid Waste Disposal Act, controls the management of solid waste in Texas. Recent developments in Texas include a June of 2018 ruling by the Texas Supreme Court in which a City of Laredo ban on plastic bags was struck down, citing the State law on solid waste disposal pre-empts local ordinances. Several Texas municipalities have had plastic bag bans in place prior to this ruling, some for many years, including Brownsville, Eagle Pass, Port Aransas, Kermit, Sunset Valley, and Freer. The anticipated effect of the ruling is that it will make other local government ordinances banning materials unenforceable as well.

Local jurisdictions banning plastic bags has been a common practice in other parts of the country for many years. In California alone, roughly 140 cities and counties have plastic bag bans in place. In August of 2014, California became the first state to enact legislation imposing a statewide ban on single-use plastic bags at large retail stores. In 2009, Washington D.C. enacted a local ban on the use of disposable non-recyclable plastic carryout bags, and to establish a fee on all other disposable carryout bags provided by grocery stores, drug stores, liquor stores, restaurants, and food vendors.

Many other cities, towns, and counties across the United States have implemented bans or fees on the use of plastic bags, including one in Arizona, seven in Alaska, eight in Colorado, two in Connecticut, one in Florida, six in Hawaii, one in Iowa, three in Illinois, sixty-nine in Massachusetts, five in Maryland, fifteen in Maine, one in Michigan, three in North Carolina, twelve in New Jersey, two in New Mexico, seventeen in New York, nine in Oregon, seven in Rhode Island, five in South Carolina, three in Utah, one in Vermont, and nineteen in Washington⁴.

Given the focus of bans by local governments, many state legislatures do not prioritize the issue, leaving it to the local governments. With the recent Texas Supreme Court ruling, local government ordinances banning materials in Texas would not be useful at this time.

³ <https://www.codegreenhouston.org/>

⁴ <https://www.forbes.com/sites/trevornace/2018/09/20/heres-a-list-of-every-city-in-the-us-to-ban-plastic-bags-will-your-city-be-next/#1913e2663243>



Extended Producer Responsibility (EPR)

The State of Texas has passed two extended producer responsibility state laws. In 2007, the 80th Texas Legislature passed HB 2714 requiring all manufacturers offering to sell new computer equipment⁵ in or into Texas to perform the following tasks:

- Offer consumers a free and convenient recycling program;
- Submit a notification and recovery plan to the Texas Recycles Computer Program; and
- Submit a manufacturers' annual computer recycling report to TCEQ by January 31 of each year. This report must track the weight of computer equipment collected, recycled, and reused.

In 2011, the 82nd Texas Legislature passed SB 329 which requires television manufacturers to perform the following tasks⁶:

- Permanently attach a brand label to the television;
- Document that the collection, reuse, and recycling of their collected covered television equipment complies with state regulations. For instance, if a manufacturer is using a television recycler in the state of Texas, the recycler must be registered with TCEQ;
- Maintain a television recycling program or join a recycling leadership program.

City of Houston

The City of Houston has a Strategic Procurement Division (SPD) that manages procurement activities for the City. The current policies of the SPD do not include environmentally preferred or required practices related to source reduction. However, there is an administrative procedure, A.P Number 2-15, dated April 23, 1991, that establishes guidelines for the procurement of products made from recyclable materials.

1.3 Existing Public Information Programs

The City's current public information programs primarily focus on City-provided services related to collection and drop-off programs, without emphasis on source reduction. More details about current public information programs are described in Section 3.2.

1.4 Needs and Gaps Assessment

- Source reduction is not currently a primary focus for the City, and there are no specific policies or outreach materials aimed at encouraging source reduction, with the exception of grasscycling and the GRBC webpage dedicated to promoting zero waste habits.
- The City's current Strategic Procurement Division guidelines do not include source reduction policies.

Metrics Related to Source Reduction

Table 1-1 identifies the metrics that could be tracked to measure future success related to source reduction.

**Table 1-1
Source Reduction Metrics**

Metric	Measurement	Source	Current	Define Success	Future
Waste Generation Rate Single-Family (SF)	See Below Total SF Generated Tons / # of Single-Family Households	See Below Tonnage & household data	See Below 1.95 tons per household ¹	See Below Decrease tons per household	
City of Houston	Total Generated Tons / City Population	Tonnage & population data	1.78 tons per person ²	Decrease tons per person	

⁵ Computer equipment is defined as a monitor, a desktop computer/laptop, and an accompanying keyboard and mouse made by the same manufacturer.

⁶ <https://www.tceq.texas.gov/p2/recycle/electronics/television-recycling-program-manufacturer-guidance>



Education Materials Disseminated (Source Reduction)	Number of people/entities receiving information (e.g. hits on website, hard copy materials)	Public Officer	Information	Not currently tracked	Number receiving information increases
Education Funding	\$/household	Public Officer	Information	Not currently known	Meet or exceed peer communities
Buildings participating in LEED certification (or similar program) with source reduction component	Number of buildings	General Services Department for Texas Gulf Coast Region Chapter ⁷	26 LEED Certified facilities only); more than 100 in Houston Area;		Increase in LEED certified (or similar program) buildings

1. Per the 2019 Waste Generation Report, the estimated tons generated per household is estimated to be 1.95 tons in 2019. The total tonnage generated for single-family homes is based on the FY 2016 & FY 2017 per capita rate that was calculated using City provided data for the single-family homes served by the Houston Solid Waste Management Department. The per capita rates were then extrapolated to include all City of Houston single-family homes, including those not currently served by the Houston Solid Waste Management Department.
769,218 total single-family tons / 462,736 households = 1.95 tons per household.
2. Per the 2019 Waste Generation Report, the estimated tons generated per person is projected to be 1.78 tons in 2019. The total tonnage generated is an estimate based on a combination of data sources provided by the City of Houston, as well as H-GAC's population forecast. It is important to note that the total tonnage amount includes municipal solid waste, recycling, yard waste, and construction & demolition (C&D) tons. Furthermore, the total estimated tonnage generated in the City of Houston also includes tonnage generated by employees who work within the City, who may not also reside within the City (i.e. commuters).
4,238,052 Tons (Estimated 2019 Tons for the City of Houston) / 2,383,675 (Estimated 2019 Population for the City of Houston) = 1.78 tons per person.

1.5 Potential Future Actions

Overall Objective: Encourage and facilitate waste prevention and reduction for all Houston residents and businesses, while leading by example.

The following potential future actions will be further evaluated for viability in Task 6 – Strategic Analysis and may be recommended for inclusion in the final Integrated Resource Recovery Management Plan.

1. Expand education of residents and businesses to include source reduction opportunities.
 - a. Include tips to promote source reduction activities in the City's ongoing education and outreach materials.
 - b. Update the Solid Waste webpage to include source reduction tips.
 - c. Measure success by tracking single family generation rates and total generation rates.
 - d. Measure success by increasing the number of citizens reached with education materials.
2. Evaluate and modify, as appropriate, the City's current purchasing practices and guidelines for City buildings and facilities to lead by example
 - a. The City could create a sustainability purchasing team to develop an Environmentally Preferable Purchasing Guide (EPPG) to promote and encourage environmental stewardship across all City agencies. The sustainability purchasing team would likely be made up of volunteer City employees from multiple departments across the City in order to represent and the different departments' varying purchasing interests. The purpose of the EPPG could include supporting markets for recycled and other environmentally preferable products by encouraging City agencies and contractors to buy such products wherever practicable as well as outlining operating standards for waste reduction and recycling. The purchasing guidelines can go beyond purchasing recycled content items and include initiatives such as hand dryers and refillable soap dispensers in City restrooms. These initiatives could be reiterated through policy memos distributed to all City departments. The EEPG should also include measurable goals in order to monitor progress. The following table provides some examples of measurable goals.

⁷ https://usgbctexasgulfcoast.org/content.php?page=Houston_Area_LEED_Buildings



**Table 1-2
Environmental Considerations in Purchasing Decisions for Goods and Services**

2025 Goal	2030 Goal
EPPG update	100% compliance with revised policy (effective implementation)
Purchase printer/copy paper products that contain 100% recycled material with a minimum 30% postconsumer content; 90% compliance	95% compliance
Purchase green office supplies: paper (other than printer/copier), metal, or plastic products that contain a minimum 10% recycled materials; 35% compliance	70% compliance
Purchase remanufactured inkjet, laser, and toner cartridges; 30% compliance	90% compliance
Purchase cleaning products that meet the Green Seal standards; 60% compliance	70% compliance
Purchase paint with low level of VOCs; 80% compliance	95% compliance

3. Implement a citywide “Green Building Code” to codify requirements for new construction and redevelopment projects to meet certain environmental criteria that include source reduction in coordination with the LEED certification in practice for City facilities. (On June 23, 2004, City Council adopted the Green Building Resolution, which set a target of Silver level LEED certification for new construction, replacement facilities and major renovations of city of Houston-owned buildings and facilities with more than 10,000 square feet of occupied space. The “Green Building Code” could require similar standards beyond City facilities, applying to any new construction or redevelopment taking place citywide.)
 - a. Could be implemented through revisions and additions to City of Houston Code of Ordinance, Chapter 10 – Buildings and Neighborhood Protection.
 - b. Could begin with City-owned structures to lead by example, and eventually include all construction in the City.
 - c. LEED certification requirements could be expanded to include City-specific standards for additional emphases on source reduction, reuse and recycling.
 - d. The code revisions could emphasize reduction of different types of wastes (e.g. C&D, MSW) during the construction process, and could include requirements for facilitating recycling during construction and after the building is occupied.
 - e. Measure success by how many buildings are participating in the certification program.
4. Monitor progress and consider implementing incentives for the Solid Waste Environmental Excellence Protocol (SWEEP) Standards for industry related to waste generation and prevention. At the time of this writing a municipal SWEEP Standard is also in development. The SWEEP Standards are not yet publicly available.
5. Support, facilitate and participate in state and national level discussions to impact manufacturer’s type and amounts of manufacturing materials and longevity of products.
 - State:
 - Plastic bag ban issues have been taken up by the State legislature, given the recent Texas Supreme Court ruling making local government ordinances unenforceable. Monitor the following legislative actions:
 - Senate Bill (SB) 648 relating to clarifying the law regarding local government prohibitions or restrictions on the sale or use of a container or package (referred to committee).
 - SB 816 relating to the regulation by certain municipalities of disposable plastic bag use (referred to committee).
 - House Bill 856 relating to local government prohibitions or restrictions on the sale or use of a container or package (referred to committee).
 - Monitor other state level efforts.
 - National:
 - Monitor national level efforts for product stewardship opportunities to support.



2.0 Reuse

Reuse, along with source reduction, is the EPA's preferred strategy for sustainable materials management. The EPA defines reuse as "the use of a product more than once in its same form for the same purpose (conventional reuse), or for different purposes (repurposing)." Materials reuse alleviates stress on the environment as it forgoes the practice of landfilling or incineration, and additionally conserves energy and natural resources that would be needed for producing new goods.⁸ Reuse can also reduce waste collection and costs for local waste authorities associated with transportation and disposal, which are similarly implicit in source reduction. Enterprises that redirect products from the waste stream for reuse also function as sorting facilities wherein reusable products are extracted from unwanted materials before materials are recycled or landfilled.

Local reuse initiatives, spearheaded by for-profit and nonprofit organizations, have contributed to the sustainability of urban environments by diverting reusable materials from the waste stream. In addition to the economic benefits and cost savings associated with reuse initiatives, reuse also has social benefits. Many reused products are donated to charitable organizations that provide important human services to the community.

2.1 Existing City Programs and Results

Building Materials Reuse Warehouse

The Building Materials Reuse Warehouse, located at 9003 North Main St., Houston, TX, 77002, opened in April 2009 as a program of the City's Solid Waste Management Department. The Reuse Warehouse is funded in part by a waste reduction grant from the Houston Galveston Area Council (H-GAC), a region-wide voluntary association of local governments in the 13-county Gulf Coast Planning region of Texas. It benefits the community by providing space for excess building materials that would otherwise be disposed in local landfills, while also fostering a culture of reuse and expanding partnerships between community stakeholders.

The Reuse Warehouse accepts material from individuals, supply companies, and builders, and makes it freely available for reuse by any non-profit organization (i.e. churches, schools, affordable housing, veterans, homeless shelters, etc.). The Reuse Warehouse does not limit the amount of material non-profit organizations can take but does work to ensure fair access to materials by various organizations. While, the Reuse Warehouse is only able to pass along building materials to non-profit organizations and not the public; many of the local organizations that collect from the Reuse Warehouse are able to make materials available to individuals through their organizational missions. Nonprofits like Living Paradigm, West Street Recovery, and Avenue CDC, for example acquire materials from the Reuse Warehouse and work directly with homeowners.⁹

The Reuse Warehouse only accepts building material that is in suitable condition for reuse and includes the following material types: cabinets, copper, doors, electrical fixtures and equipment, fans, flooring materials, glass, gutters, hardware, lighting, lumber, metal, mirrors, pipe, plumbing, plywood, roofing materials, screens, sheetrock, sinks, showers, trim, tubs, wall coverings, or windows.

Since its inception, the Reuse Warehouse has acquired approximately 9.5 million pounds of material, and in 2015, it was estimated that approximately 90% of all incoming material was donated to various non-profit organizations. In 2017 and 2018, approximately 1.4 million pounds and 988,727 pounds of material was donated to the Reuse Warehouse, respectively. Table 2-1 summarizes the 2017 & 2018 donations made to the Reuse Warehouse by material type.

⁸ <https://www1.nyc.gov/assets/dsny/docs/2017-NYC-Reuse-Sector-Report-FINAL.pdf>

⁹ <https://www.houstonchronicle.com/life/home/design/amp/RePurpose-Depot-local-nonprofits-use-recycling-13117638.php>



**Table 2-1
Reuse Warehouse Donations, 2017 & 2018 (in Pounds)**

	CY 2017	CY 2018
Bitumen	3,148	40,880
Cardboard	42,021	20,000
Ceramic	28,483	19,683
Concrete	179,219	170,561
Doors	34,315	45,302
Glass	33,883	17,876
Masonry	185,542	209,863
MEP	25,224	52,765
Metal	185,271	53,670
Miscellaneous	4,804	3,995
Plastic	409,014	31,063
Soil	45,785	178,471
Wood	208,166	144,598
Total (Pounds)	1,384,875	988,727

Chemical Swap Shop & ReStore

The City's Chemical Swap Shop and ReStore are operated by the City's Solid Waste Management Department, and they are located at the Environmental Service Center (ESC) South location. Every Friday, between 9 am and 12 pm, household chemicals and paint that were brought to the ESC South location for disposal, but appear to be in good condition, are made available for citizen reuse. Citizens may take away these items at no charge, however, there is a limit of six (6) chemical items and a cart load of paint per week. The ReStore, which acts as a book swap, a recycling information library, as well as a repository for craft items and post-consumer and post-industrial scrap, also makes items available to the public during the Reuse Chemical Take-Away.

Table 2-2 summarizes the materials reused and recycled at the North and South ESC locations.

**Table 2-2
Materials Reused/Recycled (in Pounds)**

	FY 2016	FY 2017
All Materials Collected¹	871,569	854,004
Total # of Customers²	5,433	5,408
Material Reused/Recycled		
Antifreeze	16,648	8,557
Bandit Signs	28,800	20,149
Batteries	4,288	13,974
Cardboard	11,580	7,020
Cooking Oil	18,550	20,690
Electronics Collections	70,795	60,855
Motor Oil	33,169	31,483
Plastic Buckets	-	-
Reuse Books	722	1,701
Reuse Chemicals	17,964	18,467



	FY 2016	FY 2017
All Materials Collected¹	871,569	854,004
Total # of Customers²	5,433	5,408
Reuse Paint ¹	85,957	84,871
Scrap Metal	61,802	38,069
Shredco Paper ³	-	4,600
Tires	5,244	3,418
Total (Pounds)	355,519	313,854
% of Materials Reused/Recycled	40.79%	36.75%

2.2 Existing Regional Private and Nonprofit Programs

Repurpose Depot

The Repurpose Depot was started by Caroline Kostak, a former flight controller for NASA's Space Shuttle and International Space Station program shortly after Hurricane Harvey flooded the Houston metropolitan area in August 2017. Although the Repurpose Depot operates as a for-profit business, it partners with The ReUse People of America, a 501(c)3, a non-profit dedicated to keeping reusable building materials out of the landfill. The Repurpose Depot, a 6,800 square-foot metal warehouse located at 305 McFarland Street in the East End of Houston, is a reclaimed building materials retail warehouse open to the public during regular business hours and by appointment.

Homeowners who are planning a demolition can contact the Repurpose Depot to remove usable materials, including doors, windows, flooring, cabinets, and appliances. Although there is an upfront cost to homeowners to use this service, they do qualify for a tax write-off that varies depending on the size of the home. Usable materials are then sent to the Repurpose Depot where they're sorted by material type and made available to the public. Some examples of materials available at the Repurpose Depot include:

- Stacks of bricks and pavers, \$0.50 each
- Lighting, prices range between \$15.00 (basic light fixture) and \$70.00 (chandelier)
- Flagstone, \$3.00 per square foot
- Granite counters, \$10 per square foot
- Windows, prices range between \$100 (single pane wood window) and \$500 (hurricane window)
- Hardwood flooring, \$1.25 per square foot

Houston Habitat for Humanity ReStore

The Houston Habitat for Humanity ReStores are non-profit home improvement and donation centers that sell new and gently used furniture, home accessories, building materials, appliances, flooring, cabinetry, and other miscellaneous items at a discounted price. Profits generated from the ReStores support Houston Habitat's mission of partnering with low to moderate income Houston families to assist them to obtain and maintain affordable housing. Two Habitat ReStores are currently located in the City of Houston, and they are open Monday through Saturday between 9 am and 5 pm.

State of Texas Alliance for Recycling (STAR) Reuse Council

the State of Texas Alliance for Recycling (STAR), is "a 501c3 recycling organization whose mission is to advance recycling through partnerships, education, and advocacy for the benefit of Texas". The City of Houston was actively involved in establishing the STAR Reuse Council, which focuses on waste diversion through reuse. The City also hosted the first ever Texas Reuse Tour in Houston. The City's Reuse Warehouse was the local host of the Reuse People's National Reuse Contest for three years before the annual contest had to be discontinued after the 2017 event due to time and expense considerations. The STAR Reuse Council stepped in and held a statewide Texas Reuse Contest in 2018. The STAR Reuse Council provides other events, such as reuse tours, as well as access to multiple resources on its webpage (<https://www.recyclingstar.org/working-groups/reuse-council/>).



2.3 Existing Policies and Regulations

State Regulations

There are no Texas regulations specifically related to reuse; however, it should be noted that the State’s Solid Waste Disposal Act defines "Recycling" as "the legitimate use, reuse, or reclamation of solid waste". For the purpose of this report, the term "Reuse" refers to the EPA definition: "the use of a product more than once in its same form for the same purpose (conventional reuse), or for different purposes (repurposing)."

City of Houston The City of Houston SPD that manages procurement activities for the City does not currently include environmentally preferred or required practices related to reuse. However, there is an administrative procedure, A.P Number 2-15, dated April 23, 1991, that establishes guidelines for the procurement of products made from recyclable materials.

The City promotes reuse by promoting its Building Materials Reuse Warehouse, and the Chemical Swap Shop.

2.4 Existing Public Information Programs

Promotion of the Reuse Warehouse and Chemical Swap Shop are included in the City’s current education and outreach materials.

2.5 Needs and Gaps Assessment

The City is directly involved in promoting and facilitating the reuse of building materials and chemicals but is not directly involved in promoting or facilitating the reuse of other materials.

Metrics Related to Reuse

Table 2-3 identifies the metrics that should be tracked to measure future success related to reuse.

**Table 2-3
Reuse Metrics**

Metric	Measurement	Source	Current	Define Future Success
Waste Diversion Rate	Diverted Tons / Total Tons Generated	Tonnage data	See Below	Increase diversion percentage
Single-Family (SF)	Total SF Generated Tons / # of Single-Family Households	Tonnage & household data	1.95 tons per household ¹	Decrease tons per household
City of Houston	Total Generated Tons / City Population	Tonnage & population data	1.78 tons per person ²	Decrease tons per person
Education Materials Disseminated (Reuse)	Number of people/entities receiving information (e.g. hits on website, hard copy materials)	Public Information Officer	Not currently tracked	Number receiving information increases
Education Funding	\$/household	Public Information Officer	Not currently known	Meet or exceed peer communities
ReUse Warehouse	Items Donated	Pounds data	1.2 million pounds/year ³	Meet or exceed current number of items donated
City ReStore & Chemical Swap Shop	Items Recovered / Total # of Items Donated	Pounds data	36.75% ⁴	Meet or exceed current % of materials diverted/reused
Electronics donation and recycling	Items Recovered	Pounds data	1.5 million pounds ⁵	Meet or exceed current number of items recycled

1. Per the 2019 Waste Generation Report, the estimated tons generated per household is estimated to be 1.95 tons in 2019. The total tonnage generated for single-family homes is based on the FY 2016 & FY 2017 per capita rate that was calculated using City provided data for the single-family homes served by the Houston Solid Waste Management Department. The per capita rates were then extrapolated to include all city of Houston single-family homes, including those not currently served by the Houston Solid Waste Management Department.
769,218 total single-family tons / 462,736 households = 1.95 tons per household.



Metric	Measurement	Source	Current	Define Future Success
2.	Per the 2019 Waste Generation Report, the estimated tons generated per person is projected to be 1.78 tons in 2019. The total tonnage generated is an estimate based on a combination of data sources provided by the City of Houston, as well as H-GAC's population forecast. It is important to note that the total tonnage amount includes municipal solid waste, recycling, yard waste, and construction & demolition (C&D) tons. Also, the total estimated tonnage generated in the city of Houston also includes tonnage generated by employees who work within the city, who may not also reside within the City (i.e. commuters). 4,238,052 Tons (Estimated 2019 Tons for the City of Houston) / 2,383,675 (Estimated 2019 Population for the city of Houston) = 1.78 tons per person.			
3.	See Table 2-1. Estimated average of 2017 & 2018 tons (in calendar year).			
4.	See Table 2-2.			
5.	See Table 3-4.			

2.6 Potential Future Actions

Recycling & Reuse

Overall Objective: Expand and innovate reuse and recycling opportunities to all Houston residents and businesses to increase diversion and recovery, while reducing contamination.

The following potential future actions will be further evaluated for viability in Task 6 – Strategic Analysis and may be recommended for inclusion in the final Integrated Resource Recovery Management Plan.

1. Encourage and facilitate the reuse of household and business items
 - a. The City could develop an interactive online tool to include on the City's solid waste webpage, to allow residents to type in an item, and the proper handling and options for reuse or recycling could be provided. (See Pinellas County, FL "A to Z guide" as an example at the following link)
<http://www.pinellascounty.org/solidwaste/getridofit/default.htm>
2. Increase education and promotion of reuse opportunities including additional means (i.e. social media, radio, television spots), in conjunction with expanding education and outreach described in Section 1.5.1.
3. Implement a "Green Building Code" to codify requirements for new construction and redevelopment projects citywide to meet certain environmental criteria, including reuse principles (among other things), described in more detail in Section 1.5.3.
4. Consider the need for additional City-run facilities for reuse, including which materials, how much material to anticipate, and accessibility of potential facilities.
5. Consider City-hosted "fix it fairs" to facilitate refurbishing and reusing items. (See Portland, OR Fix-It Fairs as an example at the following link)
<https://www.portlandoregon.gov/bps/41892>
6. Measure success by tracking single family generation rates and total generation rates.
7. Measure success by increasing the number of citizens reached with education materials.



3.0 Recycling

The EPA defines recycling as a series of activities by which discarded materials are collected, sorted, processed, converted into raw materials, and used in the production of new products. This section focuses on traditional recyclables (i.e. paper and containers), and discusses the City's recycling programs, services, and facilities. Note that according to the State's Solid Waste Disposal Act, the term "Recycling" refers to "the legitimate use, reuse, or reclamation of solid waste". For the purpose of this report, the term recycling refers to the EPA definition of processing and converting materials for the production of new products, as reuse is described separately.

