City of Charleston

Local Action Plan on Climate Change
December 2003

Prepared by: Tommy Linstroth

Cities for Climate Protection Campaign
International Council for Local Environmental Initiatives

Authors Note

Sustainability is an important concept for the 21st century. Increased population and development pressures necessitate a more holistic approach to resource management. Individuals and institutions taking responsibility for the impacts caused by their actions is a primary step in this process. The following report analyzes the City of Charleston's greenhouse gas emissions, as well as evaluates energy and resource use by the municipality.

It took extensive efforts of many individuals to make this report as comprehensive as it is. While there is always room for improvement, this report gives an exceedingly beneficial snapshot of where Charleston has been, where it is currently headed, and the alternative course the City could take, if it so chooses.

Global warming is a very serious issue. Unfortunately, it is also on not currently addressed at the Federal level. However, this opens the door for innovative approaches from a bottom up policy creation process – many opportunities exist for individuals, institutions and municipalities to reduce their effects on the planet.

Tommy Linstroth
Master of Environmental Studies Program
College of Charleston

A special thank you to:

Ryan Bell
Laura Cabiness
Mary Dellucci
Dr. Angela Halfacre
Melissa Ladd
Dr. James Neff
Philip Overcash

And to everyone else that contributed to make this report possible.

Table of Contents

Executive Summary

This report summarizes the results of an audit of total greenhouse gas emissions by the City of Charleston from 1994 – 2002. The emissions are reported in Metric Tonnes Carbon Dioxide Equivalents (MTCDE), according to their Global Warming Potential (GWP), to provide the relative contribution of each gas to global warming.

Climate change refers to "any change in climate over time, whether due to natural variability or as a result of human activity". Variations in climate are influenced by a variety of natural factors including changes in orbital parameters, volcanic activity, solar irradiance, and changes in the composition of the atmosphere. Gases in the atmosphere that reradiate escaping heat back to earth are called "greenhouse gases". This process keeps the earth's surface about 30°C (54° F) warmer than it would be without an atmosphere. Indeed, this phenomenon, known as the "Greenhouse Effect," is a critical component of the many interlocking systems needed to support life on Earth.

However, human activities have led to an "enhanced greenhouse effect," also known as global warming. Overwhelming evidence indicates that global warming is a significant problem that requires direct action from policymakers. In the past century, the concentration of carbon dioxide in the atmosphere has risen almost 30%, with methane more than doubling, and nitrous oxide increasing 15%. The increase of atmospheric CO_2 from 1960-2000 was 54 parts per million (ppm), which far exceeded the 36-ppm rise that occurred from 1760-1960. The majority of greenhouse gas (ghg) emissions are the direct result of burning fossil fuels. Atmospheric scientists almost universally agree that the accumulation of ghg in the atmosphere is responsible for the earth's rising temperature. The United States, with 3% of the world's population, currently contributes 25% of the world's total atmospheric CO_2 emissions.

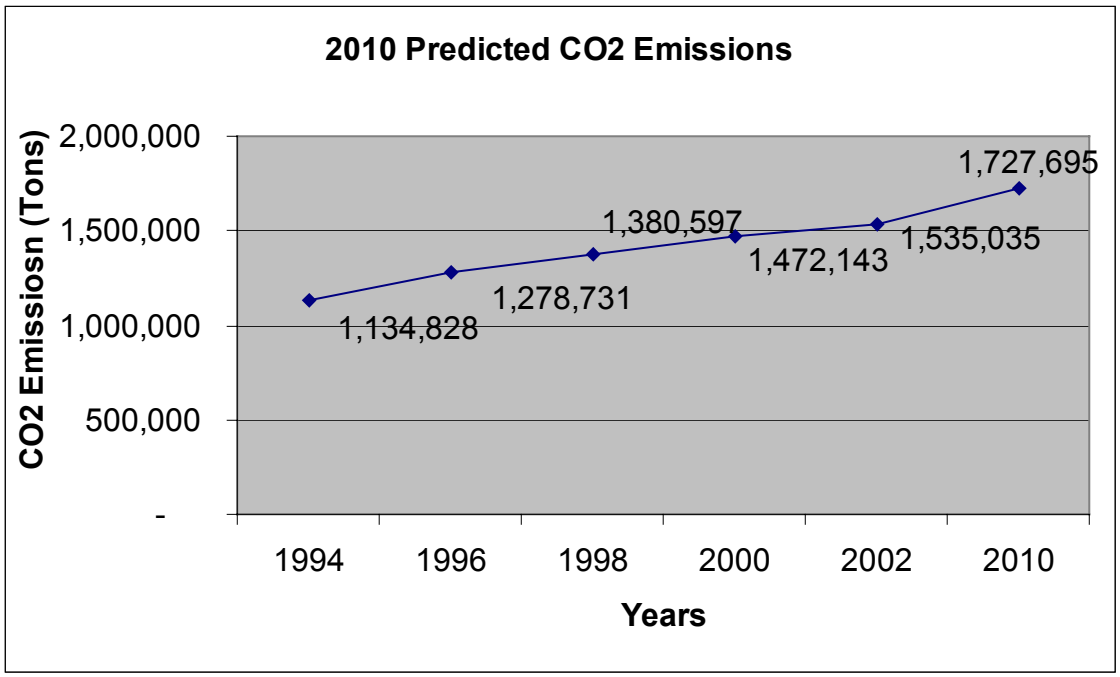
The global average surface temperature has increased over the twentieth century by about 0.6ºC. It is very likely that the 1990s was the warmest decade, and 1998 was the warmest year in recorded history since 1861. The 14 warmest years since record keeping began in 1866 have occurred since 1980. Satellite images show that there was a 10% decrease in snow cover since the late 1960s in the Northern Hemisphere. Northern summer sea-ice extent has decreased by 10-15% and become 40% thinner. Tide gauges have shown that the global average sea level rose 0.1-0.2 meters during the twentieth century.

