# EMISSIONS REDUCTION PLAN

**AUGUST 2008**

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## INTRODUCTION

Houston is the fourth largest city in the nation, with an estimated population of 2.23 million as of January 1, 2007.[1] Houston's population is among the youngest and most diverse in the U.S., with more than ninety spoken languages.[2] The City is expected to experience continued growth through 2010. At the current rate, the City of Houston's population will reach 2.32 million by 2010.[3]

Houston's economy has a broad industrial base in the energy, aeronautics, and technology industries, and only New York City is home to more Fortune 500 headquarters. The Port of Houston ranks first in the United States in international waterborne tonnage and second in total cargo tonnage. In 2006, the regional Gross Area Product was $325.5 billion, slightly larger than the Gross Domestic Product of Austria, Poland, or Saudi Arabia. If Houston were an independent nation, it would rank as the world's 30th largest economy. Houston ranks second in employment growth rate among the ten most populous metropolitan areas in the U.S., and we expect to see job growth continue to outpace other cities.

Our growing population and vibrant economy present environmental challenges, particularly concerning air quality and climate change, due to emissions from all sectors—business, government, and individuals. The combination of the country's largest petrochemical and refining complex, second largest port, large construction and development projects, and significant on-road travel (in excess of 140 million vehicle miles traveled per day) result in high ambient levels of some air pollutants. These include ozone, particulate matter, volatile organic compounds, and significant emissions of greenhouse gases. It is the goal of the city to reduce emissions of these pollutants.

As the population grows, City government will have to provide a broader array of services to more people. We will do so by increasing the number and expertise of our personnel, enhancing infrastructure capacity, and providing new and expanded neighborhood services and facilities such as curbside trash and recycling pick up, parks, libraries, and community centers. Our challenge is to continue to increase services, while reducing the associated emissions generated by City activities. This will require conservation of resources, greater efficiency in operations, and environmentally conscious purchasing decisions. This Multi-Pollutant Emission Reduction Plan outlines our 2010 emission targets and the strategies we will employ to achieve our targets.

The table below shows our current and projected emissions of Greenhouse Gases (GHGs), Oxides of Nitrogen (NOx), and Volatile Organic Compounds (VOCs). The first row contains our baseline inventory from 2005. The second row contains the emissions we would expect to generate if our emissions were to grow at the same rate as our population is projected to grow (11.3%) between 2005 and 2010. The last row contains the emissions we expect to produce in 2010, considering the growth in city services attributable to a larger population and the emission reductions we expect to obtain from the strategies described in this Plan. The 2010 goal is conservative because it is based solely on readily quantifiable emission reductions attributable to strategies developed through mid-2008. We expect to continue to develop additional strategies that will further reduce our emissions, and to quantify additional reductions.

**Table 0-1: Emissions from Municipal Operations, 2005 and 2010 Goal**

| Source | Pollutant (tpy) | | |
|---|---|---|---|
| | GHG | NOx | VOC |
| 2005 Baseline Inventory | 1,968,848 | 1,928 | 306 |
| 2010 Business As Usual | 2,123,989 | 2,145 | 340 |
| 2010 Emissions Goal | 1,751,933 | 1,629 | 306 |

[1] Estimated by the City's Planning and Development Department. This estimate includes evacuees from Hurricane Katrina in September 2005 that chose Houston as their permanent residence.

[2] Houston's median age is 32.3 years or 11.5% below the national median age of 36.4 years. Source: U.S. Census Bureau, 2006 American Community Survey.

[3] Based on data from the U.S. Census Bureau and the Texas State Data Center available at http://www.houstontx.gov/planning/Demographics/demographics/Ann_%20Pop_%20Est07.htm , the City of Houston's population increased by an average 1,866 people per month for the 63 months between April 1, 2000 and July 1, 2005. The 2010 population was projected from the January 1, 2007 population estimate by the City's Planning and Development Department using an average monthly increase of 1,866.

## 2005 BASELINE EMISSIONS INVENTORY

Our first step in developing this plan was to identify pollutants to inventory and reduce based upon their impact on air quality and climate change. We targeted greenhouse gases (GHGs)[4] nitrogen oxides (NOx)[5] and volatile organic compounds (VOCs).[6] The GHG category includes carbon dioxide ($CO_2$), methane (CH4), and nitrous oxide ($N_2O$), which are the three most common anthropogenic GHGs.

Next, we generated a baseline inventory of the selected emissions, using 2005 as the baseline year. We organized the primary sources of city emissions into three categories: Buildings and Structures (electricity and natural gas used to operate City facilities); Mobile Sources (on-road and non-road vehicles); and Waste. We then calculated the emissions of each pollutant for each source category.

We relied on data drawn from many sources to generate the baseline inventory. For inputs, Center PointEnergy and the Energy Division of the City's General Services Department provided electricity and natural gas consumption data. Allied Waste, a City contractor, and the City's Solid Waste Department provided waste data. Fleet data sources include the Fleet Division of the City's General Services Department and City departments with significant fleet size. In most cases, we had sufficient data from these sources. In cases where specific historical or forecast data were unavailable, we extrapolated estimates from existing data

To calculate the associated emissions, we relied primarily on the International Council for Local Environmental Initiatives' (ICLEI) Clean Air and Climate Protection (CACP) software. An explanation of the methodology, emission factors, and equations employed by the software is located in the Clean Air and Climate Protection Software User's Guide.[7] The text and footnotes throughout the plan cite the specific sources, estimate methodologies, and assumptions underlying the data.

All of the contributors to pollutant emissions are measured in customary units, such as kilowatt-hours (kWh) of electricity, million British thermal units (MMBtu), vehicle miles traveled (VMT), and tons of waste. Emissions are expressed in the common unit of short tons per year (tpy), released into the atmosphere, unless otherwise noted.[8] GHG emissions are expressed in carbon dioxide equivalents ($CO_2e$), which is a measure of the impact each gas has on climate change expressed in terms of the potency of carbon dioxide. The table below summarizes the baseline inventory.

**Table 0-2: City of Houston Emissions Inventory by Source and Pollutant, 2005**

| Source | Pollutant (tpy) | | |
|---|---|---|---|
| | GHG | NOx | VOC |
| Mobile Sources | 88,522 | 225 | 206 |
| Buildings and Structures | 1,024,017 | 1,703 | 100 |
| Waste | 856,309 | - | - |
| **Total** | **1,96848** | **1,928** | **306** |

[4] GHGs are created by human activity and contribute to global climate change by trapping the thermal radiation that warms the Earth. This Plan quantifies emissions of the three most common human produced GHGs: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O),4 and are reported in tpy of carbon dioxide equivalents (CO2e).4 Nitrogen oxides (NOx) are highly reactive gases that form from incomplete or inefficient fuel combustion in motor vehicles, non-road equipment and power plants.

[5] NOx is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels. NOx can also be formed naturally.

[6] VOCs are any compound of carbon that participates in atmospheric photochemical reactions, and contribute to the formation of ground-level ozone creation and global climate change. Many VOCs are listed as Hazardous Air Pollutants by the EPA and are known carcinogens. More information on the specific VOCs included in the plan can be found in the Help Menu of the Clean Air and Climate Protection Software. Clean Air and Climate Protection Software: A Joint Project of STAPPA/ALLAPCO, ICLEI and the EPA. Available at: http://www.cacpsoftware.org Date accessed: January 15, 2008

[7] Clean Air and Climate Protection Software: A joint Project of STAPPA/ALLAPCO, ICELI and the EPA. Available at: http://www.cacpsoftware.org Date accessed: January 15, 2008

[8] One short ton is equivalent to 2,000 pounds.

## BUILDINGS AND STRUCTURES

This source category includes emissions associated with the electricity and natural gas consumed by facilities, lighting structures, and water production and wastewater treatment plants, as given in the table below. The city's 24 departments occupy more than 340 facilities. These include fire stations, police stations, libraries, health clinics, community centers, convention centers, office buildings, and recreational facilities. Lights include the maintenance and operation of 2,450 signalized traffic intersections, 1,600 school zone flashers, 178,800 street and freeway lights, and 16,000 stand-alone light fixtures in parks and recreational areas. The water production and wastewater treatment plants are industrial operations conducted at 44 facilities.

**Table 1-1: Emissions Attributable to Buildings and Structures, 2005**

| Source | Pollutant (tpy) | | |
|---|---|---|---|
| | GHG | NOx | VOC |
| **Buildings and Facilities by Department** | | | |
| Convention & Entertainment | 40,910 | 65 | 2 |
| Finance & Administration | 171 | 0 | 0 |
| General Services[9] | 83,974 | 132 | 3 |
| Health & Human Services | 7,995 | 12 | 0 |
| Houston Airport System | 198,404 | 308 | 9 |
| Library | 7,533 | 12 | 0 |
| Municipal Courts | 3,036 | 5 | 0 |
| Parks and Recreation | 33,646 | 53 | 1 |
| Public Works | 26,986 | 42 | 1 |
| Solid Waste | 3,117 | 5 | 0 |
| | | | |
| **Lights** | | | |
| Parks Lights | 201 | 0 | 0 |
| Street Lights | 90,542 | 143 | 4 |
| Traffic Signals | 17,295 | 27 | 1 |
| | | | |
| **Water Production and Wastewater Treatment** | 510,207 | 899 | 79 |
| **Total** | **1,024,017** | **1,703** | **100** |

**Sources:** The Energy Division of the General Services Department provided the energy used in kilowatt-hours of electricity and therms of natural gas. ICLEI's CACP software and the Public Works and Engineering Department provided emissions outputs shown here.

## EMISSIONS REDUCTION MEASURES

### Strategy #1: Wind Energy

The city is changing the generation source of one-third of its electricity purchases from traditional sources to renewable, environmentally friendly wind power. In 2007, the city negotiated a contract for thirty megawatts of wind energy. In 2008, the city negotiated an additional ten megawatts of wind energy. The contract gives the city the ability to purchase up to eighty megawatts of renewable power, which represents 50% of the city's annual power usage as of 2005.

Wind Energy is a domestic source of power, and is in abundant supply. It is also one of the lowest-priced renewable energy sources available today, costing between four and eight cents per kilowatt-hour. The city's move to wind power comes as the nation recognizes Texas as one of the top producers of wind power, and as regulators forecast a substantial increase in the demand and use of wind energy over the next twenty-five years.

[9] The General Services Department includes energy consumed by the Affirmative Action, Legal, Planning, Human Resources, Information Technology, Housing, Police, and Fire Departments, the Houston Emergency Center, and the offices of the Mayor, City Council Members, City Controller and City Secretary.

The wind energy contract has a negotiable structure and allows for the incremental increase of wind power over time. The city's strategy is to increase available wind power in increments of ten megawatts each year for the five-year contract term, while retaining competitive pricing. By 2010, the city will utilize fifty megawatts of wind energy.[10] This change in energy sources will yield a significant reduction in emissions, as shown in the table below.

**Table 1-2: Emission Reductions from Wind Purchases**

| | Pollutant (tpy) | | |
|---|---|---|---|
| | **GHG** | **NOx** | **VOC** |
| 2005 Emissions Inventory | 1,024,017 | 1,703 | 100 |
| 2010 Business As Usual | 1,139,464 | 1,895 | 111 |
| Wind Energy Purchase | -314,626 | -431 | -13 |
| **2010 Goal** | **824,838** | **1,464** | **98** |

**Source:** The Energy Division of the General Services Department provided the electricity used in kilowatt-hours. ICLEI's CACP software generated the emissions outputs shown in this Table based on 50 megawatts of wind energy.

### Strategy #2: Facility Retrofits with Energy Services Company Financing

The City of Houston contracted the services of two energy services companies, or ESCOs, to develop, install, and finance projects designed to improve energy efficiency and decrease maintenance costs for facilities over a seven to twenty year period. These ESCOs will act as a project developer for a wide range of tasks and assume the technical responsibility and financial risk associated with the project implementation.

The ESCOs will evaluate the energy-saving opportunities in 271 city facilities, and then recommend a package of improvements to be paid for through savings. The energy savings agreement will guarantee a 30% reduction in energy use in these buildings. Many types of building improvements can be undertaken through such an agreement, including new lighting technologies, boilers and chillers, and energy management controls.

The ESCOs have the potential to reduce emissions as shown in the table below. The energy savings are expected to exceed this projection.

**Table 1-3: Emissions Reduction Potential Resulting from the SCO**

| | Pollutant (tpy) | | |
|---|---|---|---|
| | **GHG** | **NOx** | **VOC** |
| 2005 Emissions Inventory | 85,964 | 136 | 3 |
| 2010 Business As Usual | 95,656 | 151 | 3 |
| ESCO | -27,472 | -38 | -1 |
| **2010 Goal** | **68,183** | **114** | **2** |

**Sources:** The Energy Division of the General Services Department and the Mayor's Office of Environmental Programming provided the energy used in kilowatt-hours of electricity; ICLEI's CACP software generated the emissions outputs. 2010 Business as Usual emissions and emissions reduced are extrapolated using the projected population growth rate (11.3%).

### Strategy #3: LED Traffic Signals

The Traffic and Transportation Division of the Public Works and Engineering Department is implementing the Light Emitting Diode (LED) Traffic Signal Project as part of the city's comprehensive program to control and reduce energy use. Under the Project, the City of Houston will replace the incandescent bulbs at all of its 2,450 signalized intersections with LEDs, which have several advantages over their incandescent counterparts.

[10] Fifty-megawatts of wind energy is equal to 438,000 megawatt-hours or 438 million kWh

In addition to being 75% more energy efficient than incandescent bulbs, LEDs have better contrast even in direct sunlight, faster switching capability, and they gradually dim rather than burning out altogether. The city has already converted 300 signals to LEDs, which produced an annual savings of more than 2.7 million kWh of electricity.

| Table 1-4: Emission Reductions from LED Traffic Signals | | | |
|---|---|---|---|
| | Pollutant (tpy) | | |
| | GHG | NOx | VOC |
| 2005 Emissions Inventory | 17,295 | 27 | 1 |
| 2010 Business As Usual | 19,245 | 30 | 1 |
| LED Traffic Signals | -13,960 | -19 | -1 |
| **2010 Goal** | **5,284** | **11** | **0** |

**Source:** The Energy Division of the General Services Department provided the electricity used in kilowatt-hours. ICLEI's CACP software generated the emissions outputs shown here, based on 75% efficiency gained from LEDs. 2010 Business as usual emissions are extrapolated using the projected population growth rate (11.3%).

### Strategy #4: Houston Airport System's Environmental Initiatives

In order to optimize the management of environmental issues at the city's three airports, the Houston Airport System is implementing a formal Environmental Management System (EMS). The EMS will govern how the Airport System's employees apply environmental objectives in day-to-day activities, and it will serve as the framework in assessing the System's performance against its environmental goals/targets. The EMS establishes the policies and procedures to meet environmental performance targets, legal requirements, and voluntary commitments.

The energy reduction measures include installing motion detectors for lighting specific interior areas, installing control measures such as photo cells, clocks and/or timers on all outside lighting, cutting the energy supply to unoccupied retail space, and requiring lights in electrical closets be turned off when not in use. These simple low-cost measures will reduce annual energy consumption at the airports by 3,050,190 kWh. The corresponding emissions reduction is shown in the table below.

| Table 1-5: Emission Reductions from the Houston Airport System's Energy Saving Initiatives | | | |
|---|---|---|---|
| | Pollutant (tpy) | | |
| For Houston Airport System | GHG | NOx | VOC |
| 2005 Emissions Inventory | 198,404 | 308 | 9 |
| 2010 Business As Usual | 220,772 | 343 | 10 |
| HAS Energy Efficiency Measures | -2,438 | -3 | 0 |
| **2010 Goal** | **218,334** | **339** | **10** |

**Sources:** The General Services Department provided the energy used in kilowatt-hours of electricity. The Houston Airport System provided the energy savings. ICLEI's CACP software generated the emissions outputs. 2010 Business as Usual emissions and emissions reduced are extrapolated using the projected population growth rate (11.3%).

### Strategy #5: Citywide Lighting Retrofit Project

The General Services Department instituted a supply-side energy management program in 2006. The program includes the implementation of a citywide lighting retrofit and replacement project. The project involved replacing 8,000 tubular 1½" (T12) fluorescent lamps and magnetic ballasts with energy-efficient tubular 1" (T8) twenty-eight watt lamps, electronic ballasts, and compact fluorescent lights. The City upgraded the lighting at several city facilities, including the administrative building of the Houston Fire Department and the Central Police Station Complex. The forecasted energy savings from project implementation is approximately 9.8 million kWh (9,766,022). Emissions reduced by the project are shown in the table below.

| Table 1-6: Emission Reductions from the Lighting Retrofit Project | | | |
|---|---|---|---|
| | Pollutant (tpy) | | |
| | GHG | NOx | VOC |
| 2005 Emissions Inventory | 25,186 | 40 | 1 |
| 2010 Business As Usual | 28,025 | 45 | 1 |
| Lighting Retrofits | -7,806 | -11 | 0 |
| **2010 Goal** | **20,220** | **33** | **1** |

**Sources:** The Energy Division of the General Services Department provided the energy savings in kilowatt-hours of electricity. ICLEI's CACP software generated the emissions outputs. 2010 Business as Usual emissions and emissions reduced are extrapolated using the projected population growth rate (11.3%).

