2007 Community Greenhouse Gas (GHG) Emissions Inventory

June 2009

City of Houston,
Mayor's Office of Environmental Planning

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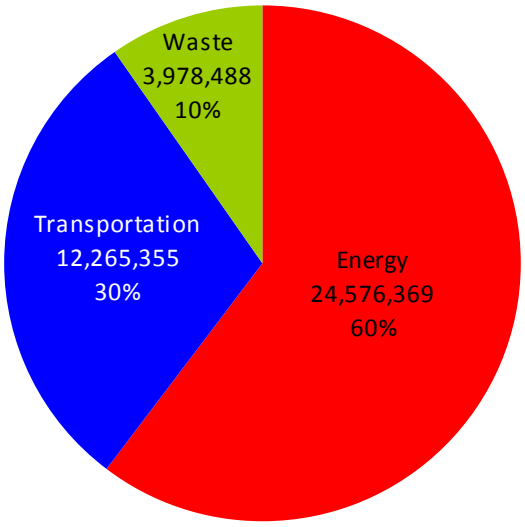
EXECUTIVE SUMMARY

As government standards for air pollutants becomes stricter and the possibility of a cap-and-trade system becomes more likely, a 2007 baseline Houston community greenhouse gas (GHG) emissions inventory is financially and environmentally crucial. To determine feasible and realistic strategies to reduce emissions, the community must identify the GHG emissions baseline, the source of these emissions, and key opportunities for reduction. Thus, as the Mayor has indicated over the past five years, this project will help Houston achieve a reputation as a leader in energy efficiency and help residents and businesses achieve cost efficiency and improved air quality.

Briefly, this 2007 community inventory utilized data gathered from CenterPoint Energy (CNP) and several public agencies, including the City of Houston (COH), Houston-Galveston Area Council (H-GAC), Texas Commission on Environmental Quality (TCEQ), and the U.S. Environmental Protection Agency (EPA). As a beta-tester city, the City of Houston utilized a new software program called Project 2 Degrees (P2D) to compute and record the inventory. P2D is a secure, password-protected, web-based emissions tracker program jointly created by Microsoft Corporation, ICLEI – Local Governments for Sustainability, and the Clinton Climate Initiative with the help of Ascentium Corporation and the Center for Neighborhood Technology (CNT).

The results of this inventory indicated that energy use produced more than half of the community's GHG emissions, whereas transportation emissions made up nearly a third of GHG emissions. The table below presents a summary of the 2007 community greenhouse gas emissions inventory.

2007 Community GHG Inventory	
Sector	**GHG (tpy)**
Energy	**24,576,369**
Electricity	22,257,878
Natural Gas	2,318,491
Transportation	**12,265,355**
On-road	10,896,494
Plane	867,925
Boat	200,856
Nonroad	181,894
Train	118,186
Waste	**3,978,488**
Landfills	3,559,224
WWTPs	419,264
Total	**40,820,212**



The remainder of this project summary will provide a more in-depth analysis of these three sectors. The complete methodology and technical appendices are provided in the "2007 Community GHG Emissions Inventory Complete Report".

INTRODUCTION

It is well-documented that air pollutants are detrimental to the public health and well-being of communities. However, the factors that contribute to polluted air are magnified in Houston's current context: a growing population and growing economy.

According to the City of Houston Planning and Development Department, as of January 1, 2009, Houston is not only the fourth largest city in the U.S., but it also boasts a growing population of 2.25 million. According to the Greater Houston Partnership (GHP), if the city of Houston were a state, it would rank 36th in population ahead of New Mexico[1]. Contributing to its growth, the city of Houston is vast; according to the Greater Houston Convention and Visitors Bureau, the city boasts a land area of 639 square miles, enough to contain the cities of New York, Washington, Boston, San Francisco, Seattle, Minneapolis, *and* Miami[2]. According to the City of Houston, by 2010, the city of Houston will reach a population of nearly 2.32 million[3].

Coupled with this growing population is a large, diverse, and growing economy. Not only is Houston home to more than 5000 energy firms, but it is also home the largest medical center in the world—The Texas Medical Center. Moreover, Houston is home to one of the nation's busiest ports—the Port of Houston, which ranks first in the U.S. for international waterborne tonnage and second in total cargo tonnage[4]. According to the GHP, the city of Houston ranks first in fastest job growth, first in the lowest cost of living among major metropolitan areas, and third in the number of Fortune 500 headquarters.

A growing population and economy implies an increase in emissions from increased waste, transportation, and energy use. This increase in emissions coupled with an increased possibility of stricter air pollutant regulations as a result of a changing political climate illustrates the need for a baseline community emissions inventory. This baseline will allow residents, businesses, and the government to identify opportunities and strategies for emissions reduction and enable each sector to set goals for measured improvement.

[1] Greater Houston Partnership. (2009). Economic Development: Population and Demographics. Retrieved January 21, 2009 from http://www.houston.org/economic-development/demographics/.
[2] Greater Houston Partnership. (2009). Economic Development: Ratings and Rankings. Retrieved January 21, 2009 from http://www.houston.org/economic-development/ratings-rankings/index.html.
[3] City of Houston, Planning and Development. (2009, January 1). Demographics. Retrieved January 21, 2009 from http://www.houstontx.gov/planning/Demographics/dem_links.htm.
[4] City of Houston. (2008, August). Multi-Pollutant Emissions Reduction Plan. Retrieved January 21, 2009 from http://www.greenhoustontx.gov/reports/emissionreduction20090114.pdf.

2007 COMMUNITY GHG INVENTORY OVERVIEW

To develop the 2007 GHG emissions baseline inventory, a three-step process was employed:

Data Collection → Data Entry → Data Analysis

During the data collection phase, the scope of the project was delineated. The inventory comprises the geopolitical boundaries of Houston city limits. Data was collected for calendar year 2007 for three main sectors: energy use, transportation, and waste from CenterPoint Energy, the TCEQ and HGAC, and COH, TCEQ, and EPA, respectively. The subsectors (and units of measurement) included electricity and natural gas use by rate class (kWh and MMBtu), vehicle miles traveled (VMT), fuel use (gallons), and volume of waste by location (tons or gallons).

Once collected, the next step was to organize the data for entry into the Project 2 Degrees (P2D) software. The most recent emission factors from the 2008 Local Government Operations Protocol (LGOP) were used. P2D calculates GHG emissions in carbon dioxide equivalent (CO2E), but this includes carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O).

In addition, the software categorizes GHG emissions by "scope". Scope 1 emissions are all direct emissions from sources located within city limits. Scope 2 emissions are indirect emissions that result as a consequence of activity within city limits; limited to electricity generation, district heating, steam and cooling consumption. In contrast, scope 3 emissions are all other indirect and embodied emissions that occur as a result of activity within city limits.

Once input, the final phase was data analysis. The table below presents the 2007 community GHG emissions inventory by scope in tons per year (tpy).

Houston's 2007 Community GHG Emissions Inventory by Scope in tpy					
Emission source	**Within city limits**		**Sum 1 & 2**	**Outside city limits**	**Sum (1, 2, & 3)**
Sector	**Scope 1**	**Scope 2**	**Sub-total**	**Scope 3**	**Total**
Energy	**2,318,491**	**20,487,415**	**22,805,905**	**1,770,464**	**24,576,369**
Electricity	0	20,487,415	20,487,415	1,770,464	22,257,878
Natural Gas	2,318,491	0	2,318,491	0	2,318,491
Transportation	**11,176,183**	**0**	**11,176,183**	**1,089,172**	**12,265,355**
On-road	10,896,494	0	10,896,494	0	10,896,494
Plane	0	0	0	867,925	867,925
Boat	0	0	0	200,856	200,856
Nonroad	181,894	0	181,894	0	181,894
Train	97,795	0	97,795	20,391	118,186
Waste	**906,460**	**0**	**906,460**	**3,072,029**	**3,978,488**
Landfills	487,196	0	487,196	3,072,029	3,559,224
WWTPs	419,264	0	419,264	0	419,264
Total	**14,401,133**	**20,487,415**	**34,888,548**	**5,931,665**	**40,820,212**

As the table shows, 85% of total emissions are within the geopolitical jurisdiction of Houston. On the other hand, 15% of total emissions (or all scope 3 emissions) are beyond the geopolitical jurisdiction of

Houston, but the City may have creative policy options available to influence or reduce these emissions. The following sector-specific results indicate that there is significant opportunity in the electricity sub-sector and on-road sub-sector to reduce community GHG emissions. Together these two sub-sectors comprise 81% of total emissions – 27% of total emissions from on-road emissions and 55% from electricity use.

ENERGY USE

Electricity and natural gas usage within the Houston community is 60% of total GHG emissions; GHG emissions from electricity are 91% of total energy emissions and emissions from natural gas usage is only 9% of total energy emissions. Thus, to determine the source of these emissions, the following 2 tables present electricity and natural gas emissions by CenterPoint Energy rate class or sector.

Electricity GHG Emissions, 2007

Sector	GHG (tpy)	% of Total
Residential	**9,696,098**	**43.6%**
Single Family	7,231,586	32.5%
Multi-Family	2,356,354	10.6%
Mobile Home	108,157	0.5%
Commercial	**8,135,703**	**36.6%**
Small Commercial	8,135,703	36.6%
Industrial	**2,460,860**	**11.1%**
Large Commercial & Industrial	2,460,860	11.1%
Lighting	**194,753**	**0.9%**
Streetlights	153,721	0.7%
Miscellaneous Lighting	41,033	0.2%
T&D Losses*	**1,770,464**	**8.0%**
TOTAL	**22,257,878**	**100.0%**

Natural Gas GHG Emissions, 2007

Sector	GHG (tpy)	% of Total
Residential	**866,589**	**37%**
Commercial	**905,929**	**39%**
Large Commercial	599,114	26%
Small Commercial	306,815	13%
Industrial	**545,973**	**24%**
Large Ind/Transport**	457,218	20%
Industrial	88,755	4%
Total	**2,318,491**	**100%**

*T&D Losses: Transmission and distribution loss is the loss of electricity in the lines as it is transmitted and distributed from generation locations to end-use locations (2007 ERCOT T&D loss factors).
**Transport: Refers to a situation where a company provides natural gas transportation service to those end use locations rather than natural gas sales service.

As the electricity table indicates, the greatest GHG emissions occurred in the small commercial and single family sectors. From the zip code maps provided in the complete report, small commercial emissions are greater along the 290W, 10W, and 10E corridors. There are also higher small commercial electricity emissions near the Medical Center/Reliant Stadium area, near 59N in Humble, and near 45N in Spring. In contrast, higher single family emissions are along the 290W ad 10W corridors as well as near the Kingwood, Lake Houston, and Clear Lake areas (mainly suburban areas).

The natural gas table shows that the greatest GHG emissions occurred in the large commercial and large industrial/transport sectors. It is important to note that unlike electricity emissions, natural gas emissions were the greatest closer to the center of Houston. The highest large industrial/transport GHG emissions are within the 610 loop; similarly, the highest large commercial emissions occurred within Beltway 8 and concentrated within the 610 loop.

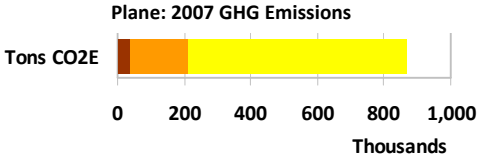
From these results, it is clear that electricity use is highest among residents and small businesses, whereas natural gas use is highest among large industries and companies. Therefore, there is an

opportunity to decrease electricity use among single family residents in suburban neighborhoods and among small business owners throughout Houston using energy efficiency incentives and programs aimed at educating the community about the environmental and financial benefits of natural gas use.

TRANSPORTATION

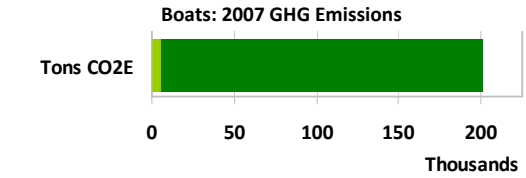
Transportation GHG emissions were calculated for on-road vehicles, planes, boats, nonroad, and trains. Analysis indicates that on-road GHG emissions comprise 27% of total community GHG emissions and 89% of total transportation emissions. As such, a brief analysis of emissions from planes, boats, nonroad, and trains follows; however, the remainder of this section provides a more in-depth analysis of on-road emissions.

Due to data availability, GHG emissions from planes and boats were direct entry. The diagram to the right presents the 2007 GHG emissions from planes, which are all scope 3. It is important to note that these are only emissions up to the mixing height (3000 feet) and do not include en route emissions or non-aircraft sources. As such, emissions from planes up to the mixing height comprise only 7% of transportation emissions. One recommendation is that the next inventory may benefit from integrating en route emissions, which can be as much as 90% of a trip's total GHG emissions, so further knowledge may be gained in regard to Houstonian air travel.



	Tons CO2E	Percent of Total
Total	867,925	100%
IAH	652,697	75%
HOU	177,404	20%
EFD	37,825	4%

Like plane emissions, boat emissions were a direct entry; the data was retrieved from a 2007 TCEQ vessel study. The diagram to the left presents the 2007 GHG emissions from boats, which are all scope 3. Ninety-seven percent of boat emissions are from ocean-going vessels. However as a percent of total transportation emissions, boat emissions account for only 2% of emissions and as a percent of total community GHG emissions, boat emissions account for 0.5% of emissions.



	Tons CO2E	Percent of total
Total	200,856	100%
Ocean-Going	195,580	97%
Harbor	5,276	3%

Train and nonroad emissions each comprise approximately 1% of transportation emissions and less than 1% of total GHG emissions. The train emissions inventory below shows that the greatest emissions are from switch engines, which comprise 83% of total train emissions.

Train GHG Emissions Inventory, Tons CO2E, 2007[5]									
Scope	Train Type	BNSF		UP		Other		Total	
		Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total
3	Line Haul	4,999	16%	15,392	39%	0	0%	20,391	**17%**
1	Switch Engine	26,208	84%	23,852	61%	47,735	100%	97,795	**83%**
	Total	**31,207**	**26%**	**39,243**	**33%**	**47,735**	**40%**	**118,186**	**100%**

[5] BNSF: Burlington Northern Santa Fe Railway company; UP: Union Pacific Railroad company; Other: All other railroad companies

Similarly, the nonroad emissions inventory below shows that the greatest emissions are from industrial equipment (70% of nonroad emissions) and equipment that utilizes LPG fuel (66% of emissions).

Nonroad GHG Emissions Inventory, 2007

Equipment	CNG		Diesel		LPG		Gasoline		Total	
	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total
Agricultural	2	0%	352	1%	0	0%	27	0%	**380**	**0%**
Commercial	3,978	28%	6,744	25%	6,471	5%	4,479	21%	**21,673**	**12%**
Construction	9	0%	18,314	69%	891	1%	1,639	8%	**20,854**	**11%**
Industrial	10,312	72%	428	2%	112,497	94%	3,956	19%	**127,194**	**70%**
Lawn/Garden	0	0%	522	2%	0	0%	1,521	7%	**2,043**	**1%**
Logging	0	0%	0	0%	0	0%	0	0%	**0**	**0%**
Pleasure Craft	0	0%	114	0%	0	0%	3,320	16%	**3,434**	**2%**
Railroad	0	0%	60	0%	0	0%	0	0%	**60**	**0%**
Recreational	0	0%	51	0%	13	0%	6,195	29%	**6,259**	**3%**
Total	**14,302**	**8%**	**26,584**	**15%**	**119,873**	**66%**	**21,136**	**12%**	**181,897**	**100%**

In contrast the on-road emissions patterns below indicate that peak GHG emissions from on-road vehicles occurs on Fridays and during the evenings. Although collectively, weekday (Monday-Thursday) emissions far surpass Friday emissions, this pattern shows that policies aimed at reducing leisure, non-workday activities is key.

On-Road Emissions by Day of Week and Time of Day, 2007

Day	Morning		Midday		Evening		Overnight		Total	
	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total	Tons CO2E	% of Total
Monday	374,344	18%	467,583	15%	496,334	16%	327,065	13%	**1,665,325**	**15%**
Tuesday	374,344	18%	467,583	15%	496,334	16%	327,065	13%	**1,665,325**	**15%**
Wednesday	374,344	18%	467,583	15%	496,334	16%	327,065	13%	**1,665,325**	**15%**
Thursday	374,344	18%	467,583	15%	496,334	16%	327,065	13%	**1,665,325**	**15%**
Friday	392,853	19%	480,585	16%	512,261	16%	344,388	14%	**1,730,087**	**16%**
Saturday	143,210	7%	422,446	14%	350,932	11%	488,661	19%	**1,405,249**	**13%**
Sunday	71,379	3%	316,561	10%	303,022	10%	408,894	16%	**1,099,856**	**10%**
Total	**2,104,820**	**19%**	**3,089,923**	**28%**	**3,151,549**	**29%**	**2,550,202**	**23%**	**10,896,494**	**100%**

The following two tables present emissions by type of vehicle and fuel by day of the week and time of the day, respectively. Many conclusions can be drawn from the first table of results; however, below are some key conclusions:

- 48% of on-road emissions are from passenger vehicles
- 34% of on-road emissions are from light-duty trucks
- 84% of on-road emissions are from gasoline vehicles
- 93% of diesel, on-road emissions are from heavy-duty trucks
- 85% and 89% of heavy-duty trucks and buses, respectively are diesel emissions

On-Road Emissions by Day of Week and Type of Vehicle, 2007, Tons CO2E

Day	Passenger Vehicle			Light Duty Truck			Heavy Duty Truck			Buses			MC	GRAND TOTAL		
	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gas	Gasoline	Diesel	Total
Monday	730,405	536	730,941	546,794	2,636	549,430	56,730	304,654	361,384	2,747	20,229	22,976	594	1,337,270	328,055	1,665,325
Tuesday	730,405	536	730,941	546,794	2,636	549,430	56,730	304,654	361,384	2,747	20,229	22,976	594	1,337,270	328,055	1,665,325
Wednesday	730,405	536	730,941	546,794	2,636	549,430	56,730	304,654	361,384	2,747	20,229	22,976	594	1,337,270	328,055	1,665,325
Thursday	730,405	536	730,941	546,794	2,636	549,430	56,730	304,654	361,384	2,747	20,229	22,976	594	1,337,270	328,055	1,665,325
Friday	895,659	641	896,300	551,602	2,655	554,257	35,568	227,248	262,817	984	15,077	16,061	652	1,484,465	245,622	1,730,087
Saturday	781,862	560	782,422	469,765	2,198	471,963	18,654	124,965	143,620	446	6,258	6,704	541	1,271,268	133,981	1,405,249
Sunday	584,166	420	584,586	434,170	2,064	436,234	9,371	65,427	74,799	234	3,568	3,801	437	1,028,377	71,479	1,099,856
Total	5,183,308	3,765	5,187,073	3,642,715	17,460	3,660,176	290,512	1,636,257	1,926,770	12,652	105,819	118,471	4,005	9,133,192	1,763,302	10,896,494
% of Grand Total	48%	0%	48%	33%	0%	34%	3%	15%	18%	0%	1%	1%	0%	84%	16%	100%
% of Vehicle	100%	0%	100%	100%	0%	100%	15%	85%	100%	11%	89%	100%	100%	84%	16%	100%
% of Fuel	57%	0%	48%	40%	1%	34%	3%	93%	18%	0%	6%	1%	0%	100%	100%	100%

The second table below presents on-road emissions by time of day and type of vehicle and fuel type. Similar to the table above, many conclusions can be drawn from these results; however, a few key conclusions are listed below:

- Regardless of time of day, passenger vehicles have highest on road emissions
- Emissions for passenger vehicles, light duty trucks, and motorcycles are highest from 3pm – 7pm
- Emissions for heavy duty trucks are highest from 9am – 3pm
- Emissions for buses are highest from 6am – 9am
- Similar to the conclusions alluded at in the 2 preceding tables, on-road GHG emissions reductions policies may be most effective if aimed at leisure, non-work activities

On-Road Emissions by Time of Day and Type of Vehicle, 2007, Tons CO2E

Time of Day[6]	Passenger Vehicle			Light Duty Truck			Heavy Duty Truck			Buses			MC	TOTAL		
	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gasoline	Diesel	Total	Gas	Gasoline	Diesel	Total
Morning	997,582	731	998,313	704,574	3,365	707,939	55,991	298,939	354,929	7,344	35,524	42,868	771	1,766,261	338,559	2,104,820
Midday	1,363,996	996	1,364,992	950,007	4,743	954,749	115,270	632,892	748,161	1,437	19,489	20,926	1,094	2,431,804	658,119	3,089,923
Evening	1,556,159	1,117	1,557,276	1,102,484	5,145	1,107,629	75,635	368,997	444,632	2,888	37,946	40,834	1,179	2,738,344	413,205	3,151,549
Overnight	1,265,571	922	1,266,492	885,651	4,208	889,858	43,617	335,430	379,048	983	12,860	13,843	961	2,196,782	353,420	2,550,202
Total	5,183,308	3,765	5,187,073	3,642,715	17,460	3,660,176	290,512	1,636,257	1,926,770	12,652	105,819	118,471	4,005	9,133,192	1,763,302	10,896,494

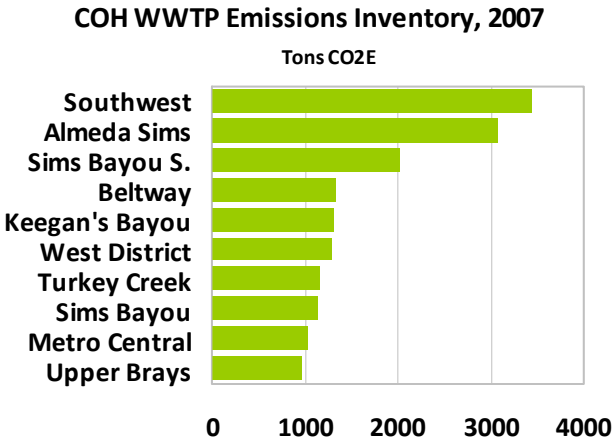
[6] Morning is 6am – 9am; Midday is 9am – 3pm; Evening is 3pm – 7pm; Overnight is 7pm – 6am

WASTE

There are two types of waste that were inventoried: wastewater treatment plants (WWTPs) and landfills. Of total community GHG emissions, WWTPs account for 1% of total emissions and landfills account for 9% of total emissions. Conversely, WWTPs comprise 11% of waste emissions and landfills comprise 89% of waste emissions.

WWTP emissions were further sub-categorized into industrial WWTPs[7], comprising 93% of WWTP emissions, and City-owned (COH) WWTPs, accounting for 7%. It is important to note that the emissions from both types of WWTPs only takes into account the emissions emitted as a result of the biological processes, whereas emissions from energy use are recorded in the energy sector, etc.

Of industrial WWTP emissions, 98.8% were from Ameri-Forge Corporation[8]. Interestingly, the top ten highest industrial WWTP emissions are located at companies that serve the oil and gas industry.



In 2007, there were 40 COH WWTPs, and together these WWTPs emitted 28,075 tons of CO2E. The average tons of CO2E emitted was 702 tpy with a standard deviation of 742 tpy. The lowest emitter was Greenridge at 37 tpy, while the highest was Southwest at 3450 tpy. Interestingly, the 69th Street WWTP was only the 18th highest emitter at 606 tpy, which is below the average. The diagram to the right is of the top 10 COH WWTPs GHG emitters. Of total COH WWTP GHG emissions, these top ten emitters account for 60% of COH WWTP emissions.

Landfill emissions were categorized in three dimensions, by scope, type of waste, and landfill name. As the table below shows, scope 1 landfill emissions account for only 14% of total landfill emissions, whereas scope 3 emissions[9] account for 86% of total landfill emissions. Furthermore, residential waste makes up nearly half of all landfill GHG emissions at 48%; commercial is 30% of emissions, construction and demolition (C&D) waste is 19% of emissions, and brush waste is 3% of emissions. This shows that there is a significant opportunity to reduce C&D emissions by diverting this to reuse and recycling facilities. In a similar manner, residential and commercial waste emissions can also be reduced through recycling of materials before landfilling.

2007 Landfill GHG Emissions Inventory by Scope, Tons CO2E

Type of Waste	Scope 1	% of Total	Scope 3	% of Total	Total	% of Total
Residential	108,717	22%	1,604,708	52%	**1,713,425**	**48%**
Commercial	22,874	5%	1,037,483	34%	**1,060,357**	**30%**
C&D	296,869	61%	390,352	13%	**687,221**	**19%**
Brush	58,735	12%	39,487	1%	**98,222**	**3%**
Total	**487,196**	**14%**	**3,072,029**	**86%**	**3,559,224**	**100%**

[7] Data for industrial WWTPs was gathered from the EPA's ECHO (Enforcement and Compliance History Online) Database.
[8] Ameri-Forge Corporation is a worldwide forged products manufacturer that serves the oil and gas, power generation, and industrial markets.
[9] Scope 3 emissions for landfills refers to all those landfills whose waste originates within city limits but the landfill itself is outside city limits.

The table below presents the landfill GHG emissions inventory by landfill and type of waste. Many conclusions can be drawn from these results; however, a few key points are listed below:

- The top three largest GHG emitting landfills, with more than 500,000 tpy each are: McCarty (Republic), Atascocita (Waste Management, Inc.) and SeaBreeze (Republic)
- The highest residential waste GHG emissions was McCarty at 21% of total residential waste emissions
- The highest commercial waste GHG emissions was SeaBreeze at 24% of total commercial waste emissions
- The highest C&D waste GHG emissions was Fairbanks at 18% of total C&D waste emissions
- The highest brush waste GHG emissions was Fairbanks at 35% of total brush waste emissions

2007 Landfill GHG Emissions Inventory by Type of Waste and Landfill, in Tons CO2E

Landfill Name	Residential		Commercial		C&D		Brush		Total	
	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total
Addicks-Fairbanks	1,576	0%	1	0%	705	0%	803	1%	**3,084**	**0%**
Atascocita	300,671	18%	247,743	23%	46,484	7%	0	0%	**594,898**	**17%**
Altair	30,959	2%	0	0%	6	0%	4	0%	**30,968**	**1%**
Baytown	125,504	7%	100,728	9%	32,954	5%	3,835	4%	**263,021**	**7%**
Blue Ridge	123,485	7%	68	0%	14,822	2%	5,882	6%	**144,257**	**4%**
Chambers County	6,448	0%	2,230	0%	468	0%	237	0%	**9,382**	**0%**
Coastal Plains	211,209	12%	154,786	15%	36,472	5%	0	0%	**402,466**	**11%**
Cougar	409	0%	918	0%	67,960	10%	14,467	15%	**83,754**	**2%**
Fairbanks	19,909	1%	498	0%	125,512	18%	34,432	35%	**180,352**	**5%**
Fort Bend Regional	15,832	1%	19,328	2%	0	0%	0	0%	**35,160**	**1%**
Galveston County	70,954	4%	34,905	3%	12,052	2%	2,426	2%	**120,338**	**3%**
Greenhouse Road	315	0%	0	0%	32,054	5%	5,691	6%	**38,060**	**1%**
Greenshadow	12,252	1%	0	0%	8,670	1%	4,126	4%	**25,048**	**1%**
Hawthorne Park	48	0%	0	0%	4,937	1%	306	0%	**5,290**	**0%**
McCarty Road	359,437	21%	140,663	13%	81,452	12%	20,985	21%	**602,536**	**17%**
North County	2,322	0%	0	0%	27,826	4%	1,139	1%	**31,287**	**1%**
Ralston Road	0	0%	0	0%	29,454	4%	0	0%	**29,454**	**1%**
SeaBreeze	194,052	11%	256,984	24%	57,669	8%	0	0%	**508,705**	**14%**
Security	151,584	9%	80,048	8%	19,555	3%	464	0%	**251,651**	**7%**
Sprint Fort Bend County	0	0%	0	0%	51,922	8%	389	0%	**52,311**	**1%**
Tall Pines	0	0%	0	0%	0	0%	0	0%	**0**	**0%**
WCT/Greenbelt/Olshan	0	0%	0	0%	29,285	4%	0	0%	**29,285**	**1%**
Whispering Pines	86,461	5%	21,457	2%	6,963	1%	3,036	3%	**117,917**	**3%**
Total	**1,713,425**	**48%**	**1,060,357**	**30%**	**687,221**	**19%**	**98,222**	**3%**	**3,559,224**	**100%**

NEXT STEPS

Given this inventory, there are four major recommendations for the next steps.

1. **Formulation of Reduction Measures.** Given this baseline inventory of GHG emissions for the Houston community, policies aimed at reducing GHG emissions from the largest sources is a key next step. As this inventory illustrated, the largest sources of GHG emissions were
    - Single family, suburban electricity use emissions
    - Friday, evening, and off-work hours on-road, passenger car emissions
    - Residential waste emissions

    Therefore, one important next step is to develop creative incentives and policies to influence the Houston community to reduce residential electricity use, limit vehicle use in leisure time, and reduce at-home waste.

2. **Calculation of Other Criteria Air Pollutants and Use of CACP 2009 Software.** One significant shortcoming of the P2D software is the lack of criteria air pollutants; however, the recently released CACP2009 software possesses the ability to calculate these pollutants—NOx, SOx, CO, VOCs, PM10, and PM2.5. Therefore, one key next step is to calculate these additional pollutant emissions to provide a more robust baseline inventory.

3. **Streamlining the Data Collection System.** Another important recommendation is the streamlining of the data collection system. The data collection process for this 2007 GHG emissions inventory took nearly 4 months. It is recommended that a regular, transparent data collection system be implemented across the city, state, or country to facilitate this data collection process. If the data values (i.e. kWh and MMBtu of energy use by rate class and zip code) were required to be reported, this process would be made significantly more efficient.

4. **Improvements to the P2D Software.** As a beta-tester city of the P2D software and a member of the P2D Advisory Council, the City of Houston has provided feedback, comments, and suggestions to the P2D team. It is recommended that Houston continue to communicate with the P2D team to provide assistance in improving the software as well as its analysis capabilities. However, before continuing the use the P2D software for future inventories, it is recommended that careful consideration be made to the timeliness and types of updates provided to member cities. It is important to note that one significant drawback to using the P2D software is that the software lacks the ability to calculate the aforementioned criteria air pollutants; therefore, it is recommended if P2D is used in future inventories that it be used in concert with CACP 2009.

These four recommendations and next steps are essential to establishing a more complete emissions inventory and establishing a transparent, systematic emissions inventory process.