Global warming is an especially relevant issue for Charleston because climate change can lead to a rise in sea level and increased frequency and intensification of hurricanes, both direct threats to the livability and attractiveness of Charleston.

The purpose of this project was to establish a baseline level of emissions originating in Charleston, but from municipal operations and from the city as a whole. Based on these findings, appropriate policy initiatives can be developed and implemented to decrease greenhouse gas emissions below the 1994 level.

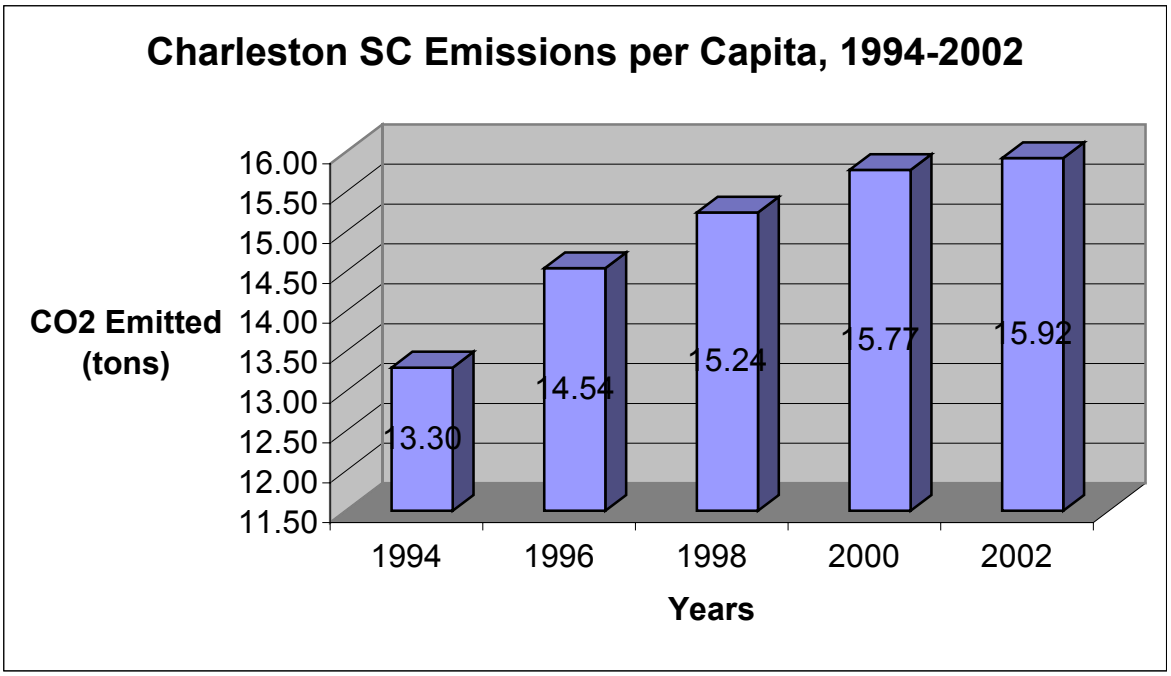
City of Charleston Emissions: Major Findings

- Charleston emitted 1,535,035 Metric Tonnes of Carbon Dioxide Equivalents in 2002
- There has been a 35% net increase in greenhouse gas emissions from 1994 – 2002.
- In a business as usual scenario, Charleston is predicted to emit 1,727,695 tons of CO2 in 2010, a net increase of 52% over 1994 levels.