3.1 Existing City Programs and Results

Residential Curbside Collection

The City provides residential curbside collection to approximately 387,000 households within its service area, including weekly garbage collection, weekly yard waste collection, every other week recycling collection, and once per month tree waste/junk waste collection. Per Chapter 39 – Solid Waste and Litter Control – of the City's Code of Ordinances, a residential unit is defined as "*houses, duplexes, condominiums, townhouses, townhomes, trailer homes, manufactured homes and patio homes. The term shall also include each apartment in an apartment project or community containing eight or fewer individual units*". These residential customers are provided with automated, single-stream, collection of recyclables. Each residential customer is provided with a green 96-gallon roll cart for recyclables collection. While the City has provided residential curbside recycling since the early 1990's, the transition to automated, single-stream recycling began in 2009.

Recyclable materials included in the City's program ("program materials") include:

- Paper: Newspaper, magazines, catalogs, junk mail, office paper;
- Plastic: Containers No. 1 through 5, and 7; examples include water and soda bottles, milk jugs, yogurt cups, detergent bottles;
- Aluminum cans and foil;
- Steel and tin cans;
- Glass;
- Cardboard (flattened); and
- Cartons: gable top and shelf stable cartons, juice cartons, soup cartons, soy milk/alternative milk cartons.

As shown in Table 3-1, the curbside recycling rate has declined in recent years. It should be noted that glass was removed from the single-stream curbside recycling program in March of 2016 due to cost concerns, and drop-off locations were offered instead through a partnership with Strategic Materials Inc. Along with a new processing contract with FCC Environmental Services (FCC), glass was recently reinstated into the curbside program in April of 2019. In Fiscal Year 2018, the curbside collection programs for both recycling and yard waste were briefly suspended due to Hurricane Harvey, which may account for some of the decline in tons collected through curbside programs, and therefore recycling and diversion rates, in FY 2018.



**Table 3-1
Single-Family (SF) Curbside Collection (Historical)**

	FY 2016	FY 2017	FY 2018 ²
SF Curbside Recycling (Tons)	62,287	51,497 ¹	36,595
SF Yard & Wood Waste (Tons)	54,479	54,569	30,612
SF Bulky Waste (Tons)	287,064	174,742	195,829
SF Curbside Garbage (Tons)	385,660	431,717	445,397
Total Tons³	789,490	712,525	708,433
Curbside Recycling Rate	7.89%	7.23%	5.17%
Curbside Yard & Wood Waste Diversion Rate	6.90%	7.66%	4.32%
Total Curbside Diversion Rate	14.79%	14.89%	9.49%

1. Glass was removed from the curbside recycling program in March of 2016.
2. The curbside collection program for recycling and yard waste was briefly suspended in FY 2018 after Hurricane Harvey.
3. This only includes tonnage collected by the City of Houston's Solid Waste Management Department.

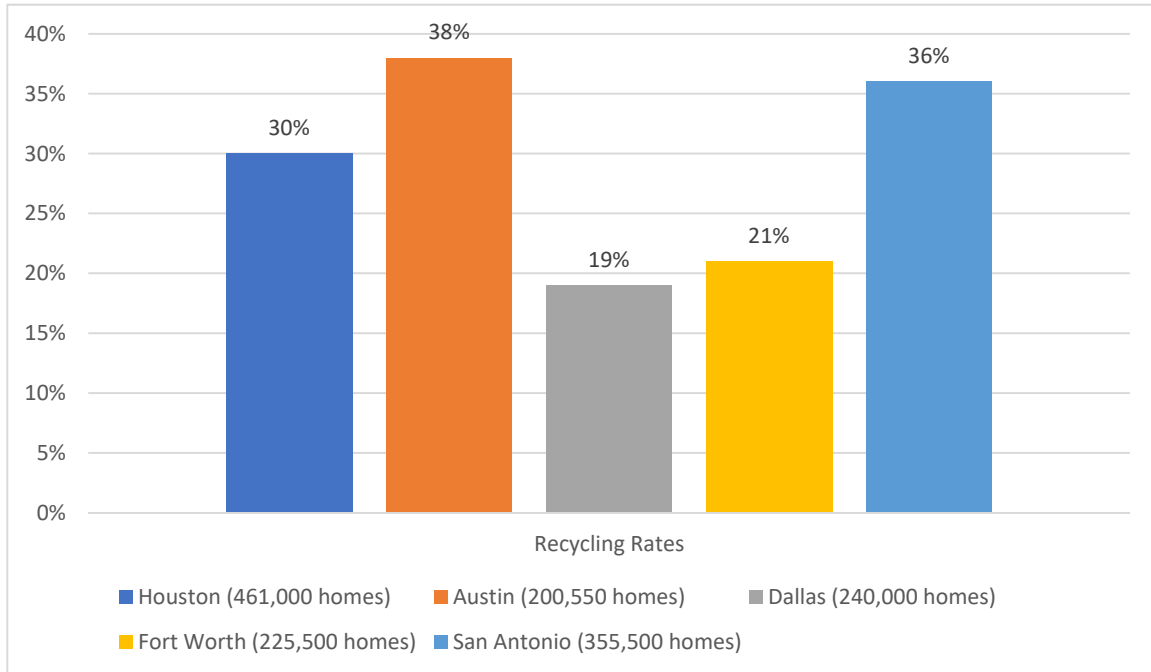
All recyclables collected by the City are processed and marketed by FCC with whom the City recently signed a 20-year contract. The City will own the \$23 million plant under the contract, although FCC manages operations and maintenance. Curbside recyclables are delivered to the material recovery facility (MRF) operated by FCC, which has an annual capacity of 145,000 tons. From there, recyclables are sorted via automated sorting robots which transfer materials to an appropriate bunker that are subsequently fed into baler machines to be baled and then marketed. Under the contract with FCC, at no time will the cost per a ton of recycled material exceed the cost per a ton of disposal to the landfill¹⁰.

The Project Team compared the City's recycling rate with the recycling rates for other Texas cities, which was aggregated using FY 2019 budget information for the City and each of the benchmark communities. Figure 3-1 summarizes the Project Team's benchmarking effort. Note that the City's total diversion rate of 30% reported in the FY 2019 budget includes curbside diversion efforts as well as additional City diversion efforts such as asphalt recovery and biosolids diversion.

¹⁰ <https://www.chron.com/news/houston-texas/houston/article/Glass-returns-to-Houston-s-curbside-recycling-13742370.php>



**Figure 3-1
Recycling Rates**



Multifamily Recycling Collection

The City's curbside recycling collection service is limited to apartment communities containing eight or fewer units. For residents residing in multifamily complexes with greater than eight units, recycling services through the City are limited to use of the Neighborhood Depository/Recycling Centers described below. Otherwise, multifamily complexes could contract directly with a private hauler for recycling collection. No data is available regarding the number of multifamily complexes that may contract with a private provider for recycling collection services.

It should be noted that per Chapter 39, Article VI – Screening of Bulk Containers of the City's Code of Ordinances, which requires that all bulk containers (i.e. dumpsters) be screened from view, allows an exemption to the screening requirements for bulk containers used exclusively for recyclable materials. This exemption makes placement of recycling containers less burdensome for locations that are limited in their ability to screen bulk containers.

Neighborhood Depository/Recycling Centers

The City operates six neighborhood depositories and three recycling centers to provide Houston residents a convenient opportunity to dispose of junk, tree, and recyclable materials. City of Houston residents may use the facilities up to four times per month; however, contractors and commercial businesses are prohibited from using the facilities. Citizens are required to unload their materials.

Accepted materials include:

- Junk waste: appliances, up to five tires, heavy trash, tree waste;
- Aluminum and tin cans;
- Household plastic containers No. 1 through 5, and 7;
- Glass bottles and jars;
- Paper;
- Cardboard; and
- Used motor oil.

Clothes and shoes are accepted at the North, Southeast, and Northeast Depositories. A list of all neighborhood depositories and recycling centers are listed in Table 3-2.



**Table 3-2
Neighborhood Depositories & Recycling Centers**

Facility	Location
Neighborhood Depositories¹	
North	9003 N Main, 77002
Northwest	14400 Sommermeyer, 77041
Northeast	5565 Kirkpatrick, 77028
South	5100 Sunbeam, 77033
Southwest	10785 SW Freeway, 77074
Southeast	2240 Central Street, 77017
City Recycling Centers	
Westpark Recycling Center ²	5900 Westpark, 77057
Clear Lake/Ellington Airport ³	246 Loop Rd., 77034
Kingwood Recycling Center ⁴	3210 W Lake Houston Pkwy. 77339

1. Hours of Operation: 9 am – 6 pm, Wednesday – Sunday.
2. Hours of Operation: 8 am – 5 pm, Monday – Saturday
3. Open 7 days a week
4. Open on weekends only, Friday – Sunday

The Westpark Recycling Center is the City's premier drive-through recycling drop-off location, open Monday through Saturday from 8:00 am to 5:00 pm. Accepted items include aluminum and tin cans, household plastic containers (No. 1 through 7, including plastic No. 6: clean, white Styrofoam), glass bottles and jars, paper, and cardboard. The Westpark Recycling Center also accepts batteries, used motor oil and filters, latex paint, antifreeze, plastic film, electronics, and tires. Textiles are also accepted.

Table 3-3 summarizes the materials collected at the neighborhood depositories and recycling centers for 2017 and 2018 (calendar years).

**Table 3-3
Drop-Off Location Materials (Tons)**

	CY 2017	CY 2018
Neighborhood Depositories		
North	459.15	482.36
Northwest	265.74	227.81
Northeast	132.16	136.60
South	88.21	65.61
Southwest	148.39	113.88
Southeast	126.79	138.17
City Recycling Centers		
Westpark Recycling Center	1,261.09	629.54
Clear Lake/Ellington Airport	481.23	232.78
Kingwood Recycling Center	359.54	291.81
Total (Tons)	3,322	2,319



Business Recycling Collection

The City offers small to mid-size businesses curbside recycling in select areas adjacent to residential curbside routes for a small fee. Businesses are eligible to receive a maximum of four 96-gallon green carts to store their recyclables, which are serviced by the City on a bi-weekly collection basis, along with residential curbside customers. Currently, 212 businesses participate in the program. The program materials are the same as the residential curbside collection, and the tons collected are included in Table 3-1 Single Family Curbside Recycling. Otherwise, businesses could contract directly with a private hauler for recycling collection. No data is available regarding the number of businesses that may contract with a private provider for recycling collection services. As was documented in the Waste Generation Report, data extrapolated from the 2017 TCEQ Study indicates that over 70% of the traditional recyclables diverted in the City come from sources other than the curbside recycling program and the drop off centers, indicating the business sector is currently very active in recycling.

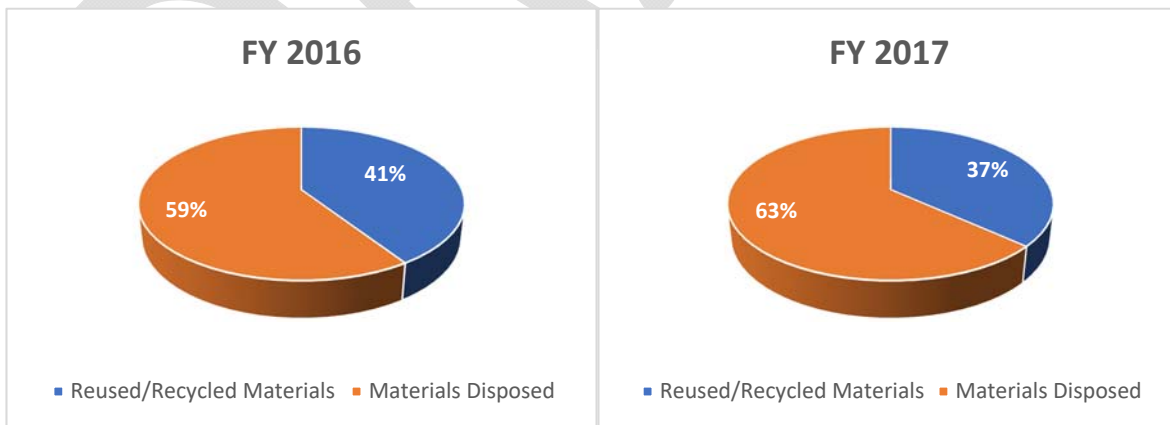
As previously noted, the City's Code of Ordinances, which requires that all bulk containers (i.e. dumpsters) be screened from view, allows an exemption to the screening requirements for bulk containers used exclusively for recyclable materials. This exemption makes placement of recycling containers less burdensome for locations that are limited in their ability to screen bulk containers.

Environmental Service Centers

The Environmental Service Centers (ESC) provide drive through drop-off locations for Houston residents to bring their household hazardous waste (HHW) such as anti-freeze, batteries, fuel, oil, paint, paint thinner, pesticides, herbicides and household cleaners. Residential electronic scrap items are accepted (monitors, televisions, printers, keyboards, mice, scanners, fax machines, telephone handsets, VCRs, CPUs, cellular phones and other small consumer electronics). These items should not be placed on the curb for collection with garbage or tree waste / junk waste pickup. Clean, white Styrofoam blocks (plastic #6) is also accepted at the ESC-South location, however packing "peanuts" are not accepted.

Figure 3-1 summarizes the percent of reused/recycled materials versus the percent disposed from all materials collected at the ESC locations for FY 2016 and FY 2017. Please note that this also includes the latex paint material collected at the Westpark Drop-off location. The City contracts with Stericycle to properly manage HHW such as antifreeze, paint, pesticides, etc. The City contracts with CompuCycle and RAKI to recycle electronics.

Figure 3-2
ESC Collections, Reused/Recycled Materials vs. Materials Disposed



Electronics Donation and Recycling

The increased adoption and use of electronic products have led to a stream of new products with relatively short life spans. Electronic products are made from precious and special metals, including gold, silver, palladium and platinum, as well as potentially toxic substances such as lead, mercury, cadmium, and beryllium. Therefore, responsible end-of-life management of e-waste is vital in order to recover valuable components and properly manage hazardous and toxic components. End-of-Life management of e-waste includes



the reuse of functional electronics, refurbishment and repair of electronics, recovery of electronic components, recycling e-waste, and disposal.

Recycling of electronics allows for precious and special metals to be recovered, reduces the environmental impact associated with electronic manufacturing from raw materials, and ensures that hazardous and toxic substances are handled appropriately. Texas implemented manufacturer take-back laws for both computers and televisions, and many of these electronic companies offer mail-back programs at no additional cost to the customer.

The City offers electronic recycling at their North and South ESC locations, in addition to the Westpark Consumer Recycling Center. The City maintains contracts with RAKI and CompuCycle for their electronics recycling; CompuCycle specializes in television and monitor recycling, while RAKI recycles the City's computers, mixed electronics, VCRs, and other miscellaneous electronic materials. Although electronic recycling is contracted out to multiple vendors, the City's available electronics recycling data is limited to CompuCycle metrics, as well as electronic recycling data tracked at the two ESC locations. Table 3-4 summarizes the available electronics recycling data.

**Table 3-4
Electronics Recycling (in Pounds)**

	FY 2016	FY 2017
ESC Electronics Reused/Recycled	70,795	60,855
CompuCycle, Electronics Recycled ¹	Not Available	1,616,488

Overall Diversion Rate

Per the 2019 Waste Generation Report total tonnage generated within the City was estimated using a combination of data sources provided by the City, as well as data from H-GAC. It is important to note that the total tonnage amount generated includes municipal solid waste, recycling, yard waste, and construction & demolition (C&D) tonnage. Based on the data summarized in the 2019, the City has a total estimated diversion rate of approximately 32.4%; the diversion rate is significantly higher than the residential curbside diversion rate of 14.83% largely due to diversion of C&D waste, which is described in greater detail in Section 5.

3.2 Existing Public Information Programs

The Solid Waste Department has Public Information Officers to help promote current programs and practices. There is also a Community Outreach Division with individuals who attend community events and communicate public services information on behalf of the Solid Waste Department, among other topics. Public Information Officers are tasked with promoting the neighborhood depositories and environmental service centers managed by the Solid Waste Department, providing general information to the public concerning trash and recycling. It should be noted that Solid Waste Management Department Public Information Officer and Community Outreach teams provide information to the public on all City solid waste services, including disaster information; program changes; addressing illegal dumping concerns; litter abatement; regular collection schedule changes due to holiday or weather delays. These responsibilities are in addition to responding to requests for public information under Texas Public Information Act requests; requests for presentations and assistance to the Mayor's Office of Special Events for trash and recycling collection for things like 4th of July fireworks; Houston marathon, various holiday parades; and partnering with Keep Houston Beautiful on community clean-up efforts. There are currently no employees dedicated solely to recycling education.

The City's public information and community outreach employees also partner with The Recycling Partnership on trash and recycling initiatives. The Recycling Partnership has provided the City with the following items which are distributed to the community at large:

- Trash and recycling related flyers
- Various swag (i.e. shirts, canvas bags, and gaming sets)
- A YouTube video promoting glass recycling



The City's public information and community outreach program is also active within the City of Houston's Independent School District, and they host an annual "Growing Up Recycling" Cart decorating contest. The contest gives students the opportunity to decorate a 96-gallon recycling cart using recycled materials and art supplies of their choosing. First, second, and third place winners are awarded a check, which is typically between \$500 and \$1,500.

Funding for the City's Public Information Programs include private sector partners contributing to education. Specifically, Living Earth pays the City \$0.10 per bag of mulch sold, which contributes to recycling education.

The FCC contract explicitly states that FCC will provide a financial contribution of \$100,000 per year to support education efforts to increase awareness about recycling in the City and will fund \$20,000 per year in educational programs operated by FCC.

According to a U.S. Chamber of Commerce Foundation report, published in May 2018, cities should expect to spend about \$1 per household on educational campaigns, or \$3 to \$4 per household if the campaign addresses changes to an existing recycling program.¹¹ The Project Team researched the marketing/public outreach budgets for the following communities:

- Dallas, Texas: Based on their FY 2019 budget, transfer community outreach activities related to their Zero Waste program from Sanitation Services is budgeted at \$1,042,971. This amounts to approximately \$4.34 per household.
- Fort Worth, Texas: According to the City of Fort Worth's FY 2019 budget, the Solid Waste fund has 5 functional areas, one of which is community education which delivers public education and outreach. Although the budget did not indicate total costs associated with solid waste specific outreach, it is worth noting that the City also maintains a separate Community and Public Engagement Department that is tasked with public outreach on behalf of all City departments. The City of Fort Worth's Communication and Public Engagement Department is budgeted at approximately \$4.1 million and maintains 42 full-time employees.
- The City of Austin's Austin Resource Recovery Department maintains a Waste Diversion program for activities associated with strategic initiatives. The FY 2019 budget for their Waste Diversion program is budgeted at approximately \$2.5 million. This amounts to approximately \$12.38 per household.

The City of Houston's Solid Waste Management Department's FY 2019 budget (a total of \$80.3 million) indicates that it supports the salaries and benefits associated with employees from the General Fund who are involved in SWMD community outreach efforts. These personnel costs (salaries and benefits) total approximately \$674,400 and include the following positions: one (1) community involvement coordinator; one (1) public information officer; one (1) community service representative; one (1) administrative specialist; and one (1) web designer. Note that these employees perform a broad set of responsibilities that are not limited to recycling education (i.e. certain public outreach employees are also responsible for educating the public on other solid waste related topics and/or coordinating special events through the Mayor's office); for the purpose of estimating a dollars per household spent on education, it is estimated that approximately 50 percent of employee time for these positions is related to recycling education.

There is also a special revenue fund referred to as the "Recycling Revenue Fund" that was created to allocate dedicated funds to be used for the expansion and implementation of the City's Recycling Programs. Efforts include citywide tree waste recycling, additional neighborhood depository sites, curbside recycling, and increased education and outreach. For FY 2019, the Recycling Revenue Fund amount is budgeted at \$5.3 million. The portion of the budget allocated for education, which was approximately \$85,000 in FY 2019, is funded through the education contribution fee paid by the recyclable materials processor, per the processing contract.

As previously noted, there are contractual requirements for both FCC and Living Earth to remit certain payments for education to the City.

Houston-Galveston Area Council (H-GAC)

Houston-Galveston Area Council (H-GAC) is a regional organization through which local governments consider issues and cooperate in solving wide area problems. Through H-GAC, local governments also initiate efforts in anticipating and preventing problems. All H-GAC programs are carried out under the policy direction of H-GAC's local elected official Board of Directors. H-GAC is made up of the

¹¹ https://www.uschamberfoundation.org/sites/default/files/media-uploads/B34CaseStudy_Layout_June20.pdf



region's local governments and their elected officials and works together with public and private sector organizations. The 13 counties in H-GAC's service region include: Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton; there are more than 100 member cities in the region.

H-GAC continues to provide the City of Houston and their Solid Waste Management Department with several recycling related grants. The Houston Police Department (HPD) and the Parks & Recreation Department also receive grants from H-GAC. Table 3-5 below summarizes the H-GAC grants received by the City of Houston SWMD, HPD, and Parks & Recreation between 2014 and 2019.

**Table 3-5
H-GAC Grants Dedicated to the City of Houston**

Year	Grant Recipient	Grant Description	Amount
2019	City of Houston - SWMD	Recycling Hoppers and Carts for Recycling Facility	\$9,032
2019	City of Houston - SWMD	Litter and Illegal Dumping Cleanup/Equipment	\$14,000
2018	Houston Police Department	Environmental Investigations Solid Waste Enforcement Expansion	\$99,095
2018	City of Houston – Parks & Recreation	Park Recycling/BigBelly's	\$20,829
2018	City of Houston - SWMD	Equipment to Support BOPA Collection	\$89,712
2018	City of Houston - SWMD	Equipment to Enhance the ReUse Warehouse	\$45,000
2017	City of Houston – Parks & Recreation	Park Recycling/BigBelly's	\$41,640
2017	Houston Police Department	Local Enforcement Cameras/Computer Hardware	\$81,124
2017	City of Houston - SWMD	Electronic Collection Events	\$57,500
2016	City of Houston - SWMD	Enhance Recycling Facility/Equipment/ReTRAC	\$64,303
2015	City of Houston - SWMD	Recycling in Parks/BigBelly Compactors	\$50,053
2015	City of Houston - SWMD	Recycling/HHW Mascots	\$9,120
			\$581,408

In addition, H-GAC has contracted with Stericycle for the collection, transportation and disposal of household hazardous waste (HHW) within the 13-county H-GAC region. The contract includes both permanent HHW facilities and one-day collection events within the thirteen counties.

H-GAC hosts several solid waste management and recycling workshops dedicated to such issues as organics recovery, solid waste and recycling procurement, recycling partnerships, recycling's economic impact, etc. Currently, H-GAC is hosting a solid waste workshop series that will feature food donation and special waste as the main topics of discussion.

3.3 Existing Markets

The City contracts with FCC to process and market traditional recyclables included in the City's collection program. The City contracts with CompuCycle and RAKI for electronics recycling. City contracts with Stericycle to properly manage HHW such as antifreeze, paint, pesticides, and household chemicals collected at the ESC's. Each of these contracts' places marketing of materials responsibilities on the vendors rather than the City. However, the City can engage each vendor to discuss market issues and work together toward market solutions, as necessary.

As was documented in the Facilities Report, there are between 150 and 200 businesses in the City that provide recycling services requiring authorization by TCEQ. (Businesses that only accept source separated materials, such as scrap dealers, are not required to secure a TCEQ authorization.) Of the businesses providing recycling services, 41 are authorized as recycling facilities in the City. These include scrap metal dealers, paper recyclers, used oil recycling, electronic recycling, mulching facilities, shingle recycling, construction & demolition material, tire recycling and others.



Market Conditions for Traditional Recyclables

In July 2017, China notified the World Trade Organization (WTO) of its intention to prohibit the import of certain solid wastes and scrap into their country, including mixed paper and mixed plastics, beginning on January 1, 2018. China also announced a new, and exceedingly stringent, contamination standard applicable to recyclable imports (0.5 percent). Prior to these new restrictions, China was importing approximately 13 million tons of paper and 776,000 tons of plastic from the United States annually. Recycling processing facilities around the United States continue to struggle to find viable markets to accept these materials.

The City' contract with FCC explicitly states that FCC is responsible for marketing the recyclable materials.

The contract also stipulates that FCC will provide quarterly market reports to the City that documents end users to which FCC has sold Recyclable Materials and that contains information on how Recyclable Materials are used and the geographic location where Recyclable Materials have been purchased. Anecdotally, it is understood that FCC is currently only marketing materials in the United States, and a majority of the materials are marketed in Texas. Though FCC is not currently exporting materials, China's actions have a negative impact on domestic markets, keeping prices low.

According to the FCC market report, a total of 3,362 tons were sold to end markets. Table 3-6 shows the tons by material type, the value per ton for the month of April 2019, and the total revenue generated.

**Table 3-6
FCC April 2019 Processing Report for City of Houston**

	Composition	Tons to Sell	Value (\$/ton)	Total Revenues
Old Corrugated Cardboard	20.21%	681.650	\$67.69	\$46,140.89
Mixed Paper	32.92%	1,110.335	\$50.44	\$56,005.35
Newspaper ¹²	0.00%	0.000	\$0.00	0.00
Aseptic Packaging	0.04%	1.349	\$0.00	0.00
Scrap Metals	1.61%	54.303	\$95.00	\$5,158.79
Aluminum Cans/Foils	0.70%	23.609	\$1,120.00	\$26,442.08
Plastic Bottle #2 Natural	1.42%	47.894	\$445.00	\$21,312.83
Plastic Bottle #2 Color	1.50%	50.592	\$320.00	\$16,189.44
Plastic Bottle #1	1.12%	37.776	\$340.00	\$12,843.84
Plastics #3 - #7	0.81%	27.320	\$64.60	\$1,764.87
Glass 3 Mix	9.07%	241.513	\$5.50	\$1,328.32
Contamination	30.60%	1,086.407	-\$27.00	\$29,332.99
Total	100%	3,362.75		\$187,186.41

¹² Newspaper is included in the Mixed Paper category, as newspapers make up much less of the material stream than in previous years.



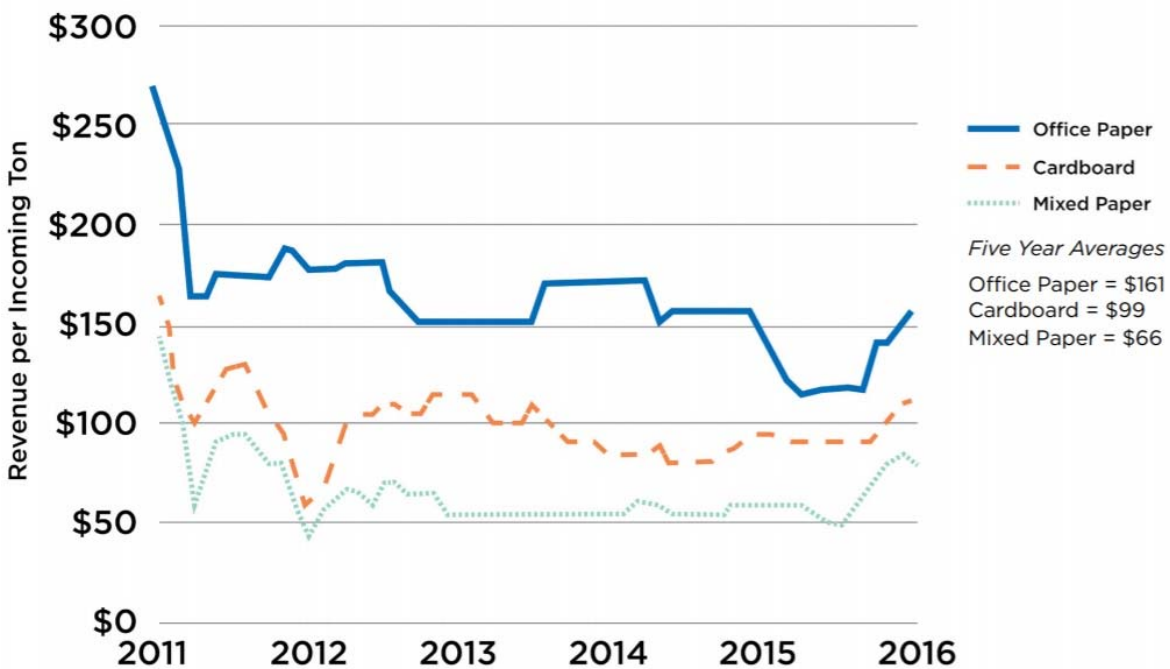
Table 3-7 shows revenues and payments per the contract with FCC for the month of April 2019.

**Table 3-7
FCC Payment to City (April 2019 Processing Report)**

Net Revenue	-\$121,871.56
Revenue Share	50.00%
City of Houston Payment	\$121,871.56
Cost per ton	\$34.33
Blended Value	\$52.72
Payment to City for Education Fee	\$8,333.33
Payment to FCC	\$67,456.65
Payment to City	\$8,333.33

As was reported in the TCEQ Study on the Economic Impacts of Recycling (July 2017), the average value of processed recyclable materials collected single stream from municipal collection programs in Texas over the past five years was \$89 per ton. As shown in the following figures, commodity pricing is volatile. Figure 3-3 shows paper recyclable revenues; Figure 3-4 shows plastic recyclable materials revenue, and Figure 3-5 shows metal recyclable materials revenue.

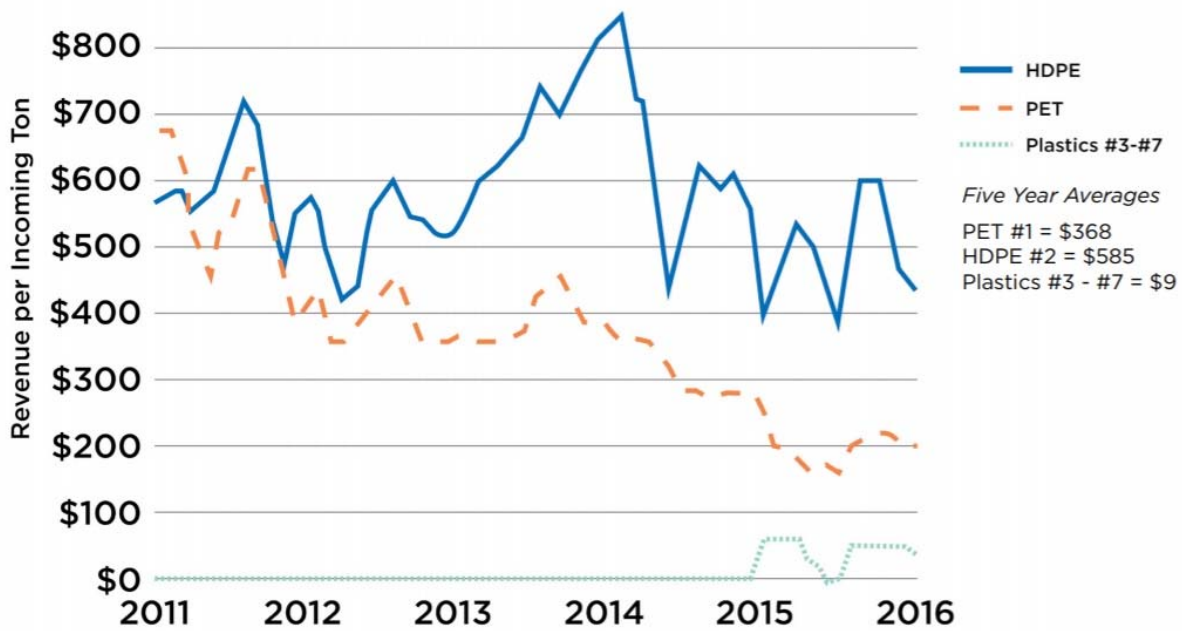
**Figure 3-3
Paper Recyclable Material Revenue (per ton)**



1. Values are based on Houston (Southcentral USA) Region as reported on RecyclingMarkets.net.

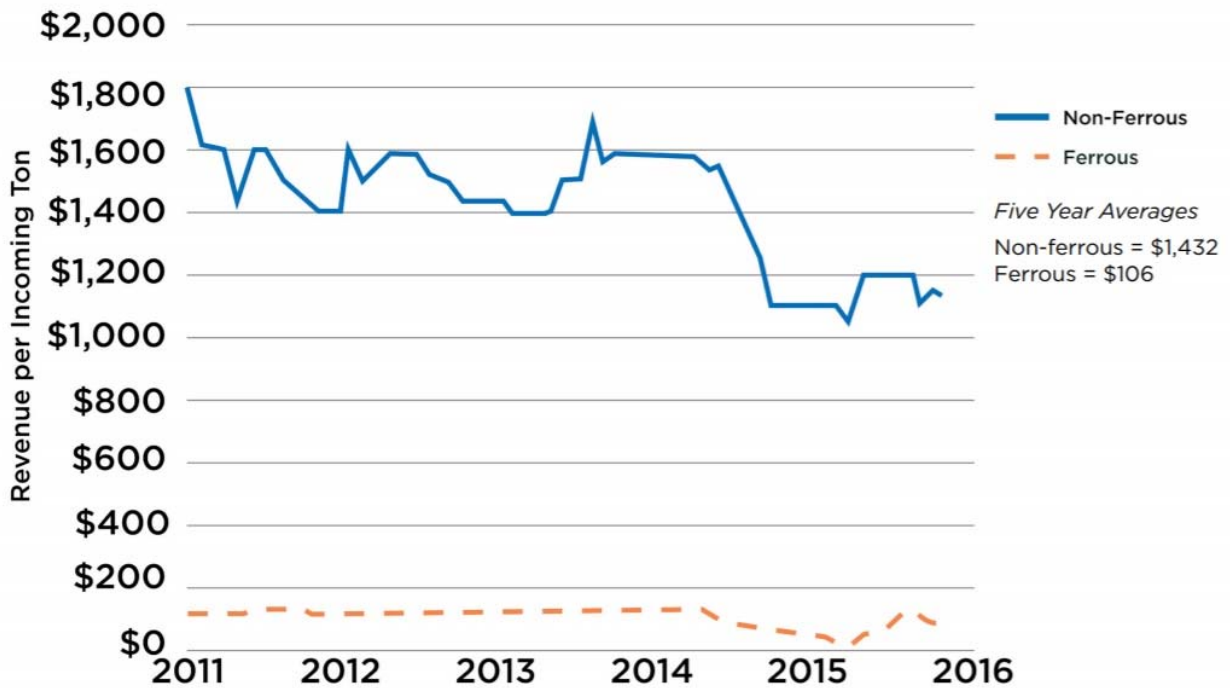


Figure 3-4
Plastics Recyclable Material Revenue (per ton)



1. Values are based on Houston (Southcentral USA) Region as reported on RecyclingMarkets.net
 2. Value of HDPE #1 is based on a combination of pricing for colored and natural HDPE. The figure assumes 57.1% colored HDPE and 42.9% natural HDPE based on recent MRF audits conducted in Texas by the Project Team.

Figure 3-5
Metal Recyclable Material Revenue (per ton)



1. Values are based on Houston (Southcentral USA) Region as reported on RecyclingMarkets.net



3.4 Existing Policies and Regulations

State Regulations

Senate Bill 649

Senate Bill 649 relating to the promotion of the use of recyclable materials as feedstock for processing and manufacturing was filed during the 86th Legislative Session, and it is scheduled to take effect on September 1, 2019.^{13,14} This bill mandates researching methods to encourage the use of recyclables as inputs for the creation of new products, which is part of a larger plan to invest in, expand, and promote the state's recycling economy.

The State of Texas Alliance for Recycling (STAR) is a driving force behind the legislation, with its Business Council members conducting active advocacy.

This legislation requires the Texas Commission on Environmental Quality (TCEQ) to examine the current recycling economy and

- Catalog materials that are being recycled;
- Investigate what materials are generated by not recycled;
- State the economic benefits of recycling;
- Determine the available capacity of existing manufacturers to use sorted recyclables as raw materials;
- Ascertain what is preventing use of recyclable materials to make new products, and offer solutions to remove impediments;
- Suggest companies or facilities needed to ensure generated recyclable materials are used to make new products and;
- Provide recommendations for increasing use of recyclable materials overall and growing the number of companies that consume recyclables as feedstock.

The bill also requests an education campaign that encourages clean materials in the recycling stream; the messaging will emphasize negative outcomes associated with contaminated recyclables.

Used Oil Recycling Program

Texas law prohibits the dumping of used oil on land or into sewers or waterways. This includes the use of used oil as a dust suppressant. Texas has also banned used oil filters from being disposed of in landfills.¹⁵ The goals of the Used Oil Recycling Program are to:

- Increase participation of public and private sector organizations and companies as used oil collection centers;
- Increase collection of used oil by collection centers;
- Increase recycling by increasing the number of collection centers; and
- Provide education and technical guidance to the regulated community and public.

City of Houston The City of Houston SPD that manages procurement activities for the City includes an administrative procedure, A.P Number 2-15, dated April 23, 1991, that establishes guidelines for the procurement of products made from recyclable materials. The policy states "It shall be the policy of the City of Houston to purchase recycled goods or products when practical, fiscally prudent, and in accordance with state competitive bidding requirements." Responsibilities are also outlined in AP No. 2015 for Materials Management to promote the purchase of recycled content, for Public Works to coordinate citywide efforts to stimulate markets, and for all City departments to ensure contractors bidding to provide products or services to the City offer recycled products whenever possible.

¹³ <https://www.wastedive.com/news/texas-recycling-industry-backing-legislation-to-boost-domestic-markets/552257/>

¹⁴ The bill has been filed without the governor's signature.

¹⁵ https://www.tceq.texas.gov/permitting/registration/used_oil/recycling.html



3.5 Needs and Gaps Assessment

Contamination

Recyclable material audits conducted on City loads showed the following contamination rates:

- January 30, 2016 showed “trash” at 22.82% (prior to FCC contract)
- June 28, 2017 showed “trash” at 25.22% (prior to FCC contract)
- December 12, 2018 showed “trash” at 30.6% (prior to FCC contract)
- April of 2019 showed “contamination” at 30.6% (as reported by FCC)

Contamination not only hurts the marketability of recyclables; it also directly impacts the costs the City pays, and revenue share the City receives. It should be noted that through negotiations, the new contract with FCC mitigates the negative impacts of contamination; however, reducing contamination should remain a priority to improve the quality of recyclable materials.

Metrics Related to Recycling

Table 3-5 identifies the metrics that should be tracked to measure future success related to recycling.

**Table 3-5
Recycling Metrics**

Metric	Measurement	Source	Current	Define Future Success
Waste Diversion Rate	Diverted Tons / Total Tons Generated	Tonnage data	See Below	Increase diversion percentage
Single-Family (SF)	Diverted SF Tons / Total SF Tons Generated	Tonnage data	14.83% ¹	Increase diversion percentage
City of Houston	Diverted Tons / Total Tons Generated	Tonnage data	32.44% ²	Increase diversion percentage
Education Materials Disseminated (Recycling)	Number of people/entities receiving information (e.g. hits on website, hard copy materials)	Public Information Officer	Not currently known	Number receiving information increases
Education Funding	\$/household	Public Information Officer	Not currently known	Meet or exceed peer communities
Curbside Recycling Participation Rates	Number of homes participating / total homes	City collection services	Not currently known	Begin tracking, increase participation
Multifamily Recycling Participation Rates	Number of complexes with an onsite recycling program / total complexes	Private haulers	Not currently known	Begin tracking, increase participation
Commercial Recycling Participation Rates	Number of businesses with a program / total businesses	City and private haulers	Not currently known	Begin tracking, increase participation
In-house City of Houston Recycling	Tons / year	In-house recycling collection data	Not currently known	Begin tracking, increase tons
Neighborhood Drop Off Centers participation	Number of visitors, tons /year	City NHD Report	10,428 customers per month/ 20.61 average tons per month ³	Increase visitors and tons



Metric	Measurement	Source	Current	Define Future Success
Total Material Processed by MRFs in Houston	Tons processed / Year	Survey H-GAC Region MRF's	307,580 tons (2017)	Increase tons processed
Contamination Rate (by sector, if possible)	% of contamination	From MRF	30.6% (April 2019)	Reduce contamination rate
End markets for recyclables	Tons sold to end markets	From MRF	3,362 (April 2019)	Increase tons marketed

1. The 14.83% is based on a 2019 estimate per the 2019 Waste Generation Report submitted to the City of Houston. Please note that the 14.83% is based on an estimate using extrapolated data from the City, and it utilizes yard waste and traditional recyclable tonnage metrics provided by the City.
2. The 32.44% is based on a 2019 estimate per the 2019 Waste Generation Report submitted to the City of Houston. Please note that the 32.44% is based on an estimate using extrapolated data from the City, the 2017 TCEQ Study, as well as C&D metrics submitted by local demolition and recycling companies that operate within the City of Houston. It is important to note that this includes the total estimated diversion rate, which would also include diversion materials that are not specifically handled by the City of Houston Solid Waste Management Department.
3. Per the City's September 2018 NHD report, there were approximately 10,428 combined customer visits at the neighborhood drop-off centers. The average tonnage from the sites amounted to approximately 20.61 tons per site in September 2018.

3.6 Potential Future Actions

Recycling & Reuse

Overall Objective: Expand and innovate recycling opportunities to all Houston residents and businesses to increase diversion and recovery, while reducing contamination.

The following potential future actions will be further evaluated for viability in Task 6 – Strategic Analysis and may be recommended for inclusion in the final Integrated Resource Recovery Management Plan.

1. Increase participation of single family homes in recycling programs, to increase amounts and types of materials and decrease contamination
 - a. Consider strict enforcement on contamination, which may require dedicated code enforcement officers and modifications to the City's Code of Ordinances, Chapter 39.
 - b. Begin tracking participation rates, which could be accomplished with technology on the collection vehicles (e.g. RFID or similar).
 - c. Improve labeling on recycling containers to include a sticker on the inside of the container lid showing what is acceptable and what is not; update labels as program changes or labels fade.
 - i. Recycle Right Recycle Across America (RAA) is a nonprofit organization that has launched a "Let's Recycle Right" campaign aimed at standardizing labeling systems for recycling containers. Standard labels are available for purchase on the RAA site (<https://www.recycleacrossamerica.org/labels>).
 - d. Increase education and promotion of the recycling program including additional means (i.e. social media, radio, television spots), in conjunction with expanding education and outreach described in Section 1.5.1.
 - e. Consider increasing recycling collection frequency to once per week.
2. Encourage greater recycling within the multifamily sector to increase amounts and types of materials and decrease contamination
 - a. Consider implementing a "universal" (i.e. mandatory) recycling ordinance to require multifamily residents to participate in recycling. If implemented, the initial phase of the universal ordinance should focus on education and outreach, eventually moving toward penalties or fines as enforcement measures



4.0 Organics

Organic materials are a significant component of the solid waste stream in Houston. In 2018 approximately 234,000 Tons of wood waste and yard waste was delivered to composters located within the city limits of Houston. In addition, approximately 45,000 Tons of biosolids was generated on a dry weight basis. Some portion of the approximately 38,000 Tons of brush and tree waste delivered to landfills can also be attributed to the City of Houston. These approximate quantities make up over 18% of an estimated 1.5 million tons per year of total waste generated in the City.

Diversion of these valuable materials from disposal is an important component of a comprehensive solid waste management program. It is estimated that approximately 30% of all of Houston’s materials currently diverted from disposal is made up of organic materials including yard trimmings, brush, leaves, food and beverages and biosolids. Diversion of organics from landfill achieves several things. It conserves landfill capacity and extends landfill life, it reduces greenhouse gas emissions from landfills where organic material is converted to methane and, most importantly, it produces valuable products - compost and mulch – which improve plant growth, reduce irrigation requirements, decrease stormwater runoff, reduce the use of agricultural and horticultural chemicals, and improve stormwater quality. In addition to adopting a low-emission collection fleet, organics diversion from landfills is the most effective climate mitigation tools within the waste sector.

4.1 Existing City Programs and Results

Residential Yard Waste and Tree Waste Collection

The City collects yard waste in City approved compostable plastic bags weekly. It collects tree waste at curbside in odd numbered months. Both services are provided only to the single-family residents served by City municipal solid waste collection. These materials are hauled to one of several Living Earth/LETSCO compost and mulch processing facilities. In FY 2018, the City reported collecting approximately 9397 tons of yard waste and 21,215 tons of tree waste from single-family residences. Table 4-1 provides green waste collected by the City in 2016-2018. FY 2018 quantities are about a 44% reduction from the previous year because the City discontinued green waste collection for most of the year in the aftermath of Hurricane Harvey. The 2018 data represent approximately 2.4 tons of yard waste and tree waste per single family household per year. The City Parks Department reported hauling 990 Tons of vegetative material from parks during the six months between December 2019 and May 2019, the only months for which data were collected. Yard waste and tree waste generated in the City in areas not served by City collection may be hauled by landscapers or contract haulers to landfills or compost/mulch facilities.

**Table 4-1
Green Waste Collected by City of Houston (Tons)**

Year	Yard Waste	Tree Waste	Total
FY 2016	14,159	38,611	52,779
FY 2017	15,412	39,157	54,569
FY 2018	9,397	21,215	30,612

Neighborhood Depository Green Waste Drop-Off

Residents may drop off yard waste and tree waste at any of six neighborhood depositories.

Backyard Composting and Grasscycling

The City promotes on its website that residents may avoid the expense of compostable bags for grass clippings by practicing grasscycling. The City also supports a Master Composter Certification program which trains residents in proper backyard composting techniques and provides certification to those who complete the training and promote backyard composting in the community. In 2018 the City certified 13 Master Composters. The City also sold backyard compost bins to residents starting in 2015. The value of backyard composting is not in the volume of organics diverted from landfill, which is relatively insignificant. Rather, its value is in promoting the



understanding of the importance of organics as resources and in building public support for composting in general. Table 4-2 provides the numbers of backyard compost bins sold in each year. The program was advertised in water bill sin 2015.

**Table 4-2
Backyard Compost Bins Sold**

Year	Bins Sold
2015	217
2016	35
2017	101
2018	172

Food Residual Recovery

The City does not provide or actively support the collection of either pre-consumer or post-consumer food residuals for recovery. It participated in a study of pre-consumer food residual collection through H-GAC and is supportive of efforts by the Council to facilitate food residuals collection for recovery. This program is not yet been fully implemented.

The EPA Food Recovery Hierarchy prioritizes reducing food waste as follows.

1. Source Reduction such as programs that assist consumers to reduce food spoilage
2. Feeding humans such as diverting edible food to food banks like the Houston Food Bank
3. Feeding animals
4. Industrial uses including energy recovery such as pyrolysis, gasification, mass burn/refuse derived fuel and anaerobic digestion among others
5. Composting
6. Landfilling and Incineration without energy recovery

The Houston Food Bank serves 18 counties and receives food from farmers, groceries/retailers, distributors, wholesalers and other food industries. It is presumed that this edible food would have been otherwise wasted. The City does not directly support or encourage diversion of food to the Houston Food Bank.

Biosolids Diversion

The City contracts with FCC Environmental Services to haul approximately 30% of its biosolids, or approximately 32,000 tons per year to landfills for disposal. The remainder is processed into a fertilizer-like product by a private entity.

4.2 Existing Markets

Because organics diversion is currently limited to compost and mulch facilities, the following market analysis is focused on these types of facilities.

Feedstock Markets

Any non-hazardous, organic material is compostable. However, not all facilities in Texas are authorized to process all compostable materials. All composting facilities in the H-GAC Region may accept feedstocks from residential, commercial, institutional and industrial generators. The Region includes composting facilities authorized at the Exempt, Notification and Registration tiers but only Exempt facilities are currently located within the City Limits of Houston.

The City of Houston is presumed to collect the majority of yard waste and tree waste generated by single-family residents and deliver it for processing. However, typically only about one third of all non-hazardous solid waste is generated by single-family residents. The rest – generated by commercial, industrial and institutional activity – is also rich in organic materials. The 52 known composting and



mulch facilities in the Region serve these sectors as well as an unknown number of single-family green waste generators who have landscapers who haul their green waste for processing. Many commercial, industrial and institutional generators already direct organics to processors for economic reasons or in compliance with internal sustainability policies. Examples of an industrial feedstock being composted in the region include brewery waste, dairy waste and food processor waste. Produce Row is a significant generator of pre-consumer vegetative material. Living Earth/LETCO processes some of the organics from Produce Row.

The universe of compostable materials in the H-GAC Region is vast. Feedstock markets are currently limited by economic haul distances, lack of haulers for food residuals due to low route density, and contamination of some compostable streams such as post-consumer food residuals. In some cases, processors are limited not only by the feedstocks that they are authorized to accept, but also by capacity, economic haul distance, low landfill tipping fees and the need to balance feedstock "recipes" for proper process control. Processors may also be limited by markets for their end products.

It is impossible to determine from landfill annual reports to TCEQ how much compostable material is currently disposed in landfills in the Region. However, Region landfills reported that in 2017 that almost 21,000 Tons of brush, alone was disposed in landfills. Recoverable organics of other descriptions are undoubtedly being landfilled, as well.

Debris from natural disasters can be diverted from disposal if it can be separated into uncontaminated and untreated wood and vegetation. The Ground Up is affiliated with a disaster debris contractor. Nature's Way is authorized to take disaster debris but has not done so in the past because they are not under contract by FEMA. After a disaster, local processors may see significantly reduced feedstock quantities because most organic material is collected by FEMA contractors at no cost to the generator.

The Houston Food Bank is one of the largest in the country. It does not currently compost food that is not able to be distributed to those in need. The Montgomery County Food Bank does compost its unusable food at Farm Dirt Compost.

Product Markets

Local markets for mulch and compost may be limiting factors for processors in the Region. Currently, organics processors in the Region sell their products to local nurseries, landscapers, mulch yards and garden centers. Some also have their own retail outlets. However, several such as Nature's Way and New Earth have broad distribution outlets and sell their products well outside the Houston area. Excess mulch is sometimes sold as fuel.

A common obstacle to marketing compost products is the lack of uniform product standards across the industry. Some products are certified through the US Compost Council Seal of Testing Assurance program or other similar programs, but such certification is not required. When inferior products are allowed to be sold in the marketplace, they often sell at reduced cost which can put higher quality products at a competitive disadvantage without sophisticated and targeted marketing programs.

4.3 Existing Policies and Regulations

Grasscycling

The City of Houston identifies grass cycling on its Solid Waste Management Department web site as a means of reducing costs to residents associated with purchasing compostable bags.

Back Yard Composting

The City supports a limited Master Composter certification program which trains residents in back yard composting. The City also sells backyard compost bins to residents.

Mulch Promotion

Living Earth/LETCO promotes the use of locally produced mulch by using bags with the City of Houston logo for mulch sold at retail in the City of Houston. This program began after Hurricane Ike. One of the goals of the program is to foster an understanding of a closed loop for Houston tree waste being recycled locally and marketed as mulch in Houston. LETCO contributes ten cents per bag of mulch sold back to the City to support recycling.



4.4 Existing Public Information Programs

Currently, the City provides public information regarding organics to information on their web site regarding how and when to put yard waste and tree waste on the curb for collection, and where to deliver these materials to depositories. Public information activities parallel those related to recycling as discussed in Section 3.4. The City does not have active enforcement programs designed to reduce the disposal of yard waste in municipal solid waste carts as a means of avoiding the use of compostable yard waste bags.

4.5 Needs and Gaps Assessment

It is an objective of the City of Houston to divert organics from landfill to preserve disposal capacity, to maximize diversion of edible food for human consumption, and also to realize the significant environmental benefits associated with the use of compost and mulch derived from processing organics.

Residential

Because the City focuses on the diversion of green waste generated by single-family residential residents, it is believed that most of this material is currently diverted to composting facilities.

Some cities attempt to increase landfill diversion by attempting to capture food residuals from single-family residents. This is most efficiently done by combining food residuals with yard waste for curbside collection. However, the amount of material captured by such programs is minimal and the contamination introduced into the process is often significant. For example, a major City in Texas conducted an audit of material collected in curbside carts designated for yard waste and food residuals. The audit revealed that less than 0.4% was made up of food. Applying 0.4% to the yard waste collected by the City of Houston yields a theoretical recovery of less than 38 tons per year of food residuals if the City of Houston were to collect residential food from single-family residences. Therefore, recovery of single-family food residuals is not recommended as a viable program at this time.

Non-Residential

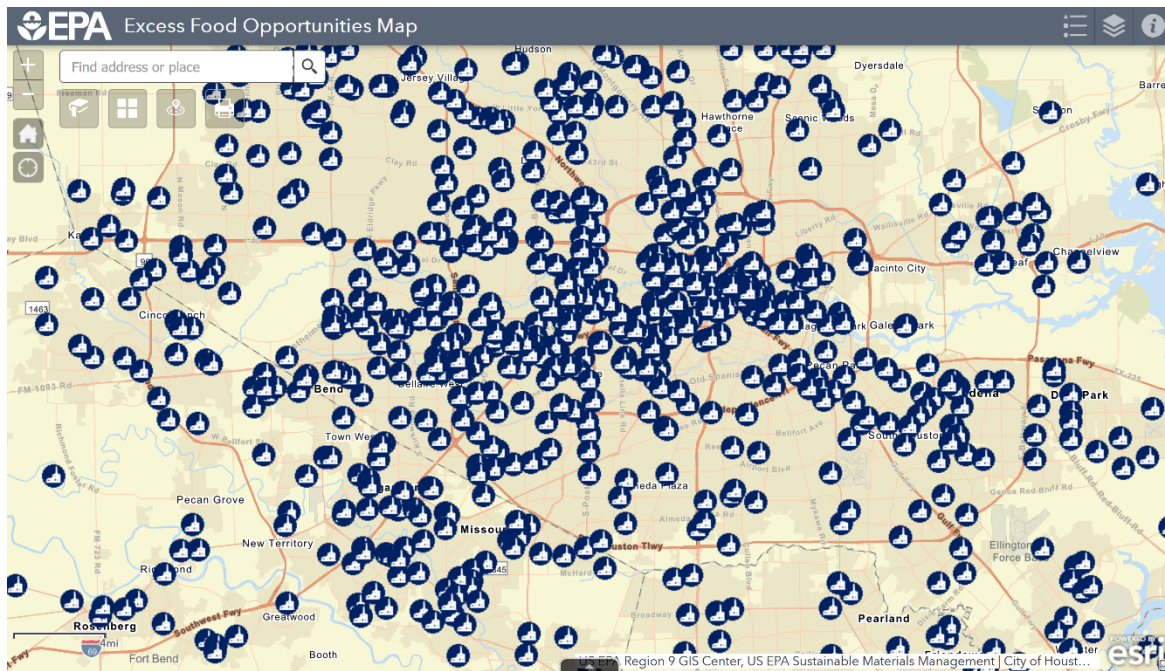
The primary opportunity for improvement through composting and mulch production is to expand the focus to commercial, industrial and institutional generators. Many of these generators currently divert organics to composters either for economic reasons or in compliance with their internal sustainability policies. Generators of organics from non-residential sectors must evaluate the cost of segregating organic materials and transporting them to facilities able to accept them, plus paying any associated tipping fees at those facilities. That cost must be weighed against the benefits of sustainability, avoided transportation cost to landfill and avoided landfill tipping fee. For generators of organic liquids such as beverages must calculate the avoided cost of pre-treatment or industrial pre-treatment fees associated with discharging to the sanitary sewer. Therefore, the availability of appropriate processors is an important consideration for non-residential generators. The City of Houston may encourage or facilitate the development of processors for more and diverse feedstocks closer to the City to improve accessibility by generators.

It is impossible to know how much organic material is generated by the commercial, industrial and institutional generators in Houston. However, it is possible to identify the largest generators of food residuals using the EPA Excess Food Opportunities mapping tool. Figure 4-1 is a map of the largest food processors and manufacturers in the area, generated using the EPA Excess Food Opportunities Map tool¹⁶. Selected categories of generators shown include but are not limited to meat processors, distilleries, canneries, dairies, grain mills and fats/oils refineries. It indicates the magnitude of the number of non-residential generators of excess food. Although some of this food may be donated to food banks or animal feed, much of it is undoubtedly not recoverable for human or animal consumption and is wasted. This is pre-consumer food residuals that may be available for diversion. This map does not include grocery stores, restaurants, educational and healthcare institutions, or other generators of food residuals. Although, these generators may be identified using the same mapping tool.

¹⁶ EPA600/R-12/705 | October 2012 | www.epa.gov/ord



Figure 4-1
Food Manufacturers and Processors



Existing composting facilities located within the City of Houston are all authorized by the TCEQ at the Exempt tier. Therefore, they are limited to processing vegetative materials such as green waste and vegetative-only food residuals. Living Earth/LETCO facilities are typically small and have near neighbors. Although they are not all operating at capacity, they are necessarily selective in the feedstocks that they choose to accept even within Exempt-tier materials to avoid excess contamination.

Other composting facilities located outside the City of Houston can accept non-vegetative organic materials such as meat, dairy, oil, grease, biosolids and various industry-generated organics that may not be accepted at facilities within the City.

To capture this material, processors must be available within an economic haul distance that can accept more diverse feedstocks in addition to green waste. In addition, generators must be able to identify haulers who are able to collect and transport their materials. Both generators and processors report that difficulty identifying appropriate haulers inhibits their ability to divert more organics from landfilling.

Organics processing is currently limited to compost and mulch facilities. This is largely due to compost and mulch facilities being economically viable, low technology, easy to permit and effective. In the future, other processes for diversion of organic materials from landfills may become feasible in Houston. Among other methods of organics diversion that may become feasible in the future include pyrolysis, gasification, mass burn/refuse derived fuel and anaerobic digestion. These techniques are addressed elsewhere with the exception of anaerobic digestion.

Anaerobic Digestion is a process in which organic materials are converted to energy at an industrial scale. It produces methane, the same gas as natural gas, as a recoverable energy source. It may also include generation of electricity from that methane. The anaerobic digestion process is not tolerant of contamination by inorganic materials, so it requires pre-sorting or mixed waste materials. The residue of the anaerobic digestion process is an organic waste, itself, which is typically composted at the end of the process. Anaerobic digestion in the context of organics diversion in a municipal setting includes two concepts – development of a new facility designed specifically to process organics from the solid waste stream, and processing select organics in an existing anaerobic digester at a wastewater treatment facility for methane recovery. Anaerobic Digestion has been a standard process at municipal wastewater treatment facilities in digesting municipal wastewater biosolids. The following table 4-3 is excerpted from an EPA document, State of Practice for Emerging Waste Conversion Technologies. While Anaerobic Digestion is technically feasible and is economically viable in some settings – primarily overseas, it is not considered economically viable in Houston where landfill costs and energy costs are relatively low.



**Table 4-3
Overview of Anaerobic Digestion**

Feedstock	food, yard and paper wastes
Primary End Product(s)	biogas, electricity
Conversion Efficiency	60%-75%
Facility Size (Capacity)	10-1001 T/Day
Product Energy Value	6000-70001 BTU/lb (estimated)

Note: (estimated) Anaerobic Digestion facilities can span a wide range of size, input, feedstock and design.

Diversion of the 30% (dry weight) of biosolids generated by City of Houston wastewater treatment plants would yield another 32,000 tons per year. The real value of such diversion lies primarily in two considerations. The first is the environmental benefits of added nitrogen and water to compost feedstocks that are able to accept it, which increases total throughput capacity and improves nutrient value of the compost product. The second is the diversion of biosolids from landfills and the corresponding reduction of greenhouse gas emissions generated there.

The following table presents metrics to measure the effectiveness of efforts to achieve objectives. The objective of reducing the generation of wasted organics in the non-residential sector is difficult to measure in part because of the magnitude and diversity of these generators. The following metrics relate to diversion of organics from landfills.

**Table 4-4
Organics Metrics**

Metric	Measurement	Source	Current	Define Future Success
Organics Disposal	Tons Disposed in Regional Landfills	TCEQ Annual Reports	21,000T/Yr Brush	Decrease Disposal
Non-residential Organics Processing	Total Tons Processed	Voluntary or Mandatory Reporting of Throughput	613,500 T/Yr in Region; >235,000 T/Yr in Houston	Increase Processing
Non-residential Organics Processing Capacity	Tons Capacity	Voluntary or Mandatory Reporting of Capacity	>815,000T/Yr in Region; 481,000T/Yr In Houston	Increase Capacity

4.6 Potential Future Actions

Overall Objective: Preserve landfill capacity and realize environmental and economic benefits by reducing the disposal of organic resources within regulatory and economic constraints.

The following potential future actions will be further evaluated for viability in Task 6 – Strategic Analysis and may be recommended for inclusion in the final Integrated Resource Recovery Management Plan.

The following strategies are categorized by sector – residential (1) and non-residential (2). Many activities affect both.

1. Increase organics diversion among businesses and industries, focusing on pre-consumer organics². Strategies include implementing a green building ordinance that incorporates incentives to divert organics, and mandating diversion of appropriate organics. Implementation may be phased, initially focusing on larger processors and manufacturers of food and later incorporating other non-hazardous, organic residuals. The City may also assist non-residential generators by providing technical support to assist with organics diversion. These activities may be incorporated in a universal recycling ordinance. The City should support and publicize the H-GAC efforts to support pre-consumer food waste collection.



2. Enforce prohibition of green waste in municipal solid waste and recycling carts.¹ Strategies include instituting an inspection program with friendly notices/education for first infractions and the ability to levy penalties after repeated violations.
3. Decrease contamination in any non-residential organics collected for processing.² Strategies include initiating public education regarding why organics collected for processing should not be contaminated^{1,2} Methods include those outlined in Section 3.2.
4. Support product markets.^{1,2} Strategies include public education regarding the environmental and economic benefits of using compost and mulch, instituting a City procurement policy favoring use of locally produced compost and mulch, and implementing a green building ordinance that incorporated incentives to use compost and mulch.
5. Divert biosolids that are currently being landfilled to composting.^{1,2} Strategies include directing the hauler to (a) processor(s) under municipal contract or for the hauler to haul to a biosolids processor of their choosing.
6. Encourage access to organics processing facilities capable of processing a broad range of organic material types.² Strategies include assisting with siting such as identifying City-owned property, acquiring property to be made available for composting, or initiating a procurement process or incentives for a processor to locate within a given geographic range.
7. Encourage diversion of brush from local landfills to organics processors.^{1,2} Strategies include public education regarding the benefits of landfill diversion and the availability of organics processors.
8. Reduce generation of organic wastes^{1,2} Strategies include incorporate the use of grasscycling, xeriscaping, on-site composting, on-site mulching and other means of reducing organics waste generation and disposal in green building ordinances or a universal recycling ordinance.
9. Periodically monitor the development of waste conversion technologies such as anaerobic digestion to periodically assess technical and economic feasibility.^{1,2}

DRAFT



5.0 Construction and Demolition Debris

5.1 Existing City Programs and Results

As detailed in the Facilities report, fifteen of the 28 operating landfills located in the HGAC region are construction and demolition waste landfills (Type IV), ten of which are operating in Houston. A total of 2.8 million tons of construction and demolition (C&D) waste were disposed at one of the 15 operating Type IV C&D landfills in the region in 2018. Regionally, these facilities have an estimated 25 to 30 years remaining capacity. In 2018, approximately 480,000 tons of C&D material were disposed in Type I landfills, approximately 7% of the total disposed in Type I facilities. (Source: TCEQ Annual Reports.)

The amounts of waste disposed in Type IV landfills has continued to increase from 2010 to present. The 2010 C&D per capita disposal rate was 1.15 pounds per capita per day (pcd); this rate increased to 1.46 pcd in 2018, a 27% increase in pcd disposal. Based on landfill reports to TCEQ, C&D disposal quantities for 2018 increased by approximately 700,000 tons in one year. This is largely due to the impacts of Hurricane Harvey, which occurred in late 2017, but for reporting purposes is shown in 2018.

There are businesses that are currently processing C&D in the region. Based on interviews with representatives from some of these firms and data from the TCEQ, approximately 2.5 million tons of C&D are processed and recycled.

HGAC indicates four Regional Recycling Drop Off Centers that accept construction waste, including:

- City of Deer Park Drop off Center (in Deer Park)
- Hardy Service Center (in Houston)
- City of Houston Building Materials Reuse Warehouse (in Houston, described in more detail in Section 2.1)
- Greenstar Recycling (in Houston)

5.2 Existing Markets

- The Facilities Report also detailed current processing practices. In summary, Cherry Companies represents the largest C&D processor in the region, recycling concrete, asphalt, steel, composition asphalt shingles and tires. Cherry reports annually recycling more than two million tons of concrete for use in road base material, about 30,000 tons of reclaimed asphalt paving for use in hot mix material, over 50,000 tons of steel to fabricate new steel products, approximately 23,000 tons of composition asphalt shingles for use in hot mix material, and nearly a half million automotive and truck tires for alternative fuel.
- The HGAC region is unique to Texas in its number of Type IV facilities. Approximately 21% of the total waste stream goes to these facilities compared to the NCTCOG region (Dallas/Fort Worth) where only 7% of the waste stream goes to Type IV facilities.
- The Sprint Fort Bend Landfill reports that it recovers C&D at its Type IV landfill. In 2017, it reported a total of 69,931 tons of C&D (17,795 tons), white goods (35.4 tons), tires (0.3 tons), shingles (2,170 tons), and concrete (49,931 tons). It also composted 1,120 tons of material and crushed 64,931 tons of concrete at this site. (Source: TCEQ Annual Report).
- The Sprint Montgomery County Landfill reported that they recovered 135 tons of C&D in 2017; this was anticipated to increase to 3,750 tons in 2018 based on their report to TCEQ.
- Lone Star operates a Type IV landfill, a Type I landfill and a C&D material processing facility. The processing facility recovers approximately 1,800 cubic yards per day, equivalent to approximately 900 to 1,800 tons per day, which, assuming 310 days of operation per year, equates to approximately 279,000 to 558,000 tons per year.
- According to a TCEQ sponsored report (Study on the Economic Impact of Recycling - 2015, TCEQ), C&D recycling accounted for 34% of the 9.2 million tons recycled in Texas in 2015.
- The Waste Generation Report detailed diversion projections, including for C&D. As previously reported, based on conversations with some of the C&D processing companies, it is estimated that approximately 1.5 million tons of C&D material are diverted on an annual basis from within the City of Houston. The types of C&D material include concrete (i.e. aggregate), reclaimed asphalt, steel, composition asphalt shingles, and tires. ¹⁷ Table 5-1 and Graph 5-1 summarize the construction and demolition diversion forecast, which is projected to increase with population growth.

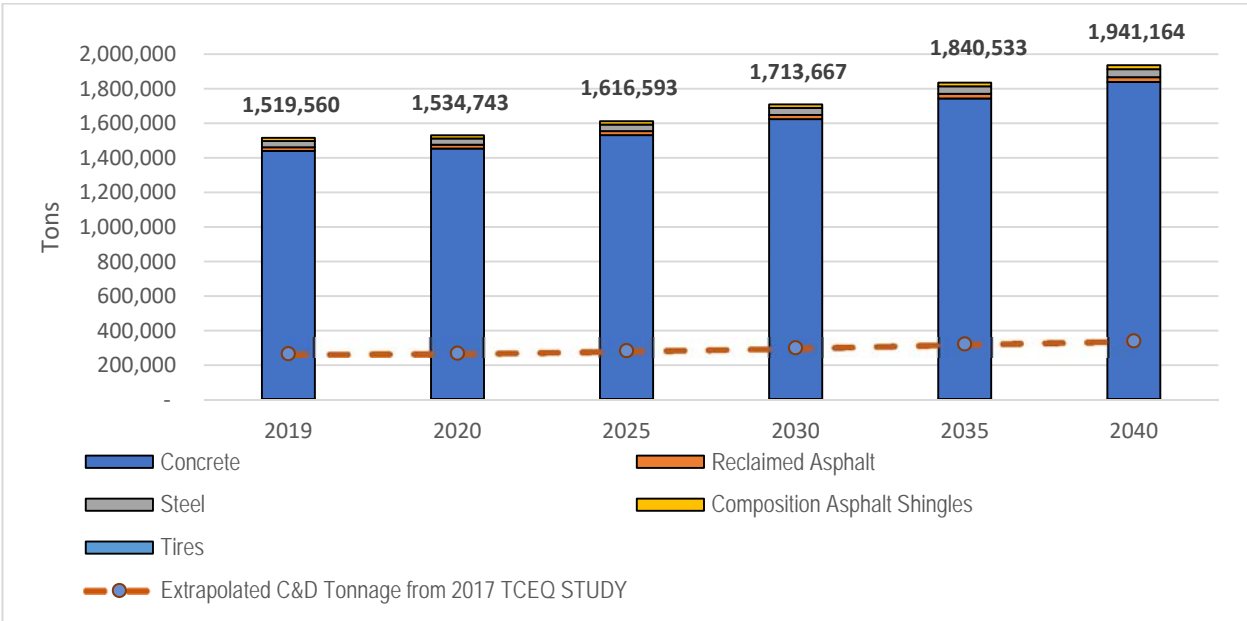
¹⁷ It was noted that the following additional material could be diverted if a market for the following materials were established: sheet rock, carpet, treated wood, gypsum, glass. For instance, approximately 350,000 cubic yards of this material is currently being landfilled by Cherry Company on an annual basis.



**Table 5-1
Construction & Demolition Materials Diverted (Tons)**

	2019	2020	2025	2030	2035	2040
C&D Materials	1,519,560	1,534,743	1,616,593	1,713,667	1,840,533	1,941,164

**Figure 5-1
C&D Diversion Forecast**



It is interesting to note that the amount of C&D actually being diverted within the city of Houston (1,519,560 tons) is significantly greater than the amount estimated per the 2017 TCEQ Study (256,271 tons). This is due to the very active C&D diversion program within the city of Houston, and Region, by a number of C&D contractors within the Houston area, most notably, Cherry Companies.

5.3 Existing Policies and Regulations

City Policies Related to C&D

The City does not currently have any policies specifically related to C&D; however, as previously noted, on June 23, 2004, City Council adopted the Green Building Resolution, which set a target of Silver level LEED certification for new construction, replacement facilities and major renovations of city of Houston-owned buildings and facilities with more than 10,000 square feet of occupied space.

5.4 Existing Public Information Programs

The City includes information about the Building Materials Reuse Warehouse in its current education and outreach materials. After disaster events, such as hurricanes, that can generate C&D waste, the City educates residents on proper set out including how to separate materials, to keep C&D materials cleaner and easier to recycle. However, additional information specific to C&D is not routinely provided by the City and is largely handled by the private sector.

5.5 Needs and Gaps Assessment

- The City is directly involved in facilitating the reuse of building materials through the Reuse Warehouse; however, the City is not otherwise directly involved in C&D collection, processing or disposal, which is largely handled by the private sector.
- The actual amount of C&D being diverted in the City is far greater than TCEQ reported in their 2017 Study.



- Based on the Waste Generation Report and supporting data, the City has an estimated diversion rate of approximately 32.4%.¹⁸ However, it should be noted that 75% of the diversion rate is due to C&D. Excluding C&D, the diversion rate is approximately 10.9%.

Metrics Related to C&D

**Table 5-2
Construction & Demolition Metrics**

Metric	Measurement	Source	Current	Define Future Success
C&D Diversion Rate	Diverted C&D Tons / Total Tons Generated	Tonnage data	24.22% ¹	Increase diversion percentage
Buildings participating in LEED certification (or similar Green Building Code program) with C&D diversion requirements	Number of buildings, tons of C&D diverted	General Services Department for City facilities; USGBC Texas Gulf Coast Region Chapter ¹⁹	26 LEED Certified (City facilities only); more than 100 in Houston Area;	Increase in LEED certified (or similar Green Buildings Code program) number of buildings; increase in C&D diverted

1. Estimated C&D tonnage diverted from within the City of Houston / Total tons generated within the City of Houston. 1,519,560 tons / 6,273,168 tons = 24.22%

5.6 Potential Future Actions

Overall Objective: Increase Resource Recovery through Reuse, Recycling, C&D and Organics Diversion.

Specific Objective: Maximize landfill capacity and realize environmental and economic benefits by reducing the disposal of C&D and organic resources within regulatory and economic constraints.

The following potential future actions will be further evaluated for viability in Task 6 – Strategic Analysis and may be recommended for inclusion in the final Integrated Resource Recovery Management Plan.

- Work with the private sector to develop markets for the following materials, which could divert additional C&D materials from the landfill:
 - Sheet rock
 - Carpet
 - Treated wood
 - Gypsum
 - Glass
- Consider implementing a “Green Building Code” to codify requirements for new construction and redevelopment projects citywide to meet certain environmental criteria, including C&D diversion (among other things), described in more detail in Section 1.5.3.
- Consider implementing a universal (i.e. mandatory) C&D recycling ordinance, which would require a debris management plan and certain diversion metrics for any construction or demolition project in the City. The requirements of the ordinance could be enforced through the permitting process.

¹⁸ 2,035,116 tons / 6,273,168 = 32.4%

¹⁹ https://usgbctexasgulfcoast.org/content.php?page=Houston_Area_LEED_Buildings