### Strategy #6: Energy efficient Vending Machines and Vending Misers

The city purchased 186 energy misers, energy saving devices, for cold beverage vending machines in city facilities. Dr. Pepper Co., the city's vending machine franchisee, installed the misers at no cost. This low cost energy saving measure saves 265,303 kWh/year. The city also requested that Fresh Brew, the city's snack machine vendor, remove the light bulbs in all snack machines. At current usage rates, this cost-free energy saving measure saved the city 74,285 kWh/year.

| Table 1-7: Emission Reductions from Energy Efficient Vending Machines and Vending Misers | | | |
|---|---|---|---|
| | Pollutant (tpy) | | |
| | GHG | NOx | VOC |
| 2005 Emissions Inventory | 750 | 1 | 0 |
| 2010 Business As Usual | 835 | 1 | 0 |
| Vending Miser and Energy Efficient Vending Machines | -272 | 0 | 0 |
| **2010 Goal** | **563** | **1** | **0** |

**Sources:** The Energy Division of the General Services Department provided the energy used in kilowatt-hours of electricity. ICLEI's CACP software generated the emissions outputs. 2010 Business as Usual emissions and emissions reduced are extrapolated using the projected population growth rate (11.3%).

### Strategy #7: LEED Certification for Construction of City Buildings

The city has already adopted the Leadership in Energy and Environmental Design (LEED) certification standards for new construction of city-owned facilities. The LEED Green Building Rating System, developed by the U.S. Green Building Council, provides a set of standards for environmentally sustainable construction. Since its inception in 1998, LEED has grown to encompass over 14,000 projects in 50 U.S. States and 30 countries around the world. LEED certification is obtained after submitting an application documenting compliance with the requirements of the rating system.

The city is pursuing LEED certification for 16 facilities, which include neighborhood and branch libraries, several fire stations, a multi-service center, the Parks Department headquarters, and a fleet maintenance facility. Six additional city facilities are pursuing LEED compliance.

Research indicates that newly constructed LEED buildings are, on average, 25%-30% more energy efficient than non-LEED buildings, according to the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database. We will update this Plan to include the emissions reductions attributable to energy savings obtained through LEED certification as reliable data becomes available.

### Strategy #8: Combined Heat and Power System at Wastewater Treatment Facilities

As the 2005 baseline inventory demonstrates, city wastewater treatment facilities consume significant amounts of electricity and natural gas, which generate significant emissions. To reduce resource consumption, the city is completing a preliminary engineering design for a combined heat and power (CHP) system at the Almeda-Sims wastewater facility. A CHP system will result in high overall energy

efficiency and environmental performance consistent with the facility's needs and the city's emission reduction goals.

Treatment facilities process wastewater from main feed wastewater pipes. Wastewater treatment is accomplished in a five-step process, the last one being the flash drying of residual waste or sludge in natural gas fired dryers. The enormous thermal/heat requirements of this process make CHP a viable, energy efficient alternative. A CHP system saves energy by capturing the heat from the flash drying process that would be rejected in the traditional separate generation of electric and mechanical energy. The system can simultaneously generate both electricity and heat, which could be used to process sludge or turned into steam to generate electricity for another facility.

A feasibility study already completed indicates that a CHP system could be introduced into the sludge drying process, by incorporating a natural-gas turbine generator and hot oil recovery system, which could reduce electricity use by greater than 50%. Even though the CHP generator would require more natural gas, the city would still realize a significant net annual savings in costs and emissions because of the reduction in electricity consumption.

## 2010 EMISSIONS GOALS FOR BUILDINGS AND STRUCTURES

The table below contains a conservative estimate of the emissions profile attributable to buildings and structures in 2010, based on the implementation of the strategies described above.

**Table 1-8: Emissions from Buildings and Structures, 2005 and 2010 Goal**

| | Pollutant (tpy) | | |
|---|---|---|---|
| | **GHG** | **NOx** | **VOC** |
| 2005 Emissions Inventory | 1,024,017 | 1,703 | 100 |
| 2010 Business As Usual | 1,139,464 | 1,895 | 111 |
| Emissions Reduction Measures | -366,574 | -502 | -15 |
| **2010 Goal** | **772,890** | **1,393** | **96** |

## MOBILE SOURCES

This source category includes emissions resulting from the operation of all on-road vehicles and non-road equipment owned and operated by the City of Houston. It does not include public transit vehicles operated by the Metropolitan Transit Authority, which is a separate legal and operating entity, or those owned and operated by private companies who contract with the city. All twenty-four city departments use vehicles for city business including emergency medical and fire response, law enforcement, parks and recreation, public works, and health and safety code inspectors. Some departments use non-road equipment, generally for construction and maintenance activities, and the Police department operates emergency-response helicopters.

In 2005, the municipal fleet consisted of approximately 10,622 taken from the calendar year 2005 fuel data provided by GSD vehicles and pieces of equipment of various types, ranging from tractors, mowers and trailers to patrol cars, garbage trucks, and fire emergency response apparatus. The majority of the units operate on gasoline or diesel fuel. In 2005, the vehicles in the fleet travel over 100 million miles, and consumed 9.4 million gallons of fuel.