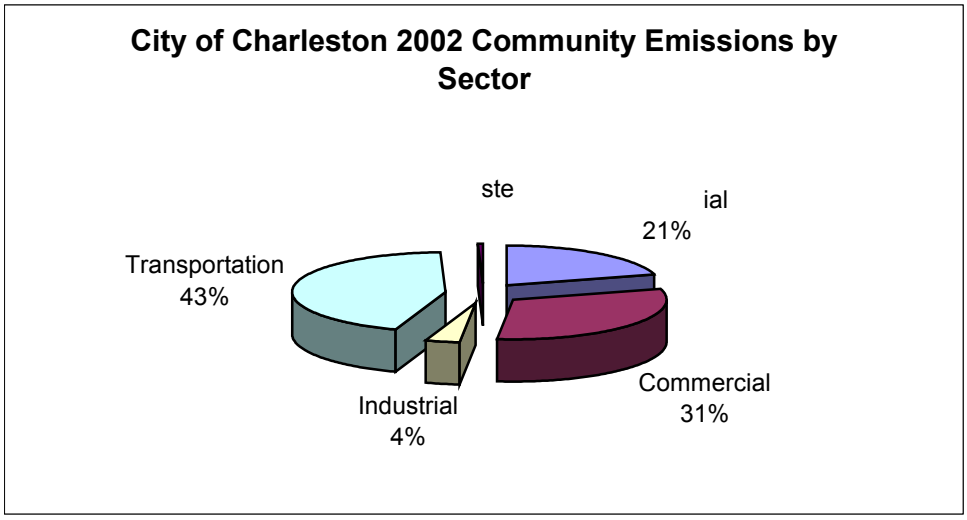
Charleston, SC Predicted 2010 Emissions

- Population increased 13% from 1994 through 2002. However, population increases have not accounted for the increase in CO_2 generated.
- Emissions during the same timeframe increased 35%, almost triple the rate of population growth.
- Emissions per capita increased from 13.3 tons of CO_2/person in 1994 to 15.9 tons of CO_2/person in 2002.



Charleston, SC Emissions/Capita, 1994-2002 (Tons of CO_2/Person)

The primary source of Charleston's GHG emissions stem from the transportation sector (47%).The commercial sector accounts for 30% of emissions, residential 20%, with industrial and waste responsible for the remaining 3% of greenhouse gas emissions.



Charleston, SC Emissions by Sector, 2002

Conclusions

Charleston's greenhouse gas emissions have been steadily increasing throughout the 1990s and early 2000s. The growth in emissions far exceeds the rate of population growth, and emissions per person have risen a substantial amount as well. The City has implemented some efficiency measures to reduce municipal emissions, but the fact remains that the city of Charleston as a whole has not taken many steps to reduce greenhouse gas emissions. However, that leaves the door wide open for a variety of possibilities that exist that will not only reduce greenhouse gas emissions, but will improve the quality of life for all citizens in the Charleston area.

Recommendations

The City of Charleston is presented with the opportunity to implement greenhouse gas reducing measures that are not only good for the environment, but that also carry long-term financial incentives. Increasing citywide sustainability should also be a driving concept for such a well run and respected municipality. Such concepts truly set cities apart, and this is an opportunity for Charleston to assume the leadership role of sustainability in the Southeast. To reduce emissions, increase sustainability and improve the quality of citizen life, the following recommendations are some of the options available that should be considered. Case studies may be provided to demonstrate where such programs have had success in the past.

1. **Creation of an Office of Energy Efficiency.**

This office will oversee all the recommendations included in the Local Action Plan, as well as become a central source for energy tracking throughout all sectors of the community. They will also create an energy policy. A comprehensive energy policy can help to galvanize support for energy conservation in all sectors of the community. By adopting an energy policy, the local government goes formally on record in support of conservation measures, and promotes future efforts to integrate them in building and planning decisions. The current structure provides no tracking system to monitor energy/fuel use and cost, preventing effective planning and reduction strategies from being implemented. This office can also seek out grants to continue to improve Charleston's greenhouse gas reduction programs while improving residents' quality of life.

2. **Environmentally Preferable Products Procurement Program**

U.S. State and local governments spend $30 to $40 billion a year on energy consuming products and equipment. By ensuring that these products are energy efficient, governments can reduce their energy bills while also cutting pollution from electricity generation. Energy Star is a voluntary labeling partnership between the U.S. EPA and industry certifying and promoting energy efficient products. The Energy Star label makes it easy to identify products that save money and prevent pollution, and Energy Star products are available from almost all manufacturers at the same cost as more energy-

intensive models. Thus advocating EnergyStar products in the City's procurement policy protects the environment without compromising quality or price.

Results

- Each Energy Star computer and monitor that replaces a non Energy Star unit save nearly 1 ton of CO2 per year
- Each Energy Star office product saves $15 to $25 per year in energy costs

3. Green Fleets

The City and County of Denver operate a combined fleet of 3,500 vehicles. Faced with rising fuel costs, increased air pollution, and Federal mandates to clean the city's air, Denver enacted the "Green Fleets" executive order on Earth Day in 1993.

Elements of a Green Fleet: As a result of this order, fleet managers must purchase the most cost-effective and lowest emission vehicle possible, while meeting operational requirements of the agency. In order to accomplish this goal, fuel efficