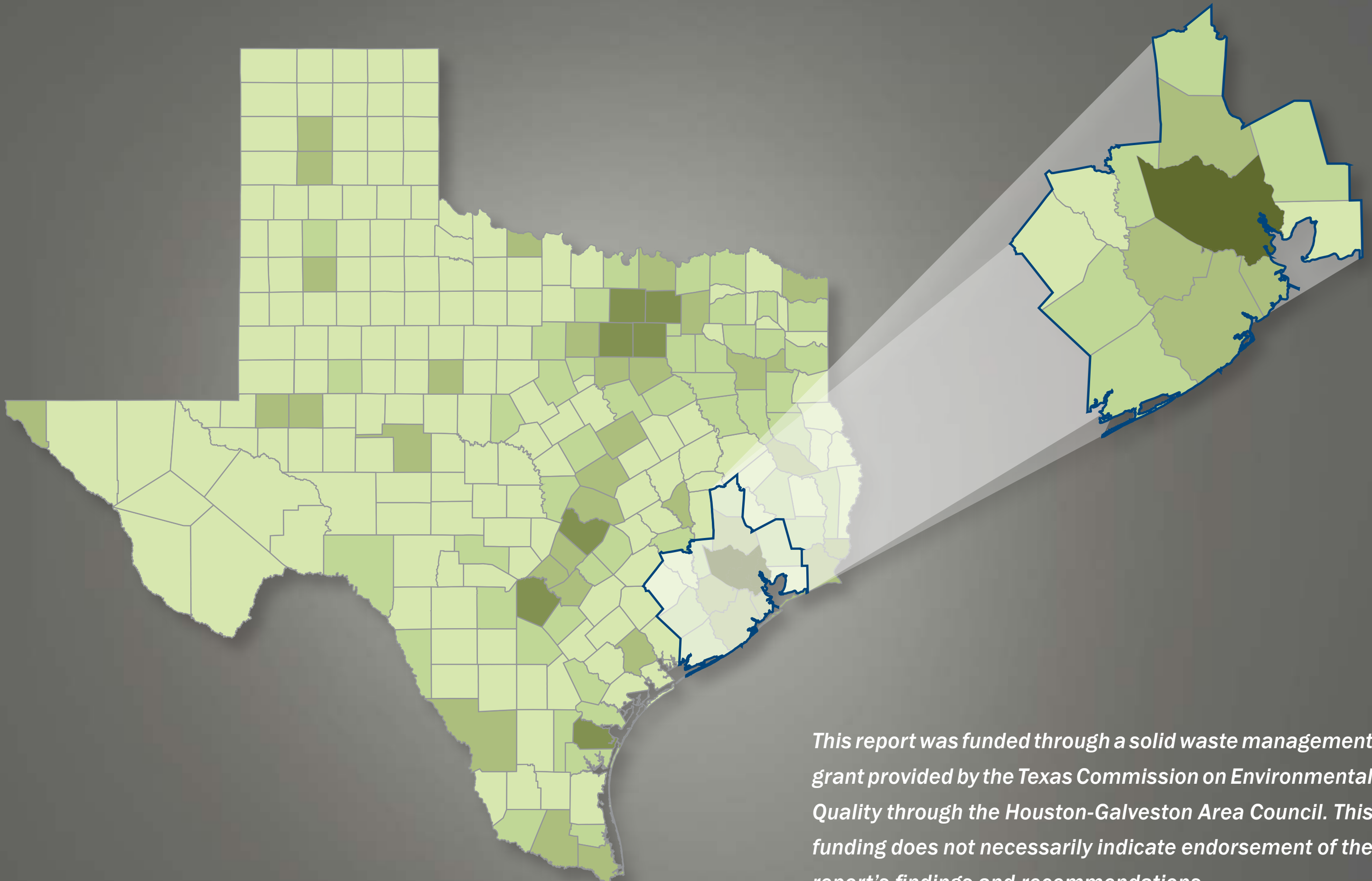

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FINAL REPORT | MAY 2013

HOUSTON–GALVESTON AREA COUNCIL

The Economic Contribution of the Recycling Industry to the Houston-Galveston Region

David Swenson Consulting

SAIC®

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SAIC Energy, Environment & Infrastructure, LLC (SAIC) was retained by the Houston-Galveston Area Council (H-GAC) to estimate the current and potential economic contribution of the recycling industry in the region. The H-GAC planning region covers the thirteen counties of Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton including the municipalities within these counties. This analysis was conducted with the following goals in mind:

- encourage local governments to continue to invest (and ideally increase their investment) in recycling in the region;
- target specific types of recycling or reuse businesses to be nurtured and grown due to their potential impact on the regional economy; and
- make the Houston-Galveston Region more sustainable by viewing discarded materials as a resource rather than a waste.

To accomplish these goals, SAIC gathered information on the number of establishments in the H-GAC Region that fell within the definition of "recycling industry", as defined in collaboration with H-GAC staff. Four sub-categories of the recycling industry were defined: 1) recycling industries (supply side); 2) recycling-reliant industries (demand-side); 3) reuse and remanufacturing; and 4) energy recovery and beneficial reuse. Twenty-six business types, defined in Table ES-1, were identified in these four sub-categories.

SAIC gathered information through regional census data, surveys, interviews, and other local, regional, and national sources to estimate the number of jobs, annual payroll, and annual gross receipts associated with each of these business types in the H-GAC Region. This information served as input to an input-output economic model that projected the direct[1], indirect[2], and induced[3] effects of the recycling industry in the region.

In collaboration with H-GAC, SAIC then developed three scenarios that could potentially increase recycling, and the economic activity associated with recycling, in the region. Once the estimates of additional jobs resulting from the increased recycling activity were estimated, the economic model was applied to project the economic contribution of the recycling industry under each scenario.

[1] *Direct effects* are directly associated with the establishments within the "recycling industry" in the H-GAC Region.
[2] *Indirect effects* are a result of the economic activity by the firms that provide goods or services to establishments in the recycling industry, such as the businesses and institutions that provide utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services.
[3] *Induced effects* accrue when workers in the direct and indirect industries spend their earnings on goods and services in the region. Most induced activity accrues to retail, services, finance, insurance, and housing expenditures.

Table ES-1
Business Types Considered

	Business Type	Description
Recycling Industry (Supply-Side)		
1	Residential collector	Recyclables collection from single or multi-family residences by private haulers or using government employees, including municipal drop-off centers and HHW collection centers
2	Non-residential collector	Collection of recyclables from industrial, commercial, and institutional facilities, including public spaces and items returned to retailers (tires, batteries, plastic bags, compact fluorescents, etc.) including waste tire haulers and used oil collectors
3	Composter/organics processor	Process organic materials including yard & wood waste, leaves, food waste, biosolids, or other organics to produce compost, mulch, soil amendments, or landfill alternative daily cover
4	Recyclable material processor	Paper stock dealers, scrap metal processors, and other establishments that minimally sort, remove contaminants, and densify primarily non-residential recovered materials (includes auto wreckers, carpet/textile processors, and tire/rubber processors)
5	Materials recovery facility	Process mixed recovered materials by sorting, crushing, and screening. Materials usually come from residential curbside/drop-off recycling collection programs or by separating recyclables directly from solid waste.
6	Construction and demolition debris recycler	Sort, crush, grind, screen construction and demolition debris
7	Electronics processor	Dismantle, crush, or shred separate electronics components and materials
8	Nonferrous secondary smelting and refining mill	Recycling and alloying of nonferrous metals from scrap, primarily produces billets, ingots, and other basic intermediates
9	Plastic reclaimer	Companies that transform recovered plastics directly into products (e.g. plastic lumber) or raw materials ready for remanufacture (flake/pellet)
Recycling-Reliant Industry (Demand-Side)		
10	Glass product producer	Produce products other than containers from recycled glass (e.g., fiberglass, plate glass)
11	Iron and steel foundry	Produce cast iron/steel products
12	Nonferrous foundry	Produce castings of nonferrous metals
13	Nonferrous product producers	Produce nonferrous formed products in integrated mills that also smelt/refine
14	Paper-based product manufacturing	Produce cellulose-based products from recovered paper/paperboard; cellulose insulation, molded fiber products, hydro-seeding, animal bedding
15	Pavement mix producer	Produce asphalt paving mix from recycled crumb rubber, recycled aggregates, recycled glass
16	Plastic product manufacturer	Companies that convert a recycled plastic clean flake or pellet into an intermediate or end product
17	Rubber product manufacturer	Produce products using ground rubber or cut rubber shapes/stampings as feedstock
18	Other recycling manufacturer	Other processors or manufacturers not elsewhere classified processing recovered materials to a raw material form for sale and/or producing recycled content products. This category includes fluorescent lamp and mercury recyclers, wallboard manufacturers recycling synthetic gypsum from power plants, and glass beneficiaries

Business Type		Description
Reuse and Remanufacturing		
19	Electronics refurbishing/reuse	Remanufacture used electronic appliances, sort, grade, dismantle, and/or rebuild
20	Used motor vehicle parts	Clean, sort, inspect, and remanufacture used parts
21	Tire retreading	Remove old tread from tires (buffings and crumb rubber) and add new rubber tread
22	Wood reuse or pallet rebuilder	Process used wood for reuse — pallet rebuilders, flooring, etc.
23	Retail used merchandise sales	Retail thrift stores, antique shops, reuse centers, shops dedicated to reused products
24	Other reuse	Establishments not otherwise classified that clean, grade, recondition, rebuild, or refurbish products for reuse, including toner cartridges, fork lifts, electric motors, power equipment, other industrial equipment, drums/intermediate bulk containers, etc.
Energy Recovery and Beneficial Reuse		
25	Energy recovery	Establishments that produce a processed fuel product from diverted waste or that combust such materials for energy including pellet fuel producers, cement kilns, biomass energy facilities, biodiesel companies, fuel blenders of used oil, etc.
26	Other beneficial uses	Establishments that use recovered materials (including ash, sludge, foundry sands, contaminated soils) for beneficial use, such as alternative daily cover at landfills and fill

Baseline Estimate

Table ES-2 shows the estimated economic contribution made by the recycling industry in the H-GAC Region under current (or baseline) conditions. The estimates are shown for each sub-category of the recycling industry. The sub-categories are presented separately because there is likely to be some overlap among the economic contribution among sub-categories. Presenting them separately avoids overestimating the economic activity associated with the recycling industry in the region and is thus a conservative approach.

Table ES-2
Estimated Economic Contribution by Recycling Industry in the H-GAC Region

Metric	Direct	Indirect	Induced	Total
Recycling Industry (Supply Side)				
Jobs	5,186	5,873	3,772	14,831
Industrial Output ($)	1,900,439,609	911,862,625	513,570,315	3,325,872,549
Value Added ($)	734,411,445	572,382,293	328,475,802	1,635,269,540
Labor Income ($)	332,393,831	367,776,151	178,239,234	878,409,215
Recycling Reliant Industry (Demand Side)				
Jobs	744	651	540	1,935
Industrial Output ($)	327,933,170	143,646,866	74,140,864	545,720,900
Value Added ($)	114,323,197	85,016,572	47,938,668	247,278,437
Labor Income ($)	45,870,317	53,982,765	26,136,990	125,990,072
Reuse and Remanufacturing				
Jobs	3,704	436	645	4,784
Industrial Output ($)	229,697,727	69,267,997	88,916,188	387,881,913
Value Added ($)	138,042,470	43,219,719	57,283,981	238,546,170
Labor Income ($)	96,636,930	26,765,786	31,176,605	154,579,321
Energy Recovery				
Jobs	625	1,477	1,225	3,327
Industrial Output ($)	977,709,681	441,959,944	167,353,500	1,587,023,125
Value Added ($)	301,166,905	222,969,238	108,386,777	632,522,920
Labor Income ($)	88,177,419	137,932,433	58,996,200	285,106,052

Recycling Industry (Supply-Side)

An estimated 451 establishments in the H-GAC Region fall into one of the nine business types within the sub-category "recycling industry (supply side)", generally collectors and processors of recyclables. Together these establishments are estimated to generate 5,186 direct jobs. An estimated 5,873 indirect jobs are associated with providing goods and services used as input to the recycling industry (supply side) establishments. An additional 3,772 induced jobs are associated with those businesses where the employees of the direct and indirect establishments purchase goods and services. The recycling industry (supply-side) establishments are projected to contribute an estimated $1.9 billion in direct industrial output[4] to the region; $734 million of which is direct value added[5]. Over $332 million of the direct value added is direct labor income[6]. When the indirect and induced effects are added to the direct effect, a total of $3.3 billion of industrial output is estimated to result from the recycling industry (supply side) in the H-GAC Region.

The business type in this sub-category that contributes the most economic activity in the region according to this analysis is recyclable material wholesalers[7]. The estimated 117 establishments in the region that fall into this businesses type account for an estimated $1.9 billion in total industrial output when direct, indirect, and induced effects are taken into account. An estimated $502 million of this is labor income resulting from 8,523 jobs. The economic contribution of this business type is due, in part, to the large number of establishments and jobs in the region. However, this business type also has relatively high multipliers, meaning a job or dollar of output produced by a recyclable material wholesaler in the region would have a relatively high indirect and induced economic effect compared to some of the other business types.

Recycling Reliant Industry (Demand-Side)

An estimated 31 establishments in the H-GAC Region fall into one of the nine business types within the sub-category "recycling reliant industry (demand side)." Together the establishments in this sub-category are estimated to generate 744 direct jobs, 651 indirect jobs, and 540 induced jobs for a total of 1,935 jobs. The recycling reliant businesses (demand side) are estimated to contribute nearly $546 million in total industrial output to the region; $247 million of this is total value added and $126 million of the total value added is labor income.

The iron and steel foundries, pavement mix manufacturers, and other recycling manufacturers account for approximately three quarters of the industrial output, value added, labor income, and jobs resulting from the recycling reliant industries (demand side) in the region Collectively, these businesses produce approximately $431 million in total industrial output, $194 million of which is total value added. Of the total value

[4] *Industrial output* for most private industries is equal to gross sales. For public or quasi-public institutions, this normally includes all public expenditures along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.

[5] *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

[6] *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social security, unemployment, retirement, and medical benefits).

[7] This business type includes paper stock dealers, scrap metal processors, and other establishments that minimally sort, remove contaminants, and densify primarily non-residential recovered materials (includes auto wreckers, carpet/textile processors, and tire/rubber processors).

added by these three business types, $94 million is labor income generated by an estimated 1,393 jobs.

Reuse and Remanufacturing

The 368 establishments in the region identified as reuse and remanufacturing establishments are estimated to generate 3,704 direct jobs, 436 indirect jobs, and 645 induced jobs for a total of 4,784 jobs. Collectively, the direct, indirect, and induced industrial output of reuse and remanufacturing establishments in the region is $388 million. Of the total industrial output, $239 million is value added. Nearly $155 million of the value added is labor income associated with the estimated 4,784 jobs. Motor vehicle parts, tire retreaders, and wood reuse business types combined produce approximately $149 million of the total industrial output for reuse and remanufacturing business types in the region.

Energy Recovery and Beneficial Use

The 22 establishments in the region identified as energy recovery establishments (none were identified as beneficial reuse establishments according to the definition in Table ES-1) had an estimated 625 direct jobs, 1,477 indirect jobs, and 1,225 induced jobs. The establishments in this business type generated an estimated $1.59 billion in total industrial output, $633 million of which was value added. An estimated $285 million of the value added was labor income for 3,327 jobs. As a result of higher paying jobs and relatively local feedstock to the energy recovery companies in the region (the majority of which are bio-diesel companies), a dollar of direct economic activity has a relatively large impact on the indirect and induced economic activity in the region.

Scenario Estimates

SAIC proposed twelve potential scenarios for consideration to H-GAC that would be likely to increase the economic activity associated with recycling in the region. The three that were selected for analysis were:

- expand policies and infrastructure for electronics diversion;
- increase use of Recycled Asphalt Pavement (RAP) and Recycled Shingle Pavement (RAS); and
- expand plastic recycling and recruit end-user for plastic to the region.

Scenario 1

In the first scenario, it is assumed that electronics recovery increases by 63 percent as a result of the following policies and actions at the State and/or local level:

- expansion of current state requirements for manufacturers to develop infrastructure to recover more electronics;
- implementation of a ban on electronics from landfill disposal;

- expansion of access to collection of electronics, especially in rural areas; and
- requirement for all processors to be certified.

In the longer term, this scenario may include expanding the capacity to process and remanufacture rare-earth metals, from electronics and other sources, in the region.

SAIC projects that as a result of these policies and programs, 2,162 additional tons of electronics would be recycled in the region each year and 744 tons would be refurbished. It is projected that this additional activity would result in 151 additional direct jobs in the recycling industry (supply-side) sub-category: 10 within the business type residential collectors, 10 within non-residential collectors, and 131 in electronics processors. In addition, 30 direct jobs (all new) are projected in the remanufacturing and reuse subcategory, in electronics refurbishers. Although additional ferrous, nonferrous, plastic, glass, and other material is likely to be generated as a result of collecting and processing the additional electronics, these materials are not anticipated to generate additional jobs for recycling reliant industries (demand side) within the region since the quantity of each of these materials is small compared to what these business types already handle in the region.

Table ES-3 shows the projected economic activity when the direct, indirect, and induced effects are taken into account as a result of recycling and refurbishing more electronics. An additional 216 jobs are anticipated as a result of the increased activity in the recycling industry (supply side), and an additional 49 jobs are anticipated as a result of the increase in activity in the reuse and remanufacturing sub-category (because of the assumed added electronics refurbishers in the region). Total industry output is projected to increase by $20.6 million per year in the recycling industry (supply side) sub-category and $5.9 million per year in the reuse and remanufacturing sub-category.

Table ES-3
Additional Economic Contribution by Recycling Industry in Scenario 1
(Direct, Indirect, and Induced)

Sub-Category	Jobs (#)	Industrial Output ($)	Value Added ($)	Labor Income ($)
Recycling Industry (Supply Side)	216	20,629,374	12,688,189	8,444,150
Recycling Reliant Industries (Demand Side)	0	0	0	0
Reuse and Remanufacturing	49	5,933,311	3,547,767	2,191,615
Energy Recovery	0	0	0	0

Scenario 2

This scenario assumes an increase in the use of recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) in road construction and the diversion of shingles and bricks on residential construction sites in the region. Specifically, this scenario includes the following activities by H-GAC, local governments, the Texas Department of Transportation (TxDOT) and contractors:

- adopt and implement current State specifications allowing expanded use of RAP and RAS in hot mix asphalt;
- promote, encourage, and incentivize the application of updated specifications that allow higher content of RAP and RAS for all construction projects in region;
- develop collection and processing infrastructure for RAS and RAP that meet demand and end use requirements;
- deploy mobile grinders to collect and process shingles at residential new construction or reroofing sites; and
- promote, encourage, and incentivize on-site use of recovered bricks at construction sites for "flatwork".

An additional 15 direct jobs are projected to process the shingles and bricks generated at new residential construction sites. Only two additional direct jobs are projected at pavement mix producers to use additional RAP and RAS in hot mix asphalt since for the most part, the existing employees could likely handle the switch from current pavement mix to increased RAP and RAS. Table ES-4 shows that 36 additional jobs and nearly $9 million of industrial output are anticipated within the recycling industry (supply side) once the direct, indirect, and induced economic activity are taken into account. The added activity within the pavement mix producers business type is projected to result in a total of six new jobs, and $2.1 million per year in additional industrial output within the recycling reliant industry (demand-side) sub-category.

Table ES-4
Additional Economic Contribution by Recycling Industry in Scenario 2
(Direct, Indirect, and Induced)

Sub-Category	Jobs (#)	Industrial Output ($)	Value Added ($)	Labor Income ($)
Recycling Industry (Supply Side)	36	8,979,436	4,417,602	1,956,563
Recycling Reliant Industries (Demand Side)	6	2,115,063	1,121,608	451,405
Reuse and Remanufacturing	0	0	0	0
Energy Recovery	0	0	0	0

Scenario 3

In this scenario, the collection and processing infrastructure and the end use capacity for plastics recycling in the region increases. Specifically, the following assumptions are made to determine the economic effect of these changes in plastic recycling in the region.

- Collection and processing infrastructure expands to allow for a 50 percent increase in plastics recovery through increasing the recovery rate of plastic resins that are currently recycled and recycling more resins on a broader scale. It is assumed that 75 percent of the additional recovery occurs in the commercial sector and 25 occurs in the residential sector.

- In addition, an end user with a capacity of 25,000 tons per year is recruited to the region.

To project the economic contribution of this scenario, it is assumed that all of the 4,972 additional tons of plastic from residential generators and one-fourth of the 14,915 tons of additional plastic from commercial generators are assumed to go to an existing MRF while the remaining commercial tons are assumed to be sufficiently separated to go directly to a plastic reclaimer in the region. It is assumed that 25,000 tons of the total plastic recycled would be directed to a new end user in the region.

Twenty additional direct jobs are projected to collect the additional residential plastic while five new direct jobs are assumed to collect the added commercially generated plastic. Three additional jobs are assumed at MRFs and eight at plastic reclaimers to process the increased tonnage. All of these direct jobs are within the recycling industry (supply side) sub-category. A new plastic product manufacturer in the region processing 25,000 tons per year is anticipated to create an additional 63 jobs.

Table ES-5 shows that the increased plastic collected and processed is anticipated to result in 77 additional jobs when the direct, indirect, and induced effects are taken into account. Recruiting a new plastic end-user to the region would result in an estimated 180 jobs when the direct, indirect, and induced effects are considered. The additional activity in the recycling industry (supply-side) is projected to increase industrial output by $16.4 million per year while adding a new plastic product manufacturer is projected to add $49.5 million in industrial output in the region each year.

Table ES-5
Additional Economic Contribution by Recycling Industry in Scenario 3
(Direct, Indirect, and Induced)

Sub-Category	Jobs (#)	Industrial Output ($)	Value Added ($)	Labor Income ($)
Recycling Industry (Supply Side)	77	16,417,913	8,623,331	4,209,286
Recycling Reliant Industries (Demand Side)	180	49,479,246	19,507,593	11,108,502
Reuse and Remanufacturing	0	0	0	0
Energy Recovery	0	0	0	0

Summary of Scenario Projections

Table ES-6 summarizes the projected additional economic activity associated with each of the scenarios described above. Although Scenario 1 (increased electronics recovery) and Scenario 3 (increased plastics recovery) are projected to create a similar number of jobs in the region, the projected economic activity resulting from Scenario 3 is much higher. This is primarily because Scenario 3 assumes that a large new end user, a plastic product manufacturer, opens a new facility in the region. This business type has a relatively high economic impact, that is, one new job in a manufacturing facility tends to have a broader ripple effect on the regional economy compared to other business types, especially those in the recycling industry (supply-side) where most of the jobs in Scenario 1 are assumed to be added. The increase in economic activity resulting from increased use of RAS and RAP, assumed in Scenario 2, is comparatively minor. The number of jobs created are fewer than in the other two scenarios and the impact to the regional economy of adding direct jobs in the particular business types that are likely to be affected (pavement mix producers and construction and demolition debris recyclers) are not large. That is, added jobs in these business types do not have as significant an indirect and induced effect as in some of the other business types.

Table ES-6
Additional Economic Contribution by Sub-Category for Each Scenario

	Scenario 1	Scenario 2	Scenario 3
Recycling Industry (Supply-Side)			
Jobs	216	36	77
Industrial Output ($)	20,629,373	8,979,436	16,417,912
Value Added ($)	12,688,189	4,417,602	8,623,331
Labor Income($)	8,444,150	1,956,562	4,209,286
Recycling Reliant Industry (Demand-Side)			
Jobs[1]	-	6	180
Industrial Output ($)	-	2,115,063	49,479,246
Value Added ($)	-	1,121,608	19,507,593
Labor Income($)	-	451,406	11,108,503
Reuse and Remanufacturing			
Jobs[1]	49	-	-
Industrial Output ($)	5,933,311	-	-
Value Added ($)	3,547,767	-	-
Labor Income($)	2,191,614	-	-

The scenarios presented here are not mutually exclusive nor do they have to be implemented in their entirety to result in a positive economic contribution to the region. However, this comparison of how different policies or investments may add to the economic contribution of the recycling industry in the region may inform the H-GAC and other local governments of the best way to grow the economy while promoting recycling in the region.

1.1 Introduction

SAIC Energy, Environment & Infrastructure, LLC (SAIC) was retained by the Houston-Galveston Area Council (H-GAC) to estimate the current and potential economic contribution of recycling activity in the region. The H-GAC planning region covers the thirteen counties of Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton including the municipalities within these counties. Specifically, the Economic Contribution of the Recycling Industry Report for the Houston-Galveston Region (the Report) was designed with the following goals in mind:

- encourage local governments to continue to invest (and ideally increase their investment) in recycling in the region;
- target specific types of recycling or reuse businesses to be nurtured and grown due to their potential impact on the regional economy; and
- make the Houston-Galveston Region more sustainable by viewing discarded materials as a resource rather than a waste.

To accomplish these goals, this analysis is designed to achieve the following:

- characterize businesses involved in recycling in the region;
- estimate the current economic contribution of the recycling activities of these businesses in the H-GAC planning region; and
- to estimate the potential economic contribution of the recycling industry if specific changes were made to policy, infrastructure, and end markets for recyclables, or other factors in the region.

1.2 Approach

The approach to this analysis was consistent with similar studies conducted by SAIC to quantify the economic contribution (sometimes called "impact") of recycling on the local, regional, or state economy. Generally, the methodology entailed gathering and analyzing data about various business types in the region that participated in recycling activities, determine the economic activity associated with these activities using an "input-output" economic model, then modifying assumptions about recycling to determine the resulting economic contribution of recycling in the region with these changes. The steps SAIC took to accomplish this are briefly summarized below.

- Worked with H-GAC staff to identify the boundaries of the analysis (e.g., what counts as "recycling activity" and what does not) and define business types.

- Developed a list of establishments in the region that fall within the defined boundaries and assigned them to a “business type” based on the most significant portion of their recycling business.
- Estimated the number of jobs, payroll, and gross receipts associated with the recycling establishments within each business type.
- Estimated the economic contribution of the establishments identified (Baseline) using an input-output model.
- Identified a dozen scenarios that are likely to increase the economic contribution of recycling activity in the region and worked with the H-GAC staff to select three of these scenarios for further analysis.
- Projected the number of jobs, payroll, and gross receipts that would result from each of these three scenarios within each business type.
- Estimated the economic contribution of recycling in the region under each of these three scenarios.

Each of these steps are described in more detail in Section 2. The results are shown in Sections 3 and 4.

2.1 Overview of the Economic Modeling Approach

This analysis uses an "input-output" model to estimate the economic contribution of the recycling industry in the H-GAC Region. Input-output (I-O) models are used to show the relative importance to the economy of a business or industry and to predict the economic impact on a region from alternative actions (e.g., implementation of a new recycling policy). I-O models take into account the interdependencies of industries, institutions, and households within a geographic region by relating the products made within a region to the products consumed by industries and households in that region. A more detailed summary of I-O models and their capabilities and limitations is included as Appendix A.

I-O models produce many kinds of data for analysis and decision-making. The more useful results for industrial leaders, planners, and policy makers are estimates of: 1) jobs, 2) total industrial output, 3) value added, and 4) labor income. These outputs are described below.

- *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.[8] This distinction is important because the relationship between job growth and labor force growth is very different in different industries. Some industries rely heavily on semi-skilled part-time labor. Other industries generally produce full-time skilled jobs.
- *Total industrial output* for most private industries is simply gross sales. For public or quasi-public institutions, this normally includes all public expenditures along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.
- *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).
- *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social security, unemployment, retirement, and medical benefits).

The results from the I-O model used in this analysis is further reported as direct, indirect, induced, and total economic effects as defined below.

[8] For example, a restaurant may employ 20 people on a half-time basis (20 jobs) to fill its labor requirement of 10 full time equivalents.

- *Direct effects* are the industrial output, personal income, value added, and jobs associated with the establishments identified as being within the “recycling industry” in the H-GAC Region.
- *Indirect effects* are the industrial output, personal income, value added, and jobs associated with the businesses and institutions in the region that provide goods or services to the establishments within the “recycling industry”. When the establishments in the recycling industry (collectors, processors, end users, remanufacturers, etc.) produce goods or services associated with recycling, they must make many purchases. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services are necessary to support the recycling industry in the region. Some of these are from suppliers in the area. Some are not. The indirect effects are the economic activity of these firms within the region that support the direct recycling industry.
- *Induced effects* accrue when workers in the direct and indirect industries spend their earnings on goods and services in the region. Most induced activity accrues to retail, services, finance, insurance, and housing expenditures. Because employment is stimulated in these industries as well, their demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity. The I-O model solves for these iterative rounds of transactions until all of the possible inter-industrial transactions have been accumulated.
- *Total economic effects* are the sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this analysis.

The term *multiplier* or *multiplier effect* is frequently used when referring to economic effects or economic impacts. This analysis results in two types of multipliers. The Type I multiplier identifies the value of direct and indirect transactions (e.g., the output of a business type and all other output that it purchases from its suppliers in the region) relative to the value of only the direct transactions. The Type II multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry being considered, in this case the recycling industry, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

In the following Sections of this report, SAIC will present the industrial output, personal income, value added, and jobs, as well as the direct, indirect, and induced effects of establishments in the recycling industry in the H-GAC Region. The Type I and Type II multipliers are also presented for the current level of recycling activity in the region and then applied to project the change in economic activity that results from alternative scenarios.

2.2 Boundaries of the Analysis

SAIC worked with the H-GAC staff to define the boundaries of the analysis, that is, to define what activities and businesses would be included when estimating the contribution of recycling to the economy of the region. It was necessary to reach consensus on the definition of the activities that would constitute recycling for the purposes of this analysis (e.g., Should reuse be included? Should recovering energy from diverted materials be included?), the materials that would be included, and at what point along the recycling chain (e.g., collection, processing, end use, and remanufacturing) activities qualify as recycling.

In collaboration with the H-GAC staff, the boundaries were ultimately defined as follows for this Report.

- Recycling (collection, processing, and end use), reuse and remanufacturing, and energy recovery/beneficial use are considered recycling for the purposes of this analysis.
- All materials that are diverted from disposal to the activities listed above will be included as long as there is economic activity associated with this activity.
- Recycling through the point at which a recovered material is used as a feedstock for a manufacturing process, reuse and remanufacturing through the point an item is reused or resold, and energy recovery through the point a fuel is produced from a recovered material is included as recycling activity in this analysis. Thus, for example, the economic activity associated with a manufacturer using recovered aluminum rather than mined bauxite to make a new aluminum beverage can falls within the boundaries of the analysis but the activity associated with the purchase of that can by a retailer instead of a can made out of virgin materials falls outside these boundaries.

Based on these boundaries, a total of 26 business types were identified whose economic activity may be attributable to recycling. Table 2-1 describes these business types that fall into four general categories:

1. *Recycling Industries (Supply Side)* – Establishments that collect and process recovered materials into feedstock for consuming industries;

2. *Recycling Reliant Industries (Demand Side)* – Establishments that use recovered material to manufacture a new product;

3. *Reuse and Remanufacturing* – Establishments that refurbish and repair recovered materials for reuse and/or sell those refurbished and repaired products; and

4. *Recovery and Beneficial Use*– Conversion of recovered materials to an energy source or use for a purpose with minimal added value to the economy, such as using mulch as daily landfill cover.

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Table 2-1
Business Types Considered

Business Type		Description
Recycling Industry (Supply-Side)		
1	Residential collector	Recyclables collection from single or multi-family residences by private haulers or using government employees, including municipal drop-off centers and HHW collection centers
2	Non-residential collector	Collection of recyclables from industrial, commercial, and institutional facilities, including public spaces and items returned to retailers (tires, batteries, plastic bags, compact fluorescents, etc.); includes waste tire haulers and used oil collectors
3	Composter/organics processor	Process organic materials including yard & wood waste, leaves, food waste, biosolids, or other organics to produce compost, mulch, soil amendments, or landfill alternative daily cover
4	Recyclable material processor	Paper stock dealers, scrap metal processors, and other establishments that minimally sort, remove contaminants, and densify primarily non-residential recovered materials (includes auto wreckers, carpet/textile processors, and tire/rubber processors).
5	Materials recovery facility	Process mixed recovered materials by sorting, crushing, and screening. Materials usually come from residential curbside/drop-off recycling collection programs or by separating recyclables directly from solid waste.
6	Construction and demolition debris recycler	Sort, crush, grind, screen construction and demolition debris
7	Electronics processor	Dismantle, crush, or shred separate electronics components and materials
8	Nonferrous secondary smelting and refining mill	Recycling and alloying of nonferrous metals from scrap, primarily produces billets, ingots, and other basic intermediates
9	Plastic reclaimer	Companies that transform recovered plastics directly into products (e.g. plastic lumber) or raw materials ready for remanufacture (flake/pellet)
Recycling-Reliant Industry (Demand-Side)		
10	Glass product producer	Produce products other than containers from recycled glass (e.g., fiberglass, plate glass)
11	Iron and steel foundry	Produce cast iron/steel products
12	Nonferrous foundry	Produce castings of nonferrous metals
13	Nonferrous product producers	Produce nonferrous formed products in integrated mills that also smelt/refine
14	Paper-based product manufacturing	Produce cellulose-based products from recovered paper/paperboard; cellulose insulation, molded fiber products, hydro-seeding, animal bedding
15	Pavement mix producer	Produce asphalt paving mix from recycled crumb rubber, recycled aggregates, recycled glass
16	Plastic product manufacturer	Companies that convert a recycled plastic clean flake or pellet into an intermediate or end product
17	Rubber product manufacturer	Produce products using ground rubber or cut rubber shapes/stampings as feedstock
18	Other recycling manufacturer	Other processors or manufacturers not elsewhere classified processing recovered materials to a raw material form for sale and/or producing recycled content products. This category includes fluorescent lamp and mercury recyclers, wallboard manufacturers recycling synthetic gypsum from power plants, and glass beneficiaries

Business Type		Description
Reuse and Remanufacturing		
19	Electronics refurbishing/reuse	Remanufacture used electronic appliances, sort, grade, dismantle, and/or rebuild
20	Used motor vehicle parts	Clean, sort, inspect, and remanufacture used parts
21	Tire retreading	Remove old tread from tires (buffings and crumb rubber) and add new rubber tread
22	Wood reuse or pallet rebuilder	Process used wood for reuse — pallet rebuilders, flooring, etc.
23	Retail used merchandise sales	Retail thrift stores, antique shops, reuse centers, shops dedicated to reused products
24	Other reuse	Establishments not otherwise classified that clean, grade, recondition, rebuild, or refurbish products for reuse, including toner cartridges, fork lifts, electric motors, power equipment, other industrial equipment, drums/intermediate bulk containers, etc.
Energy Recovery and Beneficial Reuse		
25	Energy recovery	Establishments that produce a processed fuel product from diverted waste or that combust such materials for energy including pellet fuel producers, cement kilns, biomass energy facilities, biodiesel companies, fuel blenders of used oil, etc.
26	Other beneficial uses	Establishments that use recovered materials (including ash, sludge, foundry sands, contaminated soils) for beneficial use, such as alternative daily cover at landfills and fill

2.3 Data Gathering

SAIC then used multiple sources to identify the establishments within the 13 counties that fit into each of the business types identified. Appendix B lists the primary sources used to identify the establishments within each business type in the H-GAC Region.[9] Once SAIC identified the establishments in the region that fit into each of these business types, SAIC attempted to gather the following type information about them to be used as input to the I-O model:

- the number of jobs;
- annual payroll;
- annual gross receipts;
- throughput (in tons) at establishments;
- the degree to which material input originated from within the region; and
- the degree to which the materials produced were purchased by businesses within the region.

Generally, one of three approaches was taken to gather these data:

1. If the business type aligned well with a North American Industry Classification System (NAICS) code and thus data about jobs, payroll, and gross receipts was available from the U.S. Census, then SAIC gathered information about the number of employees, the annual payroll, and annual gross receipts for this NAICS code and within the region directly from these sources.
2. For those business types that did not align directly with a NAICS code (which was most of them), SAIC surveyed establishments directly, requesting information about number of jobs, annual payroll, gross receipts, and throughput. Data that was provided was extrapolated to those establishments that did not provide data. Survey forms are included in Appendix C and the number of firms surveyed, responding, and applicable within each business type are indicated in Appendix D. We sent surveys to approximately 500 establishments and received 120 responses, 97 of which fit into the definition established for the recycling industry. Table 2-2 shows the number of establishments surveyed and respondents within each business type.
3. Finally, in other cases, the data and information were derived from industry experience, web searches, and interviews with key stakeholders and recycling industry representatives from local governments, trade associations, private haulers, and private processors of the recyclable materials.

[9] No establishments were identified in the region for Business Type 13, nonferrous product manufacturers, or Business Type 26, beneficial use.

The detailed, step-by-step approach to gathering and estimating this information for each business type can be found in Appendix D.

Table 2-2
Establishments Identified and Surveys Conducted and Entered into Database

	Business Type	Establishments Identified	Establishments Surveyed	Entered into Database(1)
Recycling Industry (Supply-Side)				
1	Residential collector	85	75	37
2	Non-residential collector	200	178	7
3	Composter/organics processor	73	67	17
4	Recyclable material processor	48	0	3(2)
5	Materials recovery facility	4	3	2
6	Construction and demolition debris recycler	21	18	5
7	Electronics processor	9	8	5
8	Nonferrous secondary smelting and refining mill	7	6	4
9	Plastic reclaimer	7	6	2
Recycling-Reliant Industry (Demand-Side)				
10	Glass product producer	3	2	1
11	Iron and steel foundry	7	0	0
12	Nonferrous foundry	6	0	2(2)
13	Nonferrous product producers(3)			
14	Paper-based product manufacturing	3	3	1
15	Pavement mix producer	10	0	0
16	Plastic product manufacturer	2	1	0
17	Rubber product manufacturer	5	4	2
18	Other recycling manufacturer	3	1	2(2)
Reuse and Remanufacturing				
19	Electronics refurbishing/reuse	1	1	0
20	Used motor vehicle parts	0	0	0
21	Tire retreading	9	0	0
22	Wood reuse or pallet rebuilder	13	12	6
23	Retail used merchandise sales	0	0	0
24	Other reuse	52	51	13
Energy Recovery and Beneficial Reuse				
25	Energy recovery	31	29	7
26	Other beneficial uses(3)	12	11	4

(1) Surveys entered if economic activity determined to be “recycling activity” as defined. Thus, more establishments may have responded to the survey that were not entered into the database.

(2) Although these categories were not officially surveyed because NAICS data were available, in some cases we entered information gained through interviews into the database to enhance the information for these categories.

(3) These category was eliminated after research determined there was no measurable economic activity in the region currently associated with nonferrous product producers or other beneficial uses as defined in this Report.

In many business types, data was only available from a few establishments and was extrapolated to all known establishments within a business type within the H-GAC Region. For example, if through survey data, several businesses within a business type provided information about the number of employees and annual payroll associated with all of their employees in the region, we would estimate the average salary per employee for that business type. Then, if we had an estimate of the total number of employees in the region within that business type, we could multiply this estimate by the average salary within that business type to estimate annual payroll for this business type as a whole in the region. Similarly, if we knew the total tons of material handled by a particular business type per year and, from employment data for several establishments, could estimate the tons processed per employee per year, SAIC could use the tons per employee and the total tons to estimate the total number of employees.

2.4 Estimating Economic Activity

The data gathered and extrapolated for each business type were compiled and entered into the I-O model described in Section 2-1. The I-O modeling system used in this analysis is the IMPLAN Model, which is one of the most widely used I-O models in the United States.[10] The outcome of the model (direct, indirect, and induced effects on total jobs, industrial output, personal income, and value added) represents the Baseline economic activity associated with the recycling industry specific to the region as presented in Section 3.

SAIC then worked with H-GAC to define three alternative scenarios. These scenarios, if implemented would be likely to change the economic activity associated with recycling within specific business types, so SAIC estimated the input for the I-O model (number of jobs, annual payroll, annual gross receipts, etc.) associated with each of these three scenarios. The I-O model was then used to project the change in the overall economic activity that would result from these scenarios, as reported in Section 4.

[10] IMPLAN is produced by the Minnesota IMPLAN Group (MIG). MIG annually updates the model using aggregated production, employment and trade data from local, regional, and national sources, including the U.S. Census Bureau County Business Patterns report and the U.S. Bureau of Labor Statistics annual report called Covered Employment and Wages. H-GAC provided the most recent regionally specific IMPLAN data for the thirteen counties for this analysis.

3.1 Introduction

According to data gathered and surveys and interviews conducted for this Report, SAIC estimates that the recycling industry in the H-GAC region consists of approximately 870 establishments. As described in Section 2, for the purposes of estimating the economic contribution of these establishments, they are grouped into the following sub-categories:

- Recycling industries (supply side);
- Recycling reliant industries (demand side);
- Reuse and remanufacturing; and
- Energy recovery/other beneficial uses.

It should be noted that because the methodology used in this analysis is unable to consistently detect the degree to which the establishments within the recycling business types supply inputs to each other (for example, how much of the plastic that plastic reclaimers accept comes from collectors and processors within the region) and thus, how much the economic contribution of each sub-category would overlap, the economic contribution of the recycling industry as a whole may be less than the sum of these four industry sub-categories.

3.2 Recycling Industry (Supply Side)

The sub-category called "recycling industry (supply side)" includes those establishments that collect and process material for industries that use recovered and processed material as a feedstock. Nine business types are included in this sub-category for the purposes of this analysis:

- Residential collectors (of recyclables);
- Commercial collectors (of recyclables);
- Composters;
- Recyclable material wholesalers/processors;
- Material recovery facilities;
- Construction and demolition debris recycler;
- Electronics processor;
- Nonferrous secondary smelters and refiners; and
- Plastics reclaimers.

Together the establishments in this sub-category are estimated to generate 5,186 direct jobs. Another 5,873 jobs are estimated within the region in establishments that provide goods and services as input to the recycling industry (supply-side). An estimated 3,772 jobs are within the establishments in the region that are patronized by the employees of the direct and indirect establishments, in other words, indirect jobs are those jobs in the businesses where employees in the recycling industry and their suppliers purchase goods or services for personal use.

In summary, the establishments that collect and process recyclable materials in the region contribute an estimated $1.9 billion in direct industrial output to the region; $734 million of which is direct value added. Over $332 million of the direct value added is direct labor income to the region. When the indirect and induced effects of the activity in this sub-category is added to the direct effect, a total of $3.3 billion of industrial output is estimated. Over $1.6 billion of this is estimated to be value added and $878 million of the value added is estimated to be labor income as shown in Table 3-1.

Table 3-1
Estimated Economic Contribution by Recycling Industry (Supply Side) in H-GAC Region

Metric	Direct(1)	Indirect(2)	Induced(3)	Total
Jobs(4)	5,186	5,873	3,772	14,831
Industrial Output ($)(5)	1,900,439,609	911,862,625	513,570,315	3,325,872,549
Value Added ($)(6)	734,411,445	572,382,293	328,475,802	1,635,269,540
Labor Income ($)(7)	332,393,831	367,776,151	178,239,234	878,409,215

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

The business type in this sub-category of recycling industries (supply side) that contributes the most economic activity in the region according to this analysis is recyclable material wholesalers[11]. The estimated 117 establishments in the region that fall into this businesses type account for an estimated $1.9 billion in total industrial output, $502 million of which is labor income resulting from 8,523 jobs when direct, indirect, and induced effects are taken into account. The economic contribution of this business type is due, in part, to the large number of establishments and jobs in the

[11] This business type includes paper stock dealers, scrap metal processors, and other establishments that minimally sort, remove contaminants, and densify primarily non-residential recovered materials (includes auto wreckers, carpet/textile processors, and tire/rubber processors).

region. However, this business type also has relatively high multipliers, meaning a job or dollar of output produced by a recyclable material wholesaler in the region would have a relatively high indirect and induced economic effect compared to some of the other business types. Table 3-2 shows the economic contribution by business type within this sub-category.

Table 3-2
Estimated Economic Contribution and Multipliers by Business Types within Recycling Industry (Supply Side) in H-GAC Region

Business Type	Metric	Direct[1]	Indirect[2]	Induced[3]	Total	Type I Multiplier[4]	Type II Multiplier[5]
Residential Collection	Jobs[6]	450	212	211	873	1.47	1.94
	Industrial Output ($)[7]	93,356,225	34,471,057	28,623,897	156,451,179	1.37	1.68
	Value Added ($)[8]	53,161,067	20,781,252	18,396,590	92,338,909	1.39	1.74
	Labor Income ($)[9]	25,757,623	12,576,987	10,031,573	48,366,183	1.49	1.88
Commercial Collection	Jobs[6]	262	190	136	588	1.72	2.24
	Industrial Output ($)[7]	80,821,231	29,453,960	18,634,447	128,909,638	1.36	1.59
	Value Added ($)[8]	30,624,309	17,838,424	12,044,462	60,507,195	1.58	1.98
	Labor Income ($)[9]	13,764,076	11,574,203	6,567,069	31,905,348	1.84	2.32
Composting	Jobs[6]	1,079	650	723	2,451	1.60	2.27
	Industrial Output ($)[7]	254,545,365	140,693,129	99,068,370	494,306,864	1.55	1.94
	Value Added ($)[8]	137,143,244	88,451,432	64,093,211	289,687,888	1.64	2.11
	Labor Income ($)[9]	77,227,978	50,747,870	34,913,523	162,889,370	1.66	2.11
Recyclable Material Processor/Wholesaler	Jobs[6]	2,332	4,102	2,088	8,523	2.76	3.65
	Industrial Output ($)[7]	1,054,127,924	583,035,264	282,819,439	1,919,982,627	1.55	1.82
	Value Added ($)[8]	397,953,250	366,180,338	179,448,884	943,582,472	1.92	2.37
	Labor Income ($)[9]	162,344,489	242,686,077	97,005,056	502,035,622	2.49	3.09
Material Recovery Facilities	Jobs[6]	112	29	30	170	1.26	1.52
	Industrial Output ($)[7]	16,042,857	4,411,087	4,075,341	24,529,285	1.27	1.53
	Value Added ($)[8]	8,396,117	2,695,078	2,633,970	13,725,166	1.32	1.63
	Labor Income ($)[9]	3,791,247	1,755,353	1,436,470	6,983,070	1.46	1.84

Business Type	Metric	Direct[1]	Indirect[2]	Induced[3]	Total	Type I Multiplier[4]	Type II Multiplier[5]
Construction and Demolition Debris Recycler	Jobs[6]	405	348	225	978	1.86	2.41
	Industrial Output ($)[7]	156,725,214	54,838,068	30,881,481	242,444,763	1.35	1.55
	Value Added ($)[8]	66,269,660	33,044,527	19,961,075	119,275,263	1.50	1.80
	Labor Income ($)[9]	20,773,209	21,172,979	10,880,993	52,827,181	2.02	2.54
Electronics Processor	Jobs[6]	181	19	32	232	1.11	1.28
	Industrial Output ($)[7]	9,231,000	2,751,573	4,297,399	16,279,972	1.30	1.76
	Value Added ($)[8]	6,629,687	1,727,869	2,724,406	11,081,963	1.26	1.67
	Labor Income ($)[9]	5,567,835	1,145,164	1,474,036	8,187,035	1.21	1.47
Nonferrous Secondary Smelters and Refiners	Jobs[6]	324	275	301	899	1.85	2.78
	Industrial Output ($)[7]	214,246,324	54,793,804	41,397,750	310,437,878	1.26	1.45
	Value Added ($)[8]	25,835,661	37,140,843	26,734,433	89,710,937	2.44	3.47
	Labor Income ($)[9]	20,961,803	23,175,658	14,601,223	58,738,684	2.11	2.80
Plastics Reclaimers	Jobs[6]	41	48	27	117	2.18	2.85
	Industrial Output ($)[7]	21,343,470	7,414,683	3,772,191	32,530,344	1.35	1.52
	Value Added ($)[8]	8,398,448	4,522,530	2,438,771	15,359,748	1.54	1.83
	Labor Income ($)[9]	2,205,571	2,941,859	1,329,292	6,476,722	2.33	2.94

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Type I multiplier* identifies the value of direct and indirect transactions (e.g., the output of a business category and all other output that it purchases from its suppliers in the region) relative to the value of only the direct transactions.

(5) *The Type II* multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by the recycling industry, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

(6) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(7) *Total industrial output* for most private industries is simply gross sales.

(8) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(9) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

3.3 Recycling Reliant Industries (Demand Side)

The recycling reliant industries (demand side) includes processors and manufacturers that used recycled feedstock to manufacture new products. They include:

- Glass product producers;
- Iron and steel foundries;
- Paper based product manufacturers;
- Pavement mix producers;
- Plastic product manufacturers;
- Rubber product manufacturers; and
- Other recycling manufacturers.

This sub-category also included the business type of nonferrous product producers, but no establishments were identified in the region that fit into this business type.

Together the establishments in this sub-category are estimated to generate 744 direct jobs, 651 indirect jobs, and 540 induced jobs for a total of 1,935 jobs. The recycling reliant businesses (demand side) are estimated to contribute nearly $546 million in total industrial output; $247 million of this is total value added and $126 million of the total value added is labor income. Table 3-3 presents the estimated economic contribution of the recycling reliant industries (demand side).

Table 3-3
Estimated Economic Contribution by Recycling Reliant Industries (Demand Side) in H-GAC Region

Metric	Direct(1)	Indirect(2)	Induced(3)	Total
Jobs(4)	744	651	540	1,935
Industrial Output ($)(5)	327,933,170	143,646,866	74,140,864	545,720,900
Value Added ($)(6)	114,323,197	85,016,572	47,938,668	247,278,437
Labor Income ($)(7)	45,870,317	53,982,765	26,136,990	125,990,072

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

The iron and steel foundries, pavement mix manufacturers, and other recycling manufacturers account for approximately three quarters of the industrial output, value added, labor income, and jobs resulting from the recycling reliant industries (demand supply) in the region Collectively, these businesses produce approximately $431 million in total industrial output, $194 million of which is total value added. Of the total value added by these three business types, $94 million is labor income generated by an estimated 1,393 jobs.

When considering the impact of each business type on the region, the highest multiplier, both input and total, are generally found in the iron and steel foundries, plastic products manufacturers, and other recycling manufacturer business types. Table 3-4 presents the estimated economic contribution of the recycling reliant industries (demand side) by business type and indicates, through the multipliers, the estimated impact of direct output or jobs in the business type on the economy of the region.

Table 3-4
Estimated Economic Contribution and Multipliers by Business Types within Recycling Reliant Industries (Demand Side) in H-GAC Region

Business Type	Metric	Direct(1)	Indirect(2)	Induced(3)	Total	Type I Multiplier(4)	Type II Multiplier(5)
Glass Products Producers	Jobs(6)	41	22	29	91	1.53	2.23
	Industrial Output ($)(7)	13,379,921	5,116,817	3,933,891	22,430,629	1.38	1.68
	Value Added ($)(8)	6,378,390	3,038,163	2,542,258	11,958,810	1.48	1.87
	Labor Income ($)(9)	3,357,743	1,867,953	1,387,284	6,612,980	1.56	1.97
Iron and Steel Foundries	Jobs(6)	194	159	124	476	1.82	2.46
	Industrial Output ($)(7)	62,581,565	27,971,902	17,051,013	107,604,481	1.45	1.72
	Value Added ($)(8)	15,944,893	18,488,525	11,018,911	45,452,329	2.16	2.85
	Labor Income ($)(9)	10,244,473	11,800,408	6,012,859	28,057,740	2.15	2.74
Paper Based Product Manufacturers	Jobs(6)	45	7	20	73	1.17	1.61
	Industrial Output ($)(7)	6,244,054	1,543,991	2,743,747	10,531,793	1.25	1.69
	Value Added ($)(8)	4,320,343	898,680	1,775,698	6,994,721	1.21	1.62
	Labor Income ($)(9)	3,177,890	585,056	966,581	4,729,527	1.18	1.49
Pavement Mix Producers	Jobs(6)	132	105	125	362	1.79	2.74
	Industrial Output ($)(7)	87,283,603	35,175,348	17,135,232	139,594,183	1.40	1.60
	Value Added ($)(8)	45,139,236	17,799,174	11,087,724	74,026,134	1.39	1.64
	Labor Income ($)(9)	12,960,576	10,794,854	6,037,339	29,792,769	1.83	2.30
Plastic Product Manufacturers	Jobs(6)	75	82	57	214	2.09	2.86
	Industrial Output ($)(7)	32,932,444	18,086,119	7,885,301	58,903,864	1.55	1.79
	Value Added ($)(8)	7,765,877	10,359,402	5,098,046	23,223,325	2.33	2.99
	Labor Income ($)(9)	4,001,839	6,441,381	2,781,188	13,224,408	2.61	3.30

Business Type	Metric	Direct[1]	Indirect[2]	Induced[3]	Total	Type I Multiplier[4]	Type II Multiplier[5]
Rubber Product Manufacturers	Jobs[6]	105	28	31	164	1.27	1.56
	Industrial Output ($)[7]	13,233,378	5,656,253	4,235,247	23,124,878	1.43	1.75
	Value Added ($)[8]	5,054,033	3,437,367	2,736,833	11,228,233	1.68	2.22
	Labor Income ($)[9]	3,383,204	2,183,847	1,493,629	7,060,680	1.65	2.09
Other Recycling Manufacturers	Jobs[6]	152	249	154	555	2.64	3.65
	Industrial Output ($)[7]	112,278,205	50,096,435	21,156,432	183,531,073	1.45	1.63
	Value Added ($)[8]	29,720,426	30,995,261	13,679,198	74,394,885	2.04	2.50
	Labor Income ($)[9]	8,744,592	20,309,266	7,458,111	36,511,968	3.32	4.18

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Type I multiplier* identifies the value of direct and indirect transactions (e.g., the output of a business category and all other output that it purchases from its suppliers in the region) relative to the value of only the direct transactions.

(5) *The Type II multiplier* identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by the recycling industry, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

(6) *Jobs means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.*

(7) *Total industrial output for most private industries is simply gross sales.*

(8) *Value added is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).*

(9) *Labor income includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).*

3.4 Reuse and Remanufacturing

The reuse and remanufacturing recycling sub-category includes businesses that reuse or remanufacture a product for its original purpose. It includes the following business types:

- used motor vehicle part dealers;
- tire retreaders;
- wood reuse or pallet rebuilders;
- retail used merchandise sales; and
- other reuse businesses.

This category also included electronics refurbishers; However, no establishments were identified in the region for which this was their primary business type. Together the establishments in this sub-category are estimated to generate 3,704 direct jobs, generate 436 indirect jobs, and 645 induced jobs for a total of 4,784 jobs. Collectively, the reuse and remanufacturing businesses in the region generate $388 million in total industrial output. Of the total industrial output, $239 million is total value added. Nearly $155 million of the value added is labor income associated with the estimated 4,784 jobs. Table 3-5 summarizes the estimated economic contribution of reuse and remanufacturing businesses in the H-GAC region.

Table 3-5
Estimated Economic Contribution by Reuse and Remanufacturing in H-GAC Region

Metric	Direct(1)	Indirect(2)	Induced(3)	Total
Jobs(4)	3,704	436	645	4,784
Industrial Output ($)(5)	229,697,727	69,267,997	88,916,188	387,881,913
Value Added ($)(6)	138,042,470	43,219,719	57,283,981	238,546,170
Labor Income ($)(7)	96,636,930	26,765,786	31,176,605	154,579,321

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Motor vehicle parts, tire retreaders, and wood reuse/pallet rebuilder business types combined produce approximately $149 million of the total industrial output. Tire retreaders and wood reuse/pallet rebuilder business types have higher multipliers in comparison to other reuse and remanufacturing business types but not as high as those in the other sub-categories of the recycling industry. The estimated economic contribution of the business types within the reuse and remanufacturing sub-category as well as the multipliers associated with each business type, is presented in Table 3-6.

Table 3-6
Estimated Economic Contribution by Business Types within Reuse and Remanufacturing in H-GAC Region

Business Type	Metric	Direct[1]	Indirect[2]	Induced[3]	Total	Type I Multiplier[4]	Type II Multiplier[5]
Used Motor Vehicle Parts	Jobs[6]	371	118	113	602	1.32	1.62
	Industrial Output ($)[7]	41,231,990	16,817,657	15,325,627	73,375,274	1.41	1.78
	Value Added ($)[8]	23,594,288	10,560,808	9,718,962	43,874,058	1.45	1.86
	Labor Income ($)[9]	14,846,919	6,999,287	5,256,759	27,102,965	1.47	1.83
Tire Retreaders	Jobs[6]	55	25	23	103	1.45	1.88
	Industrial Output ($)[7]	13,645,138	5,572,283	3,227,686	22,445,106	1.41	1.64
	Value Added ($)[8]	3,993,947	3,165,140	2,085,996	9,245,083	1.79	2.31
	Labor Income ($)[9]	2,240,285	2,006,518	1,138,194	5,384,997	1.90	2.40
Wood Reuse/Pallet Rebuilders	Jobs[6]	159	76	55	290	1.48	1.82
	Industrial Output ($)[7]	31,369,638	14,766,458	7,502,553	53,638,648	1.47	1.71
	Value Added ($)[8]	7,526,918	8,223,691	4,849,576	0,600,185	2.09	2.74
	Labor Income ($)[9]	4,876,557	5,493,977	2,645,354	13,015,888	2.13	2.67
Retail Used Merchandise Sales	Jobs[6]	2,692	109	373	3,174	1.04	1.18
	Industrial Output ($)[7]	103,436,149	16,585,613	51,776,086	171,797,849	1.16	1.66
	Value Added ($)[8]	87,307,566	10,980,579	33,462,109	131,750,253	1.13	1.51
	Labor Income ($)[9]	64,703,904	6,191,461	18,230,515	89,125,880	1.10	1.38
Other Reuse	Jobs[6]	427	107	80	614	1.25	1.44
	Industrial Output ($)[7]	40,014,813	15,525,987	11,084,237	66,625,037	1.39	1.67
	Value Added ($)[8]	15,619,751	10,289,501	7,167,339	33,076,591	1.66	2.12
	Labor Income ($)[9]	9,969,265	6,074,543	3,905,783	19,949,591	1.61	2.00

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Type I multiplier* identifies the value of direct and indirect transactions (e.g., the output of a business category and all other output that it purchases from its suppliers in the region) relative to the value of only the direct transactions.

(5) *The Type II* multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by the recycling industry, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

(6) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(7) *Total industrial output* for most private industries is simply gross sales.

(8) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(9) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

3.5 Energy Recovery

This sub-category originally included energy recovery and other establishments that applied recovered materials for beneficial uses with minimal value (such as those that produce fill from ash, sludges, or foundry sand); however, only energy recovery establishments were identified in the region for this sub-category. The energy recovery businesses in the H-GAC region produced an estimated 625 direct jobs, 1,477 indirect jobs, and 1,225 induced job. The establishments in this business type generated an estimated $1.587 billion in total industrial output, $633 million of which was value added. An estimated $285 million of the value added was labor income for 3,327 jobs, which means the average salary for this business type is higher than for any other based on the research conducted for this analysis. As a result of the higher paying jobs and relatively local feedstock to the energy recovery companies in the region, (the majority of which are bio-diesel companies), this business type has some of the highest multipliers in the recycling industry. Table 3-7 presents the estimated economic contribution of the energy recovery sub-category (only one business type identified).

Table 3-7
Estimated Economic Contribution by Energy Recovery Business Type in H-GAC Region

Metric	Direct(1)	Indirect(2)	Induced(3)	Total
Jobs(4)	625	1,477	1,225	3,327
Industrial Output ($)(5)	977,709,681	441,959,944	167,353,500	1,587,023,125
Value Added ($)(6)	301,166,905	222,969,238	108,386,777	632,522,920
Labor Income ($)(7)	88,177,419	137,932,433	58,996,200	285,106,052

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Section 4
ECONOMIC CONTRIBUTION WITH INCREASED RECYCLING

4.1 Introduction

As part of this analysis, SAIC projected the economic contribution of the recycling industry to the H-GAC Region that may result from various actions to increase recycling. These actions included adoption of policies, investment in infrastructure, and development of markets for materials. As a starting point, SAIC proposed twelve potential scenarios for consideration to the H-GAC, as summarized in Table 4-1. The H-GAC staff reviewed the proposed scenarios and selected Scenarios 2, 3, and 9 for further development and analysis.

Table 4-1
Potential Scenarios to Increase the Economic Contribution of the Recycling Industry

Scenario		Description of Scenario
1.	Expand smelting/refining for nonferrous metal	Smelt a broader range of nonferrous material in the region (currently catalytic converters come to the region for smelting from around the country) and develop refining capability in the region.
2.	Expand policies and infrastructure for electronics diversion	Expand Extended Producer Responsibility to other electronics (currently only on computers and televisions but not on other items (e.g., printers, consumer electronics). Potentially ban from disposal with sufficient notice to ramp up production. Require all processors to be certified. Expand collection of electronics in rural areas.
3.	Increase use of Recycled Asphalt Pavement (RAP) and Recycled Shingle Pavement (RAS)	Use new state specifications for hot mix with more RAP. Promote and encourage RAS on projects. Develop collection/processing infrastructure that accommodates more end uses.
4.	Increase disposal fees at regional landfills	Increasing disposal costs may direct recyclable materials that are currently disposed to recycling instead.
5.	Develop markets for tire-derived products	Expand markets for industrial products and crumb rubber applications.
6.	Expand organics collection and processing	Support, incentivize, require separate collection and diversion of organic material from residential and commercial generators. Expand rebate for composting/mulching equipment.
7.	Develop markets for using wood for boiler fuel	Expand regional markets for boiler fuel from C&D wood, brush, and wood from yard trimmings.
8.	Increase collection and processing of aggregates	End market for aggregate is strong in region so develop increased collection and crushing in region (City of Houston does not presently allow within city limits).
9.	Expand plastic recycling and develop regional market for plastics	Recruit or expand end user(s) for plastics, including #3-#7 to region.

	Scenario	Description of Scenario
10.	Increase collection and processing of glass	Expand collection of glass from commercial sector sufficiently for processor to invest in sorting equipment locally. Develop processing capacity to meet regional and statewide end user needs from within region.
11.	Increase infrastructure and use for biofuel	Expand fleets in region operating on biofuels. Develop commercial fueling stations to meet fleet needs and federal mandate.
12.	Address regulatory hurdles to food waste composting	Revisit regional TCEQ interpretation on sorting requirements for commercial food waste loads.

To project the added economic contribution that could potentially result from these scenarios, it was necessary to estimate how much and what type of additional material would be generated for recycling in the region. Then, SAIC made assumptions about how these additional materials may flow through collectors, processors, end users, or possibly remanufacturers inside and outside of the region. These recovery estimates, assumptions, and resulting economic contribution are described in this Section.

4.2 Scenario 1: Increased Recovery of Electronics

In the first scenario, it is assumed that electronics recovery increases by 63 percent as a result of the following policies and actions at the State and/or local level:

- expansion of current state requirements for manufacturers to develop infrastructure to recover more electronics;
- implementation of a ban on electronics from landfill disposal;
- expansion of access to collection of electronics, especially in rural areas; and
- requirement for all processors to be certified.

In the longer term, this scenario may include expanding the capacity to process and remanufacture rare-earth metals, from electronics and other sources, in the region.

4.2.1 Current Recovery Estimates

Based on research, surveys and interviews conducted for this project, SAIC estimates that 4,593 tons of electronics were recovered (for reuse, refurbishing, or recycling) from the H-GAC Region in 2011. This is equivalent to 1.6 pounds per person per year. This estimate is consistent with a finding by EPA that says, “States with low levels of collection report approximately one pound per capita; states with higher levels of collection report three to six pounds per capita.”[12] Table 4-2 below estimates the source (residential or commercial) and management (refurbished versus recycled) of the electronic items recovered in the region, primarily based on extrapolation of tonnage reports provided by H-GAC’s contractor for electronics management in the region. Most of the refurbished electronics are generated by the commercial sector while most of the recycled appliances are generated by the residential sector.

[12] Management of Electronic Waste in the United States: Approach Two, Draft Final Report, April 2007, EPA530-R-07-004b.

Table 4-2
Estimated Source and Disposition of Electronics Recovered in H-GAC in 2011 (Tons)

	Residential	Commercial	Total
Refurbished	83	1,093	1,176
Recycled	2,688	729	3,417
TOTAL	2,771	1,822	4,593

Table 4-3 estimates the tons of each electronic product recovered (refurbished or recycled) in the region in 2011 based on the breakdown of electronic products recovered in a 2007 report issue by EPA.[13] Based on the estimated composition of the material recycled from these products identified in the EPA report, an estimated 1,300 tons of ferrous metal, 1,000 tons of plastic, 600 tons of glass, and 300 tons of nonferrous metals enters the recycling stream from electronics each year. In addition, electronics recycled in the region are estimated to generate three tons of rare earth metals and 100 tons of other materials per year.

Table 4-3
Estimated Tons of Electronic Products Refurbished and Recycled in H-GAC Region in 2011

Management Approach	Product	Estimated Tons
Refurbished		1,176
Recycled	Computers	885
	Displays (Monitors)	1,022
	Hard Copiers	511
	Keyboard/Mice	34
	TVs	953
	Mobile Devices	12
TOTAL		4,593

4.2.2 Recovery Estimates Under Scenario 1

As described in the previous section, EPA estimates that 3 to 6 pounds of electronics per year may be recovered in communities with a "higher level of collection". With a population of 6,087,133 people in the region[14], a total of 9,131 tons of electronics would be recovered at 3 pounds per person per year and 18,261 tons would be recovered per year at a rate of 6 pounds per person. It is projected that the actions described in this scenario may increase the amount of electronics recovered to 7,500 tons per year, or 2.46 pounds per person per year. This is a 63 percent increase from what is currently estimated to be recovered. The projected items that would be refurbished and recycled in this scenario are shown in Table 4-4 on the following page. According to EPA's data on the material composition of electronics recycled, it

[13] Management of Electronic Waste in the United States: Approach Two, Draft Final Report, April 2007, EPA530-R-07-004b. Exhibit 1-1.
[14] 2010 Census

is assumed that the additional recycled electronics (excluding the refurbished electronics) would result in an additional estimated 840 tons of ferrous metal, 630 tons of plastic, 400 tons of glass, and 200 tons of nonferrous metals entering the recycling stream each year.

Table 4-4
Estimated Tons of Electronic Products Refurbished and Recycled per Year, Scenario 1

		Current	Additional	Total Scenario 1
Refurbished		1,176	744	1,921
Recycled	Computers	885	560	1,445
	Displays	1,022	647	1,669
	Hard Copiers	511	323	834
	Keyboard/Mice	34	22	56
	TVs	953	603	1,557
	Mobile Devices	12	7	19
Subtotal Recycled		3,417	2,162	5,579
TOTAL		4,593	2,906	7,500

4.2.3 Projected Economic Contribution

SAIC projects that additional jobs would be created in residential and non-residential collection, electronics processing, and electronics refurbishing to handle the additional tons of electronics refurbished and recycled in this Scenario. The basis of the estimated additional jobs created in each business type is described below.

- *Residential collectors:* It is estimated that 10 additional jobs will be created to collect the additional electronics generated by the residential sector in this Scenario, primarily at drop-off locations.
- *Non-residential collectors*: It is estimated that 10 additional jobs will be created to collect the additional electronics generated by the commercial sector in this Scenario, primarily by collectors that collect electronics from businesses and deliver them to refurbishers and recyclers.
- *Electronics processors*: Based on the current estimate that on average, 16.5 tons of electronics are processed per job per year, an additional 2,162 tons of electronics recycled would create an additional 131 jobs in this business type.
- *Electronics refurbishers*: No establishments were identified as electronics refurbishers in the initial assessment. The establishments that reportedly refurbished electronics had another primary business such as electronics processing and so fell into another business type. It is assumed that with 744 additional tons of electronics to refurbish per year, enough electronics would be available to attract establishments that primarily refurbish electronics in the region. At an estimated rate of 25 tons of electronics refurbished per person, an additional 30 jobs are projected to refurbish the additional 744 tons of electronics generated in this Scenario. This business type falls into the reuse and remanufacturing sub-category.

- *Other business types*: Although additional ferrous, nonferrous, plastic, glass, and other material is likely to be generated for recycling as a result of 2,162 additional tons per year of electronics being collected and processed for recycling, the projected amount of each of these materials is not anticipated to generate additional jobs within other business types within the region. This is because the quantity of each of these materials is small compared to what these business types already handle in the region. For example, increasing electronics recovery by 63 percent is estimated to result in an additional 200 tons per year of nonferrous metal. However, compared to the estimated existing throughput of over 25,000 tons per year of nonferrous metal smelted in the region, this additional nonferrous metal is not anticipated to create any additional jobs. In addition, much of the material may be exported out of the region for further processing, resulting in limited additional economic contribution by these business types in the region.

The additional jobs in this scenario lead to increased labor income in the region, which in turn increases the value added by the recycling industry, which in turn, leads to an increase in industrial output. This economic effect does not only occur in the recycling industries (direct impacts) but also in businesses in the region that supply the recycling industry (indirect impacts) and those who benefit from the patronage of the additional employees with additional labor income in the region (induced effects). Table 4-5 shows the estimated direct, indirect, and induced effects of each recycling industry sub-category in Scenario 1 based on the outcome of the input-output model. These are the total effects estimated, including existing activity and the activity resulting from the changes assumed in this scenario.

Table 4-5
Estimated Economic Contribution by Industry Sub-Category, Scenario 1

	Direct(1)	Indirect(2)	Induced(3)	Total
Recycling Industry (Supply-Side)				
Jobs(4)	5,342	5,900	3,806	15,047
Industrial Output ($)(5)	1,912,534,971	915,820,326	518,146,625	3,346,501,923
Value Added ($)(6)	741,743,091	574,823,243	331,391,395	1,647,957,729
Labor Income ($)(7)	337,675,136	369,357,858	179,820,372	886,853,365
Recycling Reliant Industry (Demand-Side)				
Jobs(4)	744	651	540	1,935
Industrial Output ($)(5)	327,933,170	143,646,866	74,140,864	545,720,900
Value Added ($)(6)	114,323,197	85,016,572	47,938,668	247,278,437
Labor Income ($)(7)	45,870,317	53,982,765	26,136,990	125,990,072
Reuse and Remanufacturing				
Jobs(4)	3,734	445	654	4,833
Industrial Output ($)(5)	233,031,851	70,627,916	90,155,457	393,815,224
Value Added ($)(6)	139,950,364	44,073,692	58,069,881	242,093,937
Labor Income ($)(7)	97,837,489	27,331,766	31,601,680	156,770,936
Energy Recovery				
Jobs(4)	625	1,477	1,225	3,327
Industrial Output ($)(5)	977,709,681	441,959,944	167,353,500	1,587,023,125
Value Added ($)(6)	301,166,905	222,969,238	108,386,777	632,522,920
Labor Income ($)(7)	88,177,419	137,932,433	58,996,200	285,106,052

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full-time-equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Table 4-6 shows the overall economic contribution of each recycling industry sub-category in Scenario 1 compared to the Baseline and the difference between them. An additional 216 jobs in the business types residential and non-residential collection and electronics processing and 49 jobs in the business type reuse and remanufacturing are projected. Total industry output is projected to increase by $20.6 million per year in the recycling industry (supply side) sub-category and $5.9 million per year in the reuse and remanufacturing sub-industry. In addition, this Scenario is projected to contribute approximately $12.7 million in value added, $8.4 million from labor income, in the recycling industry (supply side) and an additional $3.5 million in value added, $2.2 million from labor income, in the reuse and remanufacturing industry.

Table 4-6
Economic Contribution by Industry Sub-Category (Direct, Indirect, and Induced)
Baseline and Scenario 1

	Recycling Industry Sub-Category	Jobs (#)	Industrial Output ($)	Value Added ($)	Labor Income ($)
Baseline	Recycling Industry (Supply Side)	14,831	3,325,872,549	1,635,269,540	878,409,215
	Recycling Reliant Industries (Demand Side)	1,935	545,720,900	247,278,437	125,990,072
	Reuse and Remanufacturing	4,784	387,881,913	238,546,170	154,579,321
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Scenario 1	Recycling Industry (Supply Side)	15,047	3,346,501,923	1,647,957,729	886,853,365
	Recycling Reliant Industries (Demand Side)	1,935	545,720,900	247,278,437	125,990,072
	Reuse and Remanufacturing	4,833	393,815,224	242,093,937	156,770,936
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Difference	Recycling Industry (Supply Side)	216	20,629,374	12,688,189	8,444,150
	Recycling Reliant Industries (Demand Side)	0	0	0	0
	Reuse and Remanufacturing	49	5,933,311	3,547,767	2,191,615
	Energy Recovery	0	0	0	0

4.3 Scenario 2: Increased Asphalt, Shingle, and Brick Recovery

This scenario assumes an increase in the use of recycled asphalt pavement (RAP) and recycled asphalt shingles (RAS) in road construction and the diversion of shingles and bricks on residential construction sites in the region. Specifically, this Scenario includes the following activities by H-GAC, local governments, the Texas Department of Transportation (TxDOT) and contractors:

- adopt and implement current State specifications allowing expanded use of RAP and RAS in hot mix asphalt;
- promote, encourage, and incentivize the application of updated specifications that allow higher content of RAP and RAS for all construction projects in region;
- develop collection and processing infrastructure for RAS and RAP that meet demand and end use requirements; and
- promote, encourage, incentivize on-site use of recovered bricks at construction sites for “flatwork”.

On August 22, 2012, the State TxDOT adopted new specifications that increased the allowable percentage of RAP and RAS in hot mix asphalt. These specifications are indicated in Table 4-7. According to TxDOT, if the cities and counties in the H-GAC Region adopt these specifications; encourage or require contractors to use hot mix that meets these specifications; and ensure sufficient RAP and especially RAS is available to meet these specifications, then RAP and RAS use in the region would increase multi-fold. Thus, this Scenario also assumes that mobile grinders are deployed to collect and process shingles at residential new construction or reroofing sites.

Table 4-7
Maximum Allowable Amounts of Recycled Binder, RAP & RAS in TxDOT Specifications

Mixture Description & Location	Maximum Allowable % (Percentage by Weight of Total Mixture)	Unfractionated RAP	Fractionated RAP	RAS
Surface Mixes	35	10	20	5
Non-Surface Mixes < 8 in. From Final Riding Surface	40	15	30	5
Non-Surface Mixes > 8 in. From Final Riding Surface	45	20	40	5

Finally, in this Scenario, it is assumed that recyclers and grinders increase the recovery of bricks on residential construction sites. This particular activity was included because of a finding in a recent study of residential construction waste in the region that the market for bricks in the region is strong and "composed of two elements.[15] The first is the aggregate business which utilizes bricks as a source of crushed material to create fill and/or base of high quality." The second "is the resale of bricks as an architectural element."

4.3.1 Current Recovery Estimates

According to TxDOT, 630,000 tons of RAP and 27,000 tons of RAS was used in road construction in the State in FY2010.[16] There are no readily available data on the RAP and RAS used in the H-GAC Region but SAIC estimates that ten percent of the roads in the State lie within the thirteen county region. If the RAP and RAS are evenly distributed in the State, then currently, an estimated 63,000 tons of RAP and 2,700 tons of RAS are used in road construction in the H-GAC Region. One large construction and demolition debris recycler in the region estimates that 60 percent of the shingles generated in the region are currently recovered. However, there is no definitive data about the tons of shingles and bricks currently diverted to reuse or recycling in the H-GAC Region.

4.3.2 Recovery Estimates Under Scenario 2

The recovery estimates for RAP in this Scenario are based on the assumption that half of the roads in the region will contain 20 percent RAP and five percent RAS, a conservative estimate based on the allowable specifications. Because no information

[15] Residential C&D Waste Study, prepared in cooperation with H-GAC and the Texas Commission on Environmental Quality, July 2005.
[16] Recycling in Asphalt Paving Operations, Presentation mad by Robert E. Lee, P.E., Texas Department of Transportation. http://www.h-gac.com/community/waste/management/recycling/documents/urcp_12-10-2010_recycled_asphalt_pavement_and_asphalt_shingles.pdf

was readily available about the projected annual amount of road construction anticipated in the H-GAC Region, SAIC extrapolated estimates of projected asphalt to be used statewide to the H-GAC Region. TxDOT anticipates using approximately 10,100,000 tons of asphalt per year on the projects statewide and estimates that the private sector typically uses about the same amount, for a total of 20,200,000 tons statewide. If only half of this asphalt contained 20 percent RAP and 5 percent RAS, then, an estimated 2,020,000 tons of RAP and 505,000 tons of RAS are estimated to be needed statewide. If the currently used amount of 630,000 tons of RAP and 27,000 tons of RAS is subtracted, an additional 1,390,000 tons of RAP and 478,000 tons of RAS is assumed statewide. Given an estimated ten percent of the roads in the state are located in the H-GAC Region, it is estimated that 139,000 tons of additional RAP and 47,800 tons of additional RAS will be used in road construction in the region per year. Table 4-8 shows these calculations.

Table 4-8
Calculation of Estimated Tons of RAP and RAS Used in the H-GAC Region in Scenario 2

STATEWIDE	
10,100,000 tons	Estimated annual asphalt use by TxDOT
10,100,000 tons	Estimated annual asphalt use on non-TxDOT projects
20,200,000 tons	Total asphalt use per year, statewide
10%	Estimated percent RAP (20% in half of all new asphalt)
2,020,000	Estimated tons of RAP per year, statewide
630,000	FY2010 RAP used statewide
1,390,000	Additional RAP used statewide in Scenario 2
2.5%	Estimated percent RAS (5% in half of all new asphalt)
505,000	Estimated tons of RAS per year, statewide
27,000	FY2010 RAS used statewide
478,000	Additional RAS used statewide in Scenario 2
H-GAC	
10%	Percent of Texas roads in H-GAC
139,000	Additional RAP used in H-GAC Region in Scenario 2
47,800	Additional RAS used in H-GAC Region in Scenario 2

This Scenario also assumes that a minor amount of the additional shingles required for the RAS will be processed from the waste generated at new single-family residences built in the region. It is projected that new construction permits will be issued for 35,864 single-family residences per year in the region (a 25 percent increase over 2012). According to the composition data in the Residential C&D Waste Study prepared in cooperation with H-GAC and the Texas Commission on Environmental Quality in 2005, the construction of these single-family residences would result in 9,468 tons of shingles. If shingles were diverted at 20 percent of these residential construction sites, then an estimated 1,894 tons of shingles would be diverted. Additional shingles required for RAS would have to come from other sources, for example, roofs being replaced on existing homes. With regard to increasing brick recovery and reuse as part of this Scenario, if bricks were collected and processed from 20 percent of these sites, then an estimated 23,355 tons of bricks would be available for processing in the region each year.

4.3.3 Projected Economic Contribution

Implementing the policies, programs, and infrastructure described in this Scenario is assumed to result in additional employees in two business types: construction and demolition debris recyclers and pavement mix producers. The following describes the methodology used to estimate the number of additional employees in these business types in Scenario 2.

- *Construction and demolition debris recyclers*: It is estimated that an additional 15 employees would be needed to process 1,894 tons of shingles and 23,355 tons of bricks generated at 7,173 new residential construction sites each year (assuming this occurs on 20 percent of all new single-family construction sites in the region). This does not assume any additional jobs for processing another 46,000 tons of shingles per year to produce RAS and so can be considered a conservative estimate.
- *Pavement mix producers*: It is assumed that two additional employees would be needed at pavement mix producers to use 139,000 tons of additional RAP and 47,800 tons of additional RAS in hot mix asphalt produced for use in the region. For the most part, the existing employees would handle the switch from current pavement mix to increased RAP and RAS. However, the additional employees may be needed to ensure that incoming material meets specifications.

The additional jobs in this Scenario lead to increased labor income in the region, which in turn increases the value added by the recycling industry. This increase in economic activity does not only occur in the two business types expected to be affected (direct impacts) but also in businesses in the region that supply these establishments (indirect impacts) and those who benefit from the patronage of the additional employees (induced effects). Table 4-9 shows the estimated direct, indirect, and induced effects of each recycling industry sub-category in Scenario 2 based on the outcome of the input-output model.

Table 4-9
Estimated Economic Contribution by Industry Sub-Category, Scenario 2

	Direct(1)	Indirect(2)	Induced(3)	Total
Recycling Industry (Supply-Side)				
Jobs(4)	5,201	5,886	3,780	14,867
Industrial Output ($)(5)	1,906,244,246	913,893,665	514,714,074	3,334,851,985
Value Added ($)(6)	736,865,876	573,606,165	329,215,101	1,639,687,142
Labor Income ($)(7)	333,163,209	368,560,335	178,642,233	880,365,778
Recycling Reliant Industry (Demand-Side)				
Jobs(4)	746	653	542	1,941
Industrial Output ($)(5)	329,255,649	144,179,825	74,400,489	547,835,963
Value Added ($)(6)	115,007,125	85,286,256	48,106,664	248,400,045
Labor Income ($)(7)	46,066,689	54,146,323	26,228,465	126,441,477
Reuse and Remanufacturing				
Jobs(4)	3,704	436	645	4,784
Industrial Output ($)(5)	229,697,727	69,267,997	88,916,188	387,881,913
Value Added ($)(6)	138,042,470	43,219,719	57,283,981	238,546,170
Labor Income ($)(7)	96,636,930	26,765,786	31,176,605	154,579,321
Energy Recovery				
Jobs(4)	625	1,477	1,225	3,327
Industrial Output ($)(5)	977,709,681	441,959,944	167,353,500	1,587,023,125
Value Added ($)(6)	301,166,905	222,969,238	108,386,777	632,522,920
Labor Income ($)(7)	88,177,419	137,932,433	58,996,200	285,106,052

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full time equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Table 4-10 shows the overall economic contribution of each recycling industry sub-category in Scenario 2 compared to the Baseline. Processing more shingles and bricks at new construction sites and increasing the use of RAP and RAS in road construction is estimated to result in 42 jobs in the region when direct, indirect, and induced effects are taken into account. This results in an estimated increase in labor income of $1.9 million per year resulting from the increased activity in the recycling industry (supply-side) and $450,000 per year in labor income resulting from the increased activity in the recycling reliant (demand-side) industries. Total industrial output in the region is projected to increase by nearly $9 million per year because of the additional activity in the recycling industry (supply side) and just over $2 million per year because of the activity in the recycling reliant (demand-side) sub-category.

Table 4-10
Economic Contribution by Industry Sub-Category (Direct, Indirect, and Induced)
Baseline and Scenario 2

	Recycling Industry Sub-Category	Jobs (#)	Industrial Output ($)	Value Added ($)	Labor Income ($)
Current	Recycling Industry (Supply Side)	14,831	3,325,872,549	1,635,269,540	878,409,215
	Recycling Reliant Industries (Demand Side)	1,935	545,720,900	247,278,437	125,990,072
	Reuse and Remanufacturing	4,784	387,881,913	238,546,170	154,579,321
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Scenario 2	Recycling Industry (Supply Side)	14,867	3,334,851,985	1,639,687,142	880,365,778
	Recycling Reliant Industries (Demand Side)	1,941	547,835,963	248,400,045	126,441,477
	Reuse and Remanufacturing	4,784	387,881,913	238,546,170	154,579,321
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Difference	Recycling Industry (Supply Side)	36	8,979,436	4,417,602	1,956,563
	Recycling Reliant Industries (Demand Side)	6	2,115,063	1,121,608	451,405
	Reuse and Remanufacturing	0	0	0	0
	Energy Recovery	0	0	0	0

4.4 Scenario 3: Increased Plastics Recycling

In this Scenario, the collection and processing infrastructure and the end use capacity for plastics recycling in the region increases. Specifically, the following assumptions are made to determine the economic effect of these changes in plastic recycling in the region.

- Collection and processing infrastructure expands to allow for a 50 percent increase in plastics recovery through increasing the recovery rate of plastic resins that are currently recycled and recycling more resins on a broader scale. It is assumed that 75 percent of the additional recovery occurs in the commercial sector and 25 occurs in the residential sector.
- In addition, an end user with a capacity of 25,000 tons per year is recruited to the region.

4.4.1 Current Recovery Estimates

No data for tons of plastic currently recycled in the H-GAC Region were available so data from a recent study conducted by SAIC for the North Central Texas Council of

Governments (NCTCOG) quantifying recycling rates was used to estimate the tons of plastic currently recycled in the region. SAIC found that in the NCTCOG, approximately 22 percent of the municipal solid waste generated is recycled and 1.5 percent of the weight of material recycled is plastic. If 9,280,704 tons of municipal solid waste was reportedly disposed from the H-GAC Region in 2010, a 22 percent recycling rate would result in an estimated 2,620,533 tons recycled in the region per year. If 1.5 percent of this is plastic, then an estimated 39,773 tons of plastic is currently recycled from the H-GAC Region per year.

4.4.2 Recovery Estimates Under Scenario 3

If the tons of plastic recycled increases by 50 percent, then an estimated total of 59,659 tons of plastic would be recycled per year. This is an increase of 19,886 tons per year. This is a reasonable amount given that an estimated 8 percent of municipal solid waste disposed in Texas is estimated to be plastic. Diverting a total of 59,659 tons per year would represent a 7.4 percent recycling rate for plastic. Given that this Scenario assumes that 25 percent of the additional tonnage would come from residences and 75 percent would come from businesses, an additional 4,972 tons of residential plastic is and an additional 14,915 tons of commercial plastic is anticipated per year under this Scenario. All of the residential tonnage and one-fourth of the commercial tonnage is assumed to go to an existing MRF while the remaining commercial tons are assumed to be sufficiently separated to go directly to a plastic reclaimer in the region. It is assumed that eventually, 25,000 tons of the total plastic recycled would be directed to a new end user in the region.

4.4.3 Projected Economic Contribution

The business types that are projected to gain jobs as a result of the increased amount of plastic recycled in this Scenario are those that currently collect or process plastic for recycling in the region. In addition, an additional end user of plastic will increase the jobs in that business type. The following are the increase in jobs estimated in this Scenario within affected business types.

- *Residential collectors*: Existing establishments are assumed to require an additional 20 employees to collect the additional plastic in the region.
- *Non-residential collectors*: Even though more additional plastic is assumed to come from non-residential (commercial) rather than residential sources, fewer additional jobs are anticipated to be needed to handle this additional tonnage. Generally, a collector of commercial recyclables (or solid waste) can collect more in the same amount of time since more material is likely to be generated at each stop. In this Scenario, the increase in commercial recycling of plastic is assumed to require an additional five jobs in the region in this business type.
- *Material recovery facilities*: It is assumed that all of the additional residential tonnage and one-fourth of the additional commercial plastic will go to a Material Recovery Facility for an estimated additional tonnage of 8,700 tons per year at existing MRFs. Based on the current estimated rate of 2,767 tons processed per

employee per year at MRFs, it is projected that current facilities can process the additional materials with the addition of three jobs.

- *Plastics reclaimers*: With an additional 11,186 tons of recyclables going to plastics reclaimers (assumed to be 75 percent of the non-residential tonnage) and given the average tons of plastic processed per employee per year at existing plastic reclaimers in the region, it is assumed that eight jobs will be created in this Scenario in this business type.
- *Plastic product manufacturers*: A new plastic manufacturer in the region processing 25,000 tons per year is anticipated to create an additional 63 jobs.

As in the other scenarios, the additional jobs in this Scenario lead to increased labor income in the region, which in turn increases the value added by the recycling industry. This results in an increase in industrial output. Table 4-11 shows the estimated direct, indirect, and induced effects in each recycling industry sub-category in Scenario 3 based on the outcome of the input-output model.

Table 4-11
Estimated Economic Contribution by Industry Sub-Category, Scenario 3

	Direct	Indirect	Induced	Total
Recycling Industry (Supply-Side)				
Jobs(4)	5,222	5,896	3,790	14,908
Industrial Output ($)(5)	1,910,725,463	915,521,692	516,043,306	3,342,290,462
Value Added ($)(6)	739,222,210	574,600,967	330,069,695	1,643,892,871
Labor Income ($)(7)	334,333,194	369,177,049	179,108,258	882,618,501
Recycling Reliant Industry (Demand-Side)				
Jobs(4)	807	720	588	2,115
Industrial Output ($)(5)	355,596,423	158,839,206	80,764,517	595,200,146
Value Added ($)(6)	120,846,534	93,718,469	52,221,027	266,786,030
Labor Income ($)(7)	49,231,862	59,393,525	28,473,188	137,098,574
Reuse and Remanufacturing				
Jobs(4)	3,704	436	645	4,784
Industrial Output ($)(5)	229,697,727	69,267,997	88,916,188	387,881,913
Value Added ($)(6)	138,042,470	43,219,719	57,283,981	238,546,170
Labor Income ($)(7)	96,636,930	26,765,786	31,176,605	154,579,321
Energy Recovery				
Jobs(4)	625	1,477	1,225	3,327
Industrial Output ($)(5)	977,709,681	441,959,944	167,353,500	1,587,023,125
Value Added ($)(6)	301,166,905	222,969,238	108,386,777	632,522,920
Labor Income ($)(7)	88,177,419	137,932,433	58,996,200	285,106,052

(1) *Direct* refers to the economic activity of the establishments that are identified as being part of the recycling industry in the region.

(2) *Indirect* refers to the economic activity of suppliers in the area that provide goods or services to the recycling establishments.

(3) *Induced* refers to the economic effects of the earnings spent by those employed by the recycling industry on goods and services in the region.

(4) *Jobs* means the number of full- and part-time positions in the economy, not the number of full time equivalents.

(5) *Total industrial output* for most private industries is simply gross sales.

(6) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(7) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Table 4-12 shows the overall economic contribution of each recycling industry sub-category in Scenario 3 compared to the Baseline. The increased plastic being collected and processed is anticipated to generate 77 jobs in the recycling industry (supply-side) sub-category. Recruiting a new plastic end-user to the region would result in an estimated 180 jobs when the direct, indirect, and induced effects are considered. The additional activity in the recycling industry (supply-side) is projected to increase labor income in the region by $4.2 million, value added to the regional economy by $8.6 million, and industrial output by $16.4 million. Adding a new plastic product manufacturer with 63 new jobs is assumed to add a total of 180 jobs when indirect and induced effects are taken into consideration, with a total labor income of $11.1 million per year. This contributes $19.5 million in value added in this sub-category of recycling reliant industries and $49.5 million in additional industrial output each year.

Table 4-12
Economic Contribution by Industry Sub-Category (Direct, Indirect, and Induced)
Baseline and Scenario 3

	Recycling Sub-Industry	Jobs (1) (#)	Industrial Output (2) ($)	Value Added (3) ($)	Labor Income(4) ($)
Current	Recycling Industry (Supply Side)	14,831	3,325,872,549	1,635,269,540	878,409,215
	Recycling Reliant Industries (Demand Side)	1,935	545,720,900	247,278,437	125,990,072
	Reuse and Remanufacturing	4,784	387,881,913	238,546,170	154,579,321
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Scenario 3	Recycling Industry (Supply Side)	14,908	3,342,290,462	1,643,892,871	882,618,501
	Recycling Reliant Industries (Demand Side)	2,115	595,200,146	266,786,030	137,098,574
	Reuse and Remanufacturing	4,784	387,881,913	238,546,170	154,579,321
	Energy Recovery	3,327	1,587,023,125	632,522,920	285,106,052
Difference	Recycling Industry (Supply Side)	77	16,417,913	8,623,331	4,209,286
	Recycling Reliant Industries (Demand Side)	180	49,479,246	19,507,593	11,108,502
	Reuse and Remanufacturing	0	0	0	0
	Energy Recovery	0	0	0	0

(1) *Jobs* means the number of full- and part-time positions in the economy, not the number of full time equivalents.
(2) *Total industrial output* for most private industries is simply gross sales.
(3) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).
(4) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

4.5 Summary of Economic Contribution of Scenarios

Table 4-13 summarizes the estimated additional economic activity that would result in the region under each of the three Scenarios. The increase in industrial output, value added, labor income, and jobs versus that in the Baseline economic activity described in Section 3, is shown for recycling industries (supply side), recycling reliant industries (demand-side), and reuse and remanufacturing. The sub-category of energy recovery is not shown since none of the selected Scenarios changed the economic contribution of this sub-category.

Table 4-13
Total Economic Contribution by Sub-Category for Each Scenario as Compared to Baseline

	Scenario 1	Scenario 2	Scenario 3
Recycling Industry (Supply-Side)			
Jobs(1)	216	36	77
Industrial Output ($)(2)	20,629,373	8,979,436	16,417,912
Value Added ($)(3)	12,688,189	4,417,602	8,623,331
Labor Income($)(4)	8,444,150	1,956,562	4,209,286
Recycling Reliant Industry (Demand-Side)			
Jobs(1)	-	6	180
Industrial Output ($)(2)	-	2,115,063	49,479,246
Value Added ($)(3)	-	1,121,608	19,507,593
Labor Income($)(4)	-	451,406	11,108,503
Reuse and Remanufacturing			
Jobs(1)	49	-	-
Industrial Output ($)(2)	5,933,311	-	-
Value Added ($)(3)	3,547,767	-	-
Labor Income($)(4)	2,191,614	-	-

(1) *Jobs* means the number of full- and part-time positions in the economy, not the number of full time equivalents.

(2) *Total industrial output* for most private industries is simply gross sales.

(3) *Value added* is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).

(4) *Labor income* includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).

Although Scenario 1 (increased electronics recovery) and Scenario 3 (increased plastics recovery) are projected to create a similar number of jobs in the region, the projected economic activity in Scenario 3 is much higher. This is primarily because Scenario 3 assumes that a large new end user, a plastic product manufacturer, opens a new facility in the region. This business type has a relatively high multiplier, that is, one new job tends to have a broader ripple effect on the regional economy compared to other business types, especially those in the recycling industry (supply-side) where most of the jobs in Scenario 1 are created. The increase in economic activity resulting from increased use of RAS and RAP, assumed in Scenario 2, is comparatively minor. Fewer jobs are created than in the other two Scenarios and the direct jobs created in these two business types (pavement mix producers and construction and demolition debris recyclers) do not have as significant an indirect and induced effect as in some of the other business types.

The scenarios presented here are not mutually exclusive nor do they have to be implemented in their entirety to result in a positive economic contribution to the region. However, this comparison of how different policies or investments may add to the economic contribution of the recycling industry in the region may inform the H-GAC and other local governments of the best way to grow the economy while promoting recycling in the region.

Appendix A
Description of Input-Output Model Used in This Analysis

A.1 Input-Output Modeling Process and Limitations

The most common and widely accepted methodology for measuring the total economic impact of a firm or industry in a given geographic area is input-output (I-O) analysis and modeling of a regional economy. Input-output modeling allows researchers to investigate the interdependencies that industries, institutions, and households have with each other in a specified region, therefore, relate the products made within a region and the products consumed by industries and households in that same region. I-O models are used to show the relative importance to the economy of a business or industry, or to predict the economic impact on a region from alternative actions (e.g., implementation of a new recycling policy).

At a basic level, any industry's or institution's output (usually its gross sales) requires inputs of employees, materials, utilities, capital investments, financing, maintenance, equipment, and services. Estimates of an industry's inputs mix and whether those inputs are purchased locally (meaning within the region being modeled) are based on national and regional industrial surveys, and included in a purchased dataset for the regional economy. If the industry segment in the region differs from the default national or regional averages, adjustments to the default values should be made to calibrate and improve the quality of the model output. For this report, interviews were conducted with leading firms in most of the business categories to obtain their estimates of the degree to which inputs (e.g., recovered materials) for them and other establishments like them in the region are purchased locally. This information was used to further improve the quality of the model that was produced.

There are important limitations to I-O models that must be acknowledged. First and foremost, a detailed flow analysis and detailed surveys to confirm establishments' inputs were beyond the scope of and not performed for this report. Absent such highly detailed and costly local industry surveys, national and regional averages for major industrial input categories (the production functions) and the likelihood of a local purchase of inputs for the industries that were studied (regional purchasing coefficients) were still heavily relied on. Industries that fall within general industrial categories normally have very similar industrial input characteristics. A plastics firm that produces finished goods from recycled stock will be configured very similarly to a plastics firm that produces goods primarily from virgin inputs. Except for the source of their commodity input into production and the physical configuration of their processing machinery, their overall remaining operational characteristics — transportation, utilities, services, maintenance, financial inputs, etc. — are likely to be very similar. Consequently, in most instances, production characteristics of existing firms provided a very good first pass at identifying intra-regional linkages and supply chains of goods and services required for production.

Although the I-O model used for this report has information on up to 440 industrial categories, there is no specific set of "recycling, reuse, and recovery" industries defined in the model. For this reason it was necessary to first attempt to match the recycling sectors to the closest sector in the I-O model, and then to manipulate the production inputs and regional purchasing coefficients where they appeared to be out of the range of the expected values for recycling industry establishments. Consequently, the models that were produced were significantly modified to accept recycling, reuse, and recovery/beneficial use industries distinctly.

Other limits in these types of models include:

- Difficulties in capturing economies of scale, particularly for industries with relatively small numbers of establishments, where establishment-to-establishment variation may be significant (the current input values or production functions are, therefore, initially constant);
- An inability to identify input substitutes — especially in new technologies or in instances where input modes have changed;
- Dated data on industrial performance and purchases, particularly for industries that are newly-emerging or rapidly changing; and
- An implicit assumption that input commodity supply is infinite and perfectly elastic.

I-O models, therefore, are just that — models — that simulate industrial inter-dependencies in the current economy. I-O models are not the best models for detailed forecasting because they model the existing economy, and do not forecast the net impact of replacing a virgin-commodity establishment with a recycled-commodity establishment, for example, or the availability of suitably trained workers to accommodate industry growth. I-O models, therefore, have limits. Nevertheless, I-O models are comparably much less expensive to produce than more involved models, do an excellent job of estimating the role a particular industry has (such as the recycling industry) on a specific economy, and are useful for projecting the effects of modest changes in an industry.

The generic term "economic impact" is frequently used to describe a set of economic activities in a region. This term often suffers from misapplication. There are several kinds of economic activities that may occur within a particular region. For example:

- Firms may produce goods or provide services for export outside the region. They attract outside funds into the region that supports employment, industrial purchases, and household spending.
- Firms may substitute locally produced commodity inputs for those that previously were purchased from outside the region. In this case funds are retained in the region and flow to local suppliers of an industry.
- Firms may produce goods and services for local consumption (either by industries or by households). Although they may help to retain funds in the region, they may not cause significant additional economic activity.

I-O models identify the overall size and contribution of an industry — its *economic effect* or *economic value* — to the area mix of economic activity along with interdependencies that exist between it and other firms or service suppliers, in other words, the strength of linkages that exist among industries and the overall value (output, incomes, and jobs) of their production. In the case of firms that produce finished goods for export outside a region, there is a measurable *economic impact* — were it not for the external demand for the locally produced product, the economic activity would not be in the local economy.

A much harder measure of potential economic impact falls into the category of import substitution. If a region is able to develop indigenous industries that produce a good that substitutes for a good that is imported, then that industry is retaining dollars in the state that used to be exported. An industry that produces a good using recycled feedstock that is supplied locally will create a product that substitutes local inputs for non-local inputs. Recycling industries often fit into the import substitution category, particularly in states without virgin feedstock production infrastructures. By utilizing recycled content, they are purchasing locally and, therefore, stimulating indigenous economic activity.

This report generally reserves the use of the term economic impact only for the following purposes.

- Industries that have verifiable levels of exports where the output that they are producing is a genuine and real increase in regional industrial output;
- True import substitutes; and
- Policy or program changes that result in increases in recycling, reuse, and recovery/beneficial use and accompanying increases in industrial output.

To claim economic impacts involves much more extensive industrial measures for each category of establishments than was assessed in this report, and over a period of time because impacts are referenced from a particular point in time.

This report, therefore, presents total economic values of the current recycling, reuse, and recovery/beneficial use industry — estimates, by category, of the value of economic inter-relationships that exist for the industry. These values are the intrinsic worth of a set of industrial activities — they represent a slice of the economic pie from a particular point of view. Impacts are presented for projected increases in recycling that result from three industry growth scenarios that are driven by proposed policy and program changes.

In summary, economic models are estimates of inter-industrial linkages and regional values. They are based on an amalgam of federal, county, and state data, academic procedures, along with some survey-derived direct data, all compiled with due diligence for accuracy and reasonableness. Consequently, although an inter-industrial accounting framework is implied, all estimates are simulations of economic values based on the data employed and the assumptions implicit in the modeling.

A.2 Kinds of Economic Information Produced by I-O Models

Input-output models produce many kinds of data for analysis and decision-making. The more useful results for industrial leaders, planners, and policy makers are estimates of (1) total industrial output, (2) personal income, (3) value added, and (4) jobs. These are the categories of economic activity that are reported in detail in the data tables that follow this section. These terms are defined below:

- Total industrial output for most private industries is simply gross sales. For public or quasi-public institutions this normally includes all public outlays, along with the value of government sales and other subsidies received, to isolate the current economic value of their output to the citizens or the area served.
- Personal income includes the wages and salaries of employees and proprietors, normal profits to sole proprietors, and an estimate of the cash value of all benefits (e.g., social insurance, retirement, and medical benefits).
- Value added is a measure of gross regional product. It includes all personal income (employment compensation, incomes to sole proprietors) plus property incomes (dividends, interests, and rents), and indirect tax payments (primarily excise and sales taxes paid by individuals to businesses).
- Jobs are the number of full- and part-time positions in the economy, not the number of full time equivalents.[17] This distinction is important because the relationship between job growth and labor force growth is very different in different industries. Some industries rely heavily on semi-skilled part-time labor. Other industries generally produce full-time skilled jobs. It is always important, when possible, to quantitatively assess whether the jobs that are stimulated are part-time or full-time or higher paying versus lower paying.

Economic data is further reported as direct, indirect, induced, and total economic effects. In order to produce outputs, the establishments in the industry must purchase inputs. The inputs take two forms: (1) purchases from other businesses, and (2) labor. On a summary level, the economic activity of the establishments themselves is referred to as direct effects. Purchases from other businesses within the region being modeled create what is referred to as the indirect effect. Labor spending their income within the region being modeled create the induced effect. Total effects include the sum of all three effects. The following describes these terms in more depth.

- Direct effects refer to the operational characteristics of the firms or institutions that are considered. This analysis measured the apparent value of twenty-six categories of recycling, reuse, and recovery/beneficial use establishments. The direct output of these entities is, therefore, their reported gross sales. The direct jobs are the jobs that are associated with those establishments. The direct personal income contains their reported payments to all employees, plus an additional estimate of benefit values and of returns to sole proprietors. The estimate of benefit values and returns

[17] For example, a restaurant may employ 20 people on a half-time basis (20 jobs) to fill its labor requirement of 10 full time equivalents.

to sole proprietors were based on industrial averages in industries that are similar to the recycling, reuse, and recovery/beneficial use industries included in this analysis.

- Indirect effects measure the value of additional economic demands that the direct firms or institutions place on supplying industries in the region. When firms produce goods or conduct business or when public entities provide public services, they must make many purchases. Some of these are from suppliers in the area. Some are not. Public utilities, communications systems, fuel, wholesale goods and services, manufactured goods, financial and legal services, raw and processed commodities, and a variety of professional services are necessary to produce the direct values described above.
- Induced effects accrue when workers in the direct and indirect industries spend their earnings on goods and services in the region. Induced effects can also be called household effects, and the terms are often used inter-changeably. When workers in direct and indirect industries purchase goods and services for household consumption, they, in turn, stimulate another layer of the economy. Most induced activity accrues to retail, services, and finance, insurance, and housing spending. Because employment is stimulated in these industries as well, their demands for inputs increase, yielding an additional round or additional rounds of indirect purchases and additional rounds of induced activity. The I-O models solve for these iterative rounds of transactions until all of the possible inter-industrial transactions have been accumulated.
- Total economic effects are the sum of direct, indirect, and induced effects. They are all of the transactions attributable, either directly or indirectly, to the activities of establishments in the business categories included in this analysis.

The term multiplier or multiplier effect is frequently used when referring to economic effects or economic impacts. There are different kinds of multipliers — this analysis reports two types. The Type I multiplier identifies the value of direct and indirect transactions — e.g., the output of a business category and all other output that it purchases from its suppliers in the region — relative to the value of only the direct transactions. The Type II multiplier identifies the value of all economic transactions (direct, indirect, and induced) that are stimulated in the economy by an industry being considered, including the personal spending of employees throughout the supply chain whose economic activity is apportioned to the industry, relative to the value of only the direct transactions.

A.2.1 I-O Model Used in this Analysis

The input-output modeling system used in this analysis is the IMPLAN Model, which is one of the most widely used I-O models in the United States. IMPLAN is produced by the Minnesota IMPLAN Group (MIG). MIG annually updates the model using aggregated production, employment and trade data from local, regional, and national sources, including the U.S. Census Bureau County Business Patterns report and the U.S. Bureau of Labor Statistics annual report called Covered Employment and Wages.

Appendix B
Sources Used to Identify Recycling Businesses in Region

Source	Resource	Categories
Houston-Galveston Area Council	HHW collection site list	1-Residential collection
SAIC Energy, Environment & Infrastructure LLC	Internal Compost/Organics Database	3-Compost/organics
Carpet America Recovery Effort (CARE) Databases	Online database	4-Recyclable material wholesalers
SAIC Energy, Environment & Infrastructure LLC	SAIC Internal MRF Database	5-MRFs
Government Advisory Associates	MRF Database	5-MRFs
Construction Materials Recycling Association	C&D MRFs/recyclers	6-Construction and demolition debris recyclers
Institute of Scrap Recycling Industries /R2RIOS	Director of Membership	7-Electronics processors 4-Recyclable material wholesalers
e-Stewards	online database http://e-stewards.org/find-a-recycler	7-Electronics processors
American Chemistry Council, Plastics Division	Recycled Plastic Products Directory - http://rppd.americanchemistry.com/	9-Plastics reclaimers 16-Plastic product manufacturers
Plastics News	US Plastic Recyclers Directory	9-Plastics reclaimers
Association of Post Consumer Plastic Recyclers	Member list	9-Plastics reclaimers
Glass Packaging Institute	Online container plant and beneficiary listing	10-Glass product producers 18-Other recycling manufacturers
NAIMA North American Insulation Manufacturers Association	North American Plant Locations publication 08-2011	10-Glass product producers 18-Other recycling manufacturers
Aluminum Association	Phone interview	6-Nonferrous secondary smelting and refining 11-Nonferrous foundries 12-Nonferrous product producers
US Geological Society	Phone interview	6-Nonferrous secondary smelting and refining 11-Nonferrous foundries 12-Nonferrous product producers
Steel Recycling Institute	Western Region Representative, Phone interview	11-Iron and steel foundries
American Foundry Society	Phone interview	11-Iron and steel foundries 12-Nonferrous foundries
Nonferrous Founders' Society	Phone interview	12-Nonferrous foundries
American Forest & Paper Association	Phone interview	14-Paper-based product manufacturers

Source	Resource	Categories
Cellulose Insulation Manufacturing Association	Phone interview	14-Paper-based product manufacturers
Gypsum Association	Online member list	14-Paper-based product manufacturers and 18-Other Recycling Manufacturers (syn gypsum power plants)
Asphalt Recycling & Reclaiming Association	Member list	15-Pavement mix (RAP)
Texas Asphalt Pavement Association	Phone interview	15-Pavement mix (asphalt-rubber, RAP)
Texas Dept. of Transportation	Dale Rand, PE, Director - Flexible Pavements Branch; Recycled materials online GIS database	15-Pavement mix (asphalt-rubber, RAP)
Scrap Tire News	Scrap Tire & Rubber Users Directory 2012, Phone interview	17-Rubber product manufacturers
Association of Battery Recyclers	Member list	18-Other recycling manufacturers
Tire Retread Information Bureau	Member list	21-Tire retreaders
National Wood Pallet and Container Association	Member list	22-Wood reuse
Reusable Industrial Packaging Association	Member list	24-Other reuse
National Biodiesel Board	online member list www.biodiesel.org	25-Energy recovery
NORA	Member list (headquarters locations)	25-Energy recovery (used oil recyclers)
State of Texas Alliance for Recycling	Executive Director	Multiple
Texas Commission on Environmental Quality	Electronics EPR manufacturer reports	7-Electronics processors (quantity recycled/reused statewide)
Texas Commission on Environmental Quality	Online central registry http://www12.tceq.state.tx.us/crpub/index.cfm	Multiple
US Census Bureau	Annual Survey of Manufacturers Thomas Flood	Multiple
US Census Bureau	Metals Manufacturers Nathaniel Shelton	Multiple
US Census Bureau	Wholesale Trade	5-Recyclable material wholesalers, 20 Motor vehicle parts (used)
US Census Bureau	County Business Patterns	Multiple
Bureau Labor Statistics	Employment and wages data	Multiple

Appendix C
Recycling Economic Impact Survey

***C**ONFIDENTIAL **S**URVEY — your individual data will be kept confidential.*

This form is designed to record information separately for each location you have in the thirteen counties that surround Houston (Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton). If we did not provide you with enough forms, please make a copy of this form and write the additional facility address here:____

1. Please confirm that this questionnaire applies to you (check appropriate box):

☐ Yes, this questionnaire applies, if your establishment performs any of the following activities:

- Provides collection service for recycling/reuse of material that otherwise would be disposed as waste
- Transforms recovered scrap materials or products into a recycled raw material ready for use
- Consumes raw materials you purchase from recyclers, or that you recycle yourself into products
- Cleans/grades/refurbish products for reuse
- Sells used merchandise
- Recycles materials into fuel
- Purchases fuel derived from diverted waste products or materials
- Uses materials diverted from disposal for beneficial use, such as fill or landfill cover

☐ No, this questionnaire does not apply, if your establishment performs none of the above activities and:

- Generates recyclable materials, but does not expend additional employee time recycling versus disposal
- Recycles manufacturing scrap you generate yourself directly back into your process on-site, without sending material off-site for recycling
- Purchases intermediate products such as sheet, rolls, billets, etc. without purchasing or directly recycling recovered materials into raw materials yourself
- Only performs activities unrelated to recycling or reuse

If you selected "No" you are done – please be sure to return this form to us in the postage-paid envelope.

2. Please select one category that best matches the role your establishment plays in recycling or reuse.

ESTABLISHMENT CATEGORIES

Recycling Industries (supplies materials)		Code
	Residential collection (included drop-off centers)	1
	Non-residential collection	2
	Compost/organics processing	3
	Recyclable materials processor (e.g. paper, metal)	4
	Materials recovery facility (commingled matls.)	5
	Construction and demolition debris recycler	6
	Electronics processor	7
	Nonferrous secondary smelting and refining mill	8
	Plastics reclaimer	9
Recycling Manufacturing (consumes materials)		
	Glass product producer	10
	Iron and steel foundry	11
	Nonferrous foundry	12
	Integrated nonferrous product mill (e.g. melts scrap)	13
	Paper-based product mfg. (e.g. mill, insulation)	14
	Pavement mix producer (asphalt / Portland cement)	15
	Plastic product manufacturer	16
	Rubber product manufacturer	17
	Other recycling manufacturing (glass beneficiary)	18

Reuse and Remanufacturing		Code
	Electronics refurbishing/reuse	19
	Used motor vehicle parts	20
	Tire retreading	21
	Wood reuse or pallet rebuilder	22
	Retail used merchandise sales (thrift stores)	23
	Other reuse (drum, toner cartridge, etc.)	24
Recovery/Beneficial Uses		
	Energy recovery (fuel producer or consumer)	25
	Other beneficial uses (fill, landfill uses, etc.)	26

If you are not sure how to classify your establishment, describe what you do here and we will help you:

3. Please provide the total economic contribution of this establishment at this location:

Total Number of Employees:	*Most Recent Total Annual Payroll:* [1]	*Most Recent Total Annual Receipts :* [2]
	$	*$*

[1] Payroll includes total salary, hourly pay, bonuses, commissions, sick-leave pay, free meals, and benefits received by employees
[2] Receipts include revenue of all forms (sales, fees, rents, commissions, interest, dividends) minus all local, state, and federal tax revenue collected

4. Some establishments perform activities that are not completely related to recycling or reuse, such as using virgin material in addition to using recycled material, or collecting solid waste in addition to collecting recyclable materials. We may adjust your answers to question 3 so that only the portion of your data that relates to recycling, reuse, or energy recovery/beneficial use is included.

   Please estimate the: (1) overall average recycled content of products you produce, if you manufacture recycled content products; or (2) the portion of total revenues you derive from recycling, reuse, or energy recovery/beneficial use activities compared to unrelated activities:

_______% of goods/services provided can be considered related to recycling, reuse, or energy recovery/beneficial use [1]

[1] Base the estimate on value of goods or services provided or process inputs; do not discount for indirect costs or employees

Thank you for completing this survey! Please return it to SAIC in the postage-paid envelope.

Appendix D
Outcome of Surveys

	Business Type	Establishments Survey Information: Establishments	Surveyed	% Surveyed	Entered	Don't Apply	Apply	Status: # of Establishments	% Entered(1)	Mailed In	Phone	Other
1	Residential collection	85	75	88%	38	4	34	81	42%	7	14	13
2	Non-residential collection	200	178	89%	7	5	2	195	1%	1	0	1
3	Compost/organics processing	73	67	92%	17	1	16	72	22%	2	1	13
4	Recyclable material processor	48	0	0%	3	1	2	47	4%	0	0	2
5	Materials recovery facility	4	3	75%	2	0	2	4	50%	0	0	2
6	Construction and demolition debris recycler	21	18	86%	5	1	4	20	20%	0	1	3
7	Electronics processor	9	8	89%	5	0	5	9	56%	2	2	1
8	Nonferrous secondary smelting and refining mill	7	6	86%	4	1	3	6	50%	1	1	1
9	Plastic reclaimer	7	6	86%	2	0	2	7	29%	2	0	0
10	Glass product producer	3	2	67%	1	1	0	2	0%	0	0	0
11	Iron and steel foundry	7	0	0%	0	0	0	7	0%	0	0	0
12	Nonferrous foundry	6	0	0%	2	0	2	6	33%	0	0	2
13	Integrated nonferrous product mill	0	0	0%	0	0	0	0	0%	0	0	0
14	Paper-based product manufacturing	3	3	100%	1	0	1	3	33%	1	0	0
15	Pavement mix producer	10	0	0%	0	0	0	10	0%	0	0	0
16	Plastic product manufacturer	2	1	50%	0	0	0	2	0%	0	0	0
17	Rubber product manufacturer	5	4	80%	2	1	1	4	25%	0	0	1
18	Other recycling manufacturing	3	1	33%	2	0	2	3	67%	0	0	2
19	Electronics refurbishing/reuse	1	1	100%	0	0	0	1	0%	0	0	0
20	Used motor vehicle parts	0	0	0%	0	0	0	0	0%	0	0	0
21	Tire retreading	9	0	0%	0	0	0	9	0%	0	0	0
22	Wood reuse or pallet rebuilder	13	12	92%	6	3	3	10	30%	0	3	0
23	Retail used merchandise sales	0	0	0%	0	0	0	0	0%	0	0	0
24	Other reuse	52	51	98%	13	1	12	51	24%	3	9	0
25	Energy recovery	31	29	94%	7	2	5	29	17%	1	3	1
26	Other beneficial uses	12	11	92%	4	2	2	10	20%	0	2	0
	TOTAL	611	476	78%	121	23	98	588	17%	20	36	42

(1) In some cases, SAIC was able to gather data about particular establishments from sources other than surveys and thus data may have been entered despite the fact that no survey responses are indicated.

Appendix E
Methodology for Calculating Input to Model, by Business Type

E.1 Category #1 – Residential Collection

Gathered data and information from regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an "applicability" factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use" to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified to get an estimated number of employees in the category.

Multiplied the reported payroll for each establishment by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use" to get payroll related to these activities.

Calculated the average payroll for responding establishments and multiplied the average payroll per employee by the estimated number of employees in the category to estimate the total annual payroll.

Since no survey respondents provided information about annual receipts, developed a per employee estimate by dividing the total annual receipts in the State by total employees in the State in NAICS Category 56211 (Solid Waste Collection).

Multiplied per employee estimate of annual receipts per employee by estimated number of employees in H-GAC region collecting recyclables.

E.2 Category #2 – Non-Residential Collection

Includes collectors of used oil, hazardous waste, tires, and commercial recyclables, including document destruction companies.

Estimated used oil collector establishments from TCEQ database.

Estimated number of employees in used oil collection by dividing the estimated amount of oil properly disposed in the region (22 million gallons per year), as extrapolated from national data, estimated the number of vehicles required to collect this oil (assuming each truck can collect 3,000 gallons per day, 250 days per year), and assuming one employee per collection vehicle with 80 percent productivity.

Extrapolated number of establishments and employees from hazardous waste collection data from 2010 County Business Patterns for Harris County (NAICS code 562112 – hazardous waste collection). Estimated annual payroll and gross receipts by extrapolating payroll per employee and gross receipts per employee from 2007 Census Data.

Establishments and employees for tire collectors estimated from TCEQ registration data and follow up interviews with several tire collectors and processors. Payroll estimated based on data from 2010 County Business Patterns for Harris County (NAICS 484110- general freight trucking local payroll). Gross receipts estimate $1 per tire with number of tires based on national estimates of tires disposed per person and data for local collectors regarding number of tires imported into region for processing.

Document destruction establishments estimated based on yellow pages listings of document destruction companies. Employees estimated based on assumption of one truck per 50,000 population with 80% production employees. Annual payroll based on local census data regarding average pay per job for trucking industry. Gross receipts estimated using estimate of $20,000-30,000/truck/month per 2005 Morgan Stanley market report.

Other commercial recycling haulers based on employees, payroll, and gross receipts as provided by local commercial haulers and transfer stations and extrapolated to number of establishments in region as identified in interview.

E.3 Category #3 – Compost/Organics Processing

Gathered data and information from regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an “applicability” factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use” to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified to get an estimated number of employees in the category.

Multiplied the reported payroll and total annual receipts for each establishment by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use” to get payroll and receipts related to these activities.

Calculated the average payroll and receipts per employee for responding establishments.

Multiplied the average payroll and receipts per employee by the estimated number of employees in the category to estimate the total annual payroll and receipts.

E.4 Category #4 – Recyclable Material Wholesalers

Used 2010 US Census Data for NAICS code 423930 (Recyclable Material Merchant Wholesalers) regarding the number of establishments http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2010_00A1&prodType=table.

Multiplied the total number of establishments by an "applicability" factor based on the percent of establishments in this Category responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Used 2010 US Census Data for NAICS code 423930 (Recyclable Material Merchant Wholesalers) regarding the number of employees http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2010_00A1&prodType=table and the annual payroll for the MSA (which includes one County, San Jacinto County, that is not in the H-GAC Region and excludes four counties, Colorado, Matagorda, Walker and Wharton, that are in the H-GAC Region).

Estimated the number of employees and the annual payroll for the establishments in San Jacinto, Matagorda, and Wharton counties (the counties that recorded establishments in this NAICS code) by multiplying the average number of employees and annual payroll per establishment in the MSA by the number of establishments in those counties. No establishments were recorded for this NAICS code for Colorado and Walker counties. Added the employees and payroll for Matagorda and Wharton counties and subtracted the employees and payroll for San Jacinto County to get estimate for H-GAC region.

Multiplied 2007 US Census Data for NAICS Code 423930 in the MSA by a price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to estimate 2010 "Value of Sales, Shipments, Receipts, Revenue, or Business Done" in this Business Category.

Estimated the annual receipts for the establishments in San Jacinto, Matagorda, and Wharton counties (the counties that recorded establishments in this NAICS code) by multiplying the average annual receipts per establishment in the MSA by the number of establishments in those counties. Added the annual receipts for Matagorda and Wharton counties and subtracted the receipts for San Jacinto County to get estimate for H-GAC region.

E.5 Category #5 – Material Recovery Facilities

Gathered data and information regarding the two primary MRFs in the region from, interviews, surveys, and publicly available data to estimate the total number of employees, payroll and receipts contributed by these facilities.

Combined the data with Category #4 to avoid releasing any confidential information about individual facilities.

E.6 Category #6 – Construction and Demolition Debris Recyclers

Gathered data and information from, regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an "applicability" factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use" to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified to get an estimated number of employees in the category.

Factored the total annual receipts for each establishment that provided this information by multiplying the total reported receipts by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use".

Calculated the average factored receipts per employee for responding establishments.

Multiplied the average factored receipts per employee by the estimated number of employees in the category to estimate the total receipts.

Since no respondents provided information about payroll, estimated payroll by multiplying the estimated number of employees by the average salary for Category #3, Compost and Organics Processors.

E.7 Category #7 – Electronics Processors

Gathered data and information from, regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an “applicability” factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use” to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified to get an estimated number of employees in the category.

Factored the payroll and total annual receipts for each establishment that provided this information by multiplying the total reported payroll and receipts by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use”.

Calculated the average factored payroll and receipts per employee for responding establishments.

Multiplied the average factored payroll and receipts per employee by the estimated number of employees in the category to estimate the total annual payroll and receipts.

E.8 Category #8 – Nonferrous Secondary Smelting and Refining Mills

Gathered data and information from regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an “applicability” factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use” to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified (factored for applicability) to get an estimated number of employees in the category.

Factored the payroll and total annual receipts for each establishment that provided this information by multiplying the total reported payroll and receipts by the percent of “goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use”.

Calculated the average factored payroll and receipts per employee for responding establishments.

Multiplied the average factored payroll and receipts per employee by the estimated number of employees in the category to estimate the total annual payroll and receipts.

E.9 Category #9 – Plastic Reclaimers

Gathered data on number of establishments and the number of employees and percent of employees dedicated to recycling for each establishment from databases, surveys and interviews.

Calculated annual payroll and receipts by applying the per employee payroll and the per employee receipts average from the establishments that provided this information to the number of employees at the establishments that did not.

E.10 Category #10 – Glass Product Producers

Gathered data on number of establishments and the number of employees and percent of employees dedicated to recycling for each establishment from databases, surveys and interviews.

Calculated annual payroll and receipts by determining the State average payroll and receipts per employee for NAICS code 325998 (All other miscellaneous chemical product and preparation manufacturing) and multiplying by the number of employees attributed to recycling in the region.

Because there are less than four establishments identified in H-GAC in this category, combined findings with other categories of recycling manufacturers (Category #17 and #18).

E.11 Category #11 – Iron and Steel Foundries

Used 2010 US Census Data for NAICS Code 33151 (Ferrous Metal Foundries) for number of establishments, number of employees, and annual payroll in the MSA (all establishments identified in H-GAC were in MSA).

Multiplied 2007 US Census Data for NAICS Code 423140 in the MSA (these data not available for other counties) by a price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to estimate 2010 “Value of Sales, Shipments, Receipts, Revenue, or Business Done” in this Business Category.

Applied a factor of 54 percent to all estimates assuming that 54 percent of the incoming material to iron and steel foundries in the region is recovered.

E.12 Category #12 – Nonferrous Foundries

Based on interviews and other research, it was determined that no applicable businesses in this category identified in the H-GAC Region.

E.13 Category #13 – Nonferrous Product Producers

No applicable businesses in this category identified in the H-GAC Region.

E.14 Category #14 – Paper Based Product Manufacturers

Gathered data on number of establishments in the H-GAC Region from databases, surveys and interviews.

Estimated number of employees from survey responses and internet and factored based on percent of activity attributable to recycling at each establishment, also as determined by survey responses and internet information about activity at establishments.

Estimated the average payroll per employee and receipts per employee based on survey responses.

Multiplied average payroll and receipts per employee by estimated number of employees to get estimated total payroll and receipts in the H-GAC Region.

E.15 Category #15 – Pavement Mix Producers

Gathered data on number of establishments in the H-GAC Region from databases, surveys and interviews. All listed establishments in the H-GAC Region are in the MSA so MSA estimates for NAICS codes were assumed to capture all activity in the H-GAC Region.

Gathered total number of employees and total payroll for MSA for NAICS code 327320 (Ready Mix Concrete Manufacturing) and payroll for NAICS code 324121 (Asphalt Paving Mixture and Block Manufacturing). Used payroll for NAICS code 324121 to estimate employment assuming same average salary as for NAICS code 327320 since employment data unavailable for NAICS code.

Since receipts data were not available for MSA for both NAICS code at the MSA level, applied the percent calculated by dividing payroll by receipts in the State for each of these NAICS codes to the payroll for MSA establishments to get total receipts for these NAICS codes for establishments in MSA.

Based on estimate that asphalt has a minimum 20 percent recycled content and Portland cement mixes in H-GAC have minimum 5 percent recycled content (fly ash and some aggregates), assumed 20 percent of jobs, payroll, and receipts in NAICS code 324121 and 5 percent of jobs, payroll, and receipts NAICS code 327320 are attributable to recycling.

E.16 Category #16 – Plastic Product Manufacturers

Estimated the number of employees and the percent of employees related to recycling through websites, surveys and interviews.

Determined annual payroll by calculating the Harris County average pay per employee (from Harris County Business Patterns) within NAICS code 326113 and multiplied by number of employees estimated for establishments in this Category.

Determined annual receipts by calculating the Harris County average pay per employee (from Harris County Business Patterns) within NAICS code 326113 for 2007 (2010 data for receipts not yet available), adjusted receipts per employee by an annual price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) and multiplied by number of employees reported in H-GAC establishments.

E.17 Category #17 – Rubber Product Manufacturers

Gathered data on number of employees from establishments in H-GAC from surveys and interviews.

Determined annual payroll by calculating the State average pay per employee within NAICS code 326299 (too few establishments for census data to be provided for MSA or County) and multiplied by number of employees reported in H-GAC establishments in this Category.

Determined annual receipts by calculating the State average receipts per employee within NAICS code 326299 (too few establishments for census data to be provided for MSA or County) for 2007 (2010 data for receipts not yet available), adjusted the receipts per employee by an annual price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA), and multiplied by number of employees reported in H-GAC establishments.

Because there are less than four establishments identified in H-GAC in this category, combined findings with other categories of recycling manufacturers (Category #10 and Category #18).

E.18 Category #18 – Other Recycling Manufacturers

Gathered data on number of employees from establishments in H-GAC.

Determined annual payroll by calculating the State average pay per employee within NAICS code 327420 (too few establishments for census data to be provided for MSA or County) and multiplied by number of employees reported in H-GAC establishments in this Category.

Determined annual receipts by calculating the State average receipts per employee within NAICS code 327420 (too few establishments for census data to be provided for MSA or County) for 2007 (2010 data for receipts not yet available), adjusted the receipts per employee by an annual price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA), and multiplied by number of employees reported in H-GAC establishments.

Because these are less than four establishments identified in H-GAC in this category, combined findings with other categories of recycling manufacturers (Category #17 and Category #10).

E.19 Category #19 – Electronics Refurbishers

No applicable businesses in this category identified in H-GAC.

E.20 Category #20 – Motor Vehicle Parts (Used)

Used 2010 US Census Data for NAICS Code 423140 for number of establishments, number of employees, and annual payroll in the MSA and other counties in H-GAC, where available.

Multiplied 2007 US Census Data for NAICS Code 423140 in the MSA (these data not available for other counties) by a price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to estimate 2010 "Value of Sales, Shipments, Receipts, Revenue, or Business Done" in this Business Category.

For counties that have establishments documented in the US Census data but do not have enough establishments to release number of employees, payroll, and receipts, (for this category, this included Matagorda and Wharton), increased the total number of employees, annual payroll, and gross receipts in the H-GAC region based on the percent of the establishments in the H-GAC region that were located in those counties.

E.21 Category #21 – Tire Retreaders

Used 2010 US Census Data for NAICS Code 323212 for number of establishments, number of employees, and annual payroll in the MSA. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2010_00A1&prodType=table

Multiplied 2007 US Census Data for NAICS Code 323212 in the MSA by a price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to estimate 2010 "Value of Sales, Shipments, Receipts, Revenue, or Business Done" in this Business Category.

No establishments documented for counties in H-GAC outside of the MSA (or San Jacinto which is in MSA but outside of H-GAC region) so used MSA data from Census only.

E.22 Category #22 - Wood Reuse or Pallet Rebuilder

Used number of employees from three survey responses to estimate average number of employees per establishment and multiplied average per establishment by total number of establishments to get total number of employees.

Calculated the average pay per employee in the NAICS Category 321920, Wood Container and Pallet Manufacturing, within the MSA under the assumption that a person that makes new pallets makes the same salary as one that refurbishes pallets.

Estimated payroll by multiplying the average pay per employee by the estimated number of employees.

Calculated the average receipts per employee in the NAICS Category 321920, Wood Container and Pallet Manufacturing, within the MSA for 2007, and multiplied this by the price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to get an estimate of the receipts per employee in 2010.

Estimated total receipts by multiplying the average receipts per employee by the estimated number of employees.

E.23 Category #23 - Miscellaneous Used Merchandise Sales (retail)

Used 2010 US Census Data for NAICS Code 453310 for number of establishments, number of employees, and annual payroll in the MSA. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=BP_2010_00A1&prodType=table

Multiplied 2007 US Census Data for NAICS Code 453310 in the MSA by a price deflator of 1.053 based on the consumption of goods and services in the U.S. (from the implicit price deflator series from the BEA) to estimate 2010 “Value of Sales, Shipments, Receipts, Revenue, or Business Done” in this Business Category.

For counties that have establishments documented in the US Census data but do not have enough establishments to release number of employees, payroll, and receipts, (for this category, this included Walker and Wharton), increased the total number of employees, annual payroll, and gross receipts in the region based on the percent of the establishments in the H-GAC region that were located in those counties.

E.24 Category #24 – Other Reuse

Gathered data and information from Census information for certain NAICS codes, regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an “applicability” factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use" to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified (factored for applicability) to get an estimated number of employees in the category.

Factored the payroll and total annual receipts for each establishment that provided this information by multiplying the total reported payroll and receipts by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use".

Calculated the average factored payroll and receipts per employee for responding establishments.

Multiplied the average factored payroll and receipts per employee by the estimated number of employees in the category to estimate the total annual payroll and receipts.

E.25 Category #25 – Energy Recovery

Gathered data and information from Census information for certain NAICS codes, regional economic data, trade association information, interviews and other sources to estimate the total number of establishments in this Category.

Multiplied the total number of establishments by an "applicability" factor based on the percent of firms responding to the survey that indicated that the survey was applicable to them, thus reducing the total number of establishments assumed.

Multiplied the number of employees per responding establishment by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use" to estimate the number of employees involved in these activities at each establishment. Estimated the average number of employees for responding establishments.

Multiplied the average number of employees per establishment by the number of establishments identified (factored for applicability) to get an estimated number of employees in the category.

Factored the payroll and total annual receipts for each establishment that provided this information by multiplying the total reported payroll and receipts by the percent of "goods/services provided that could be considered to be related to recycling, reuse, or energy recovery/beneficial use".

Calculated the average factored payroll and receipts per employee for responding establishments.

Multiplied the average factored payroll and receipts per employee by the estimated number of employees in the category to estimate the total annual payroll and receipts.

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