**Table 2-1: Emissions from Mobile Sources, 2005**

| | Quantity of Units | Pollutants (tpy) | | |
|---|---|---|---|---|
| | | **GHG** | **NOx** | **VOC** |
| City Fleet | 11,285 | 88,522 | 225 | 206 |

**Source:** The General Services Department provided the gallons of fuel consumed. ICLEI's CACP software generated the emissions outputs shown here.

## EMISSIONS REDUCTION MEASURES

We will achieve emission reductions from our fleet by increasing the overall fuel economy of the fleet, using lower-emitting fuels, and adopting practices that reduce the total number of vehicle miles traveled by our fleet.

### Strategy #9: Fleet Use and Replacement

The City of Houston is replacing older, high mileage equipment in order to reduce current and future maintenance costs, increase vehicle reliability, and decrease emissions. In February 2007, the city engaged Mercury Associates, Inc. to develop a long-term fleet replacement plan and make the business case for accelerated fleet replacement. One of the key findings in Mercury's report is that fleet renewal, or accelerated replacement, minimizes the total cost of ownership.[11] Replacing equipment on a regular schedule is more cost-effective than making marginal investments in the maintenance and upkeep of older equipment.

Not only is fleet renewal more cost effective, but also by simply replacing older equipment, which tends to have fewer emission controls, the city will reduce its emissions. For example, replacing a 1998 solid waste roll-off truck with a model year 2008 truck of comparable size will emit 1.2 fewer tons of NOx over the five-year life of the vehicle, and decrease the total capital cost of ownership.[12]

### Strategy #10: The Mayor's Hybrid Initiative

In 2005, the city implemented the Mayor's Hybrid Initiative. Under this program, 50% of the city's non-specialty, light-duty fleet[13] of approximately 1,600 vehicles will be replaced with their gasoline/electric hybrid equivalents[14] by the year 2010. Initially, only compact and mid-size sedans were scheduled for replacement with a hybrid equivalent. As other models of hybrids have become available, the city has expanded its hybrid program. In 2006, we began replacing gasoline-only 4 x 4 compact sport utility vehicles with Ford Escape Hybrids. As of mid 2008, the city has 550 hybrid vehicles in its fleet, and is on a trajectory to exceed its 50% goal, or 800 units, by 2010 as hybrid technology becomes more affordable and more readily available.

**Table 2-2 Emission Reductions due to the Hybrid Initiative**

| | Pollutant (tpy) | | |
|---|---|---|---|
| | **GHG** | **NOx** | **VOC** |
| Light Duty Fleet[11] 2005 Emissions | 9,601 | 24 | 28 |
| 2010 Business as Usual | 10,683 | 27 | 31 |
| Hybrid Initiative | -1,741 | -13 | -17 |
| **2010 Goal** | **8,942** | **14** | **14** |

**Sources:** The General Services Department provided the gallons of fuel consumed and hybrid purchase frequency data. ICLEI's CACP Software generated the emissions outputs shown here. 2010 Business as Usual emissions and emissions reduced are extrapolated using the projected population growth rate (11.3%).

[11] Report on Fleet Renewal, Right Sizing, and Cost Reduction Opportunities for the General Services Department. Mercury Associates, Inc. (August 2007)

[12] The 1998 roll-off truck has a 5.0g/bhp-hr emission standard. The 2008 truck has a 1.2g/bhp-hr standard. To calculate the NOx reduction, we used the emissions standards, Texas low-emission diesel correction factor (0.943), energy conversion factor (3.03), and a two-year average of the VMT (approximately 20,000 miles)

[13] Light Duty Fleet includes 1,600 non-specialty, non-emergency, light-duty sedans and sport utility vehicles.

[14] Hybrid equivalents are gasoline/electric hybrid substitutes for traditional gasoline-only vehicles that provide significant improvements to fuel economy (i.e. 25-50% higher miles per gallon than the average for the vehicle class).

**Strategy #11: Texas Emissions Reduction Plan**

The State of Texas appropriated approximately $150 million in Texas Emission Reduction Plan (TERP) funds to subsidize local and private efforts to reduce NOx emissions and improve air quality in ozone non-attainment regions including Houston.[15] In October 2007, the City of Houston and five other local entities organized the TERP Working Group.[16] Since the Houston-Galveston-Brazoria non-attainment region still faces considerable challenges to reaching attainment of the EPA's ozone standard, the TERP Working Group intends to secure substantial funding from the TERP allocation through a third party contract between the Houston-Galveston Area Council of Governments (H-GAC) and the Texas Commission on Environmental Quality (TCEQ).

The city's participation in the TERP Working Group can yield significant NOx emissions reductions. These grant funds will be used to accelerate fleet replacement as described above. We have identified approximately 200 pieces of diesel equipment that may qualify for TERP funding. Just $2 million in grant funds can reduce NOx emissions by more than 200 tpy. The City has already filed applications with the TCEQ for Emission Reduction Rebate Grants for the replacement of six fire pumper trucks that are between 12 and 16 years old. These replacements will emit 404 pounds per year (or 35%) less NOx.

**Strategy #12: Emerging Technology**

The city is taking advantage of opportunities to utilize emerging clean emissions technology. In the past, the city collaborated with the University of Houston's College of Engineering to help reduce emissions from the city's fleet of nearly 2,800 diesel-powered units. Together, the city and the university, created a local diesel emissions testing laboratory, which will apply for emissions verification certification from the Environmental Protection Agency(EPA).[17] In addition, the city was an early adopter of TexLED, and used it exclusively well before it was mandated.

In 2008, the city took delivery of two (2) first generation, Peterbilt diesel/electric hybrid dump trucks. The Public Works and Engineering Department will utilize the five cubic yard trucks to transport right of way repair and construction materials. The incremental cost of the hybrid technology was covered by discounts from the manufacturer and dealer.

More recently, the city is working with the New Technology Research and Development Program to purchase and evaluate Eaton HLA hybrid garbage collection trucks. The Eaton system is a parallel hybrid hydraulic regenerative braking HLA system. It converts energy normally lost during braking and stores it in the form of high-pressure hydraulic fluid. This fluid is then used to provide a positive torque to the driveline in a subsequent acceleration event. The HLA system has demonstrated 20-30% better fuel economy in refuse collection applications.

Hybrid drive trains have shown the ability to simultaneously reduce fuel consumption and pollutant emissions. In the heavy-duty refuse trucks on which this project will be focused, the hybrid hydraulic system is anticipated to reduce NOx, particulate matter, hydrocarbons, and carbon monoxide emissions by 25% or more.[18]

[15] The Houston-Galveston-Brazoria non-attainment region includes Montgomery, Waller, Harris, Fort Bend, Liberty, Chambers, Galveston, and Brazoria counties. The EPA designated the HGB region as non-attainment because air pollution levels consistently exceed the national ambient air quality standards for 8-hour ozone. Additional information can be found at the EPA's website: http://www.epa.gov/oar/oaqps/greenbk/index.html.

[16] TERP Working Group members include the City, Harris County, the Port of Houston Authority, the Metropolitan Transit Authority, the Greater Houston Partnership, and the East Harris County Manufacturers Association

[17] More information on the partnership between the City of Houston and the University if Houston can be found at http://www.egr.uh.edu/news/0802/?e=cityaircontract.

[18] The Houston Advanced Research Center (HARC) provided the emissions reductions from the hybrid trucks. The emissions reductions are compared to a baseline vehicle - the exact same vehicle and engine minus the hybrid system.

Under the program, the City of Houston would purchase new Peterbilt chassis, refuse compaction bodies, and other equipment normally on their refuse trucks. The incremental cost of hybridization would be paid for under the program funding. In other words, the city gets a hybrid truck for the cost of a standard truck. The city will evaluate this technology for one-year, with the option to return the truck to its non-hybrid configuration or have a production HLA system installed.

## 2010 EMISSIONS GOALS FOR MOBILE SOURCES

The table below contains a conservative estimate of the emissions profile attributable to mobile sources in 2010, based on the implementation of the strategies described above.

**Table 2-3: Emissions from Mobile Sources, 2005 and 2010 Goal**

| | Pollutant (tpy) | | |
|---|---|---|---|
| | **GHG** | **NOx** | **VOC** |
| 2005 Emissions Inventory | 88,522 | 225 | 206 |
| 2010 Business As Usual | 98,502 | 250 | 229 |
| Emissions Reduction Measures | -1,741 | -13 | -17 |
| **2010 Goal** | **96,761** | **237** | **212** |

## WASTE

This source category includes city-generated waste and waste from residents that is collected by the city. The emissions are determined by the character and volume of the waste that is deposited into landfills. To calculate emissions, we characterized waste by and assumed its composition was commensurate with the standardized categories published by the EPA and the California Integrated Waste Management Board. These categories are:

- Food/Sludge, which includes, paper, paper related products, sludge from wastewater treatment, and food waste from the convention center, airports, and performing arts theaters,
- Plant/Yard, which is yard debris such as grass trimmings, leaves, and branches,
- Wood/Textile, which includes construction and demolition waste,
- Other, which includes anything inert or non-organic that does not decompose such as plastic, metal, and glass.

**Table 3-1: Emissions from Waste by Subcategory, 2005**

| | Waste Stream | | | | | From Landfilled Waste | Diversion Rate |
|---|---|---|---|---|---|---|---|
| | Total | Diverted | | Landfilled | | | |
| | tpy | tpy | $yd^3$ of landfill | tpy | $yd^3$ of landfill | GHG (tpy) | |
| Municipal Operations | 124,959 | 55,744 | -183,955 | 69,215 | 228,410 | 90,294 | 44.6% |
| Residential Collection | 768,113 | 17,227 | -56,848 | 750,886 | 2,477,924 | 766,015 | 2.2% |
| **Total** | **893,072** | **72,971** | **-240,804** | **820,101** | **2,706,334** | **856,309** | **8.2%** |

**Sources:** Allied Waste, Gulf Coast Recycling and the Solid Waste Department provided the waste generated in tons. ICLEI's CACP software generated the emissions outputs shown in this table. To find landfill space saved, we utilized a mixed materials estimate of approximately 3.3 cubic yards of landfill space saved for every ton of waste diverted.

## EMISSIONS REDUCTION MEASURES

The city takes a variety of approaches to diverting waste from landfills. Diverted food and sludge waste is flash dried in natural gas fired dryers to form biosolids, which can be used in applications ranging from soil conditioning to fertilizer. Paper, plastic, and metals are recycled. The city diverts plant, yard, and wood waste by mulching or composting it. We intend to continue expanding our opportunities to divert waste from landfills, as described below.

### Strategy #13: Recycling Program for All City Facilities

Currently, recycling programs are not systematized across all city facilities. Some facilities recycle a significant portion of their waste, while others do not. The city plans to implement a structured citywide recycling program for paper plastic, metals, glass, and cardboard from all city facilities during 2008. The program will utilize innovative approaches to material collection and efficient and consistent data tracking. In the end, we believe that this streamlined approach will reduce costs associated with waste disposal, divert material from landfills, reduce energy consumption in upstream commodity manufacturing by offering recycled feedstock, and reduce emissions generated by landfill decomposition. The goal of this program is to increase waste diversion rates to 25% for paper, and 10% for wood and other materials from city facilities. The materials diverted by this measure will save more than 46,000 cubic yards of landfill space.[19]

**Table 3-2: Emissions from Recycling in City Facilities, 2010 Expected**

| | Waste Stream | | | | | From Landfilled Waste | Diversion Rate |
|---|---|---|---|---|---|---|---|
| | Total | Diverted | | Landfilled | | | |
| | tpy | tpy | $yd^3$ of landfill | tpy | $yd^3$ of landfill | GHG (tpy) | |
| Food/Sludge | 82,120 | 51,313 | -169,333 | 30,807 | 101,664 | 37,289 | 62.5% |
| Paper | 27,383 | 6,846 | -22,591 | 20,538 | 67,774 | 43,919 | 25.0% |
| Plant/Yard | 18,242 | 10,415 | -34,370 | 7,827 | 25,829 | 5,369 | 57.1% |
| Wood/Textile | 315 | 31 | -104 | 283 | 935 | 172 | 10.0% |
| Other | 10,986 | 1,099 | -3,625 | 9,887 | 32,629 | 0 | 10.0% |
| **Total** | **139,047** | **69,704** | **-230,023** | **69,343** | **228,831** | **86,749** | **50.1%** |

**Sources:** 2010 tons of waste is extrapolated from 2005 using the projected population growth rate (11.3%). ICLEI's CACP software generated the emissions outputs shown in this table. To determine cubic yards of landfill space, we utilized a mixed materials estimate of approximately 3.3 cubic yards of landfill space for every ton of waste.

### Strategy #14: Recycling Program for Residents

In 2005, the City of Houston diverted approximately 2% of the household waste picked up by our Solid Waste Department. In 2007, the Solid Waste Department began a green waste program for curbside collection of wood, plant, and yard waste. The program initially served 46,000 homes, and collected and recycled via composting an average of 575 tons of materials per month. By 2010, the Department will have a citywide green waste program, serving 400,000 homes and collecting 90,000 tons of green waste per year. The materials diverted by this measure will save 187,304 cubic yards of landfill space.[20]

The city is developing a long-term plan to increase curbside recycling of household items such as paper, plastics, aluminum and glass. We expect the plan to be completed by December 2008. Our goal is to collect and divert significantly more materials from more households in all neighborhoods in Houston. Because the plan has not yet been finalized, the emission reductions associated with this growth in diversion of household items is not included in this Plan.

[19] To find landfill space saved, we utilized a mixed materials estimate of approximately 3.3 cubic yards of landfill space saved for every ton of waste diverted.

[20] To find landfill space, we utilized a mixed materials estimate of approximately 3.3 cubic yards of landfill space for every ton of waste.

| Table 3-3: Emissions from Curbside Recycling, 2010 Expected | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Waste Stream | | | | | From Landfilled Waste | Diversion Rate |
| | Total | Diverted | | Landfilled | | | |
| | tpy | tpy | yd$^3$ of landfill | tpy | yd$^3$ of landfill | GHG (tpy) | |
| Food/Sludge | 171,797 | 0 | 0 | 171,797 | 566,929 | 476,945 | 0.0% |
| Paper | 234,190 | 11,158 | -36,820 | 223,033 | 736,008 | 207,886 | 5.0% |
| Plant/Yard | 193,164 | 60,146 | -198,481 | 133,019 | 438,962 | 91,243 | 45.2% |
| Wood/Textile | 32,479 | 0 | 0 | 32,479 | 107,181 | 19,655 | 0.0% |
| Other | 223,079 | 2,683 | -8,854 | 220,396 | 727,307 | 0 | 1.2% |
| **Total** | **854,710** | **73,986** | **-244,155** | **780,723** | **2,576,387** | **795,729** | **9.5%** |

**Sources:** 2010 tons of waste was extrapolated from 2005 using the projected population growth rate (11.3%). ICLEI's CACP software generated the emissions outputs shown in this table. To determine cubic yards of landfill space, we utilized a mixed materials estimate of approximately 3.3 cubic yards of landfill space for every ton of waste. This does not include additional diversion that will be obtained from the growth in our curbside program for household items (paper, plastic, aluminum, glass).

## 2010 EMISSIONS GOALS FOR WASTE

The table below contains a conservative estimate of the emissions profile attributable to waste that is landfilled rather than diverted in 2010, based on the implementation of the strategies described above. This table does not include emission reductions associated with an enhanced curbside program for household items.

| Table 3-4: Emissions from Waste, 2005 and 2010 Goal | |
|---|---|
| | Pollutant (tpy) |
| | GHG |
| 2005 Emissions Inventory | 856,309 |
| 2010 Business as Usual | 886,023 |
| Emissions Reduction Measures | -3,545 |
| **2010 Goal** | **882,478** |

## COMMUNITY MEASURES

In addition to reducing emissions generated by city activities, the city has developed and implemented a number of programs that will result in emission reductions from other sectors. Emission reductions associated with these activities are not included in the calculations in this Plan, because the savings are attributable to the owners/actors who make the reductions possible. These strategies are outlined below.

## THE WEATHERIZATION PROGRAM

In 2006, the city collaborated with CenterPoint Energy to weatherize 641 homes in the Pleasantville community by adding insulation, caulking and weather stripping. After the City made these simple modifications to participants' homes, they saved energy, decreased the emissions associated with power generation and saves money.[21]

[21] Savings were calculated for a three-month period, based on each household's net energy (kWh) reduction at $0.16/kWh, the price-to-beat cost of energy during June, July, and August 2006 as compared to the same months in 2005.

Examples of weatherization procedures:

- ❑ Sealing cracks, gaps, holes especially around doors, windows, pipes, and other areas with high potential for heat loss, using caulk, foam sealant, weather-stripping, window film, door sweeps, and electrical receptacle gaskets.
- ❑ Installing drains or membranes to protect the home from both surface water and ground water.
- ❑ Providing proper ventilation to unconditioned spaces to protect the home from the effects of condensation.
- ❑ Installing insulation in the walls, floors, and ceilings, around ducts and pipes, around water heaters, and near the foundation of the home.
- ❑ Replacing old drafty doors with tight-sealing, foam-core doors and older windows with low-energy, double-glazed windows.
- ❑ Replacing inefficient furnaces, boilers, water heaters, and air conditioning units with energy-efficient heating and cooling equipment and programmable thermostats.

During 2007, Valero Refining joined in this effort and underwrote the cost of weatherizing 75 homes. As of August 2008, the city had weatherized 3700 homes. On average, these homes save 2,000 kWh each year. The city plans to weatherize another 6,000 homes through 2010.

**Table 4-1: Emissions Reductions from the City's Weatherization Program**

| | 2010 Projection | Emission Reduction by Pollutant | | |
|---|---|---|---|---|
| | Homes | GHG | NOx | VOC |
| | # | *tpy* | *tpy* | *tpy* |
| Weatherized | 7,500 | 10,775 | 15 | 0 |

**Source:** The Energy Division of the General Services Department provided the kilowatts of energy consumed. ICLEI's CACP software generated the emissions outputs.

## METRO PASSES FOR CITY EMPLOYEES

The city's employee transit program offers Metropolitan Transit Authority Q Cards to city employees working in downtown Houston, at no cost to the employee.[22] Between 2004 and 2006, employee participation had increased by 20% or 175 employees. The avoidance of driving by the additional employees yielded the emissions reduction indicated in the Table below. This trend of increased participation is expected to continue through 2010.

**Table 4-2: Emissions Reductions from the City's Employee Transit Program**

| | 2010 Projection | Pollutant | | |
|---|---|---|---|---|
| | Participants | GHG | NOx | VOC |
| | # | *tpy* | *tpy* | *tpy* |
| New Riders Since 2004 | 385 | -77 | -5 | -6 |

**Source:** The Human Resources Department provided the number of program participants. Vehicle miles travelled is the product of the number of new riders, each travelling 27 trips per month, 12 months per year, at approximately 29 miles per trip. ICLEI's CACP software produced the emissions outputs shown here.

[22] Designated downtown worksites include 611 Walker, City Hall, City Hall Annex, etc.

## FLEX IN THE CITY

Flex in the city is a program implemented by the City of Houston to encourage employers to try alternative scheduling options such as compressed work weeks, telecommuting to work, and flexible start and end times, eliminating their employees' rush-hour commutes on Houston's roads. While employers measure the effect of Flex in the city on productivity, the city measured the effect on mobility. An improvement in mobility was realized just by moving a relatively small number of cars off the roads during peak congestion periods. Commuters on the North and Southwest Freeways saved 906 peak-commute hours because of the 2006 Flex in the city.[23] While this is primarily a congestion mitigation measure that does not decrease the vehicle miles travelled, the outcome is a notable reduction in the community's emissions because vehicles spend less time idling in traffic.

## POWER TO PEOPLE

The City of Houston, CenterPoint Energy, Wal-Mart, and Sam's Club co-sponsored the launch of the Houston Power to People campaign designed to educate Houstonians on ways to reduce energy consumption and save money. The education campaign began with volunteers going door-to-door to homes in the Houston area handing out compact fluorescent light bulbs (CFLs). In 2007, 10,000 CFLs were distributed. Since the CFLs are used in place of inefficient bulbs, Houston-area residents reduced their greenhouse gas emissions by 365 tpy.[24]

Power to People has displays set up at retail outlets throughout the Houston area to provide information on steps residents can immediately and inexpensively take to minimize energy consumption in their homes. The information is also available at www.houstonpowertopeople.com, which the city developed and maintains.

## BUILDING MATERIALS WAREHOUSE

A 2004-2005 study completed by the Houston-Galveston Area Council of Governments (H-GAC) and Houston Advanced Research Center (HARC), showed approximately 38% of the waste stream in the Houston area is comprised of construction and demolition material. In order to divert some of this waste away from landfills, the City of Houston will build and operate a warehouse to collect and redistribute reusable materials.

Nationally, construction and demolition warehouses are successfully diverting reusable materials and providing community development opportunities. In Houston, the Habitat for Humanity Re-Store and Historic Houston are the two largest, if not the only two existing building material reuse projects in the city. Habitat's Re-Store assists low/moderate income people by providing items to fix or improve their home. Historic Houston's facility targets home builders/remodelers looking to incorporate unique features of homes. The city's building materials warehouse, which will open in the fall of 2008, will be available to non-profit groups needing low-cost materials.

## CLEAN VEHICLE TECHNOLOGY

The Houston Airport System is organizing its tenants to identify ways to improve regional air quality through the Clean Vehicle Technology initiative. The city is gathering a baseline inventory of its tenants' ground fleets, and directing them towards available state and regional grant funds to incentivize reducing emissions and improving air quality.

## CONCLUSION

The above-described strategies will set the course for our commitment to controlling the growth of emissions from city activity while our city continues to grow and prosper. We expect to update this plan periodically and welcome input from all interested parties.

[23] Saving in peak-commute hours taken from www.houstontx.gov/flexworks/flexinthecity/index.html.

[24] ICLEI's CACP software generated the emissions reduction output based on saving 507,600 kWh/year. The annual energy savings is the difference between 10,000, 13 watt CFLs and 10,000 60-watt bulbs that are used for three hours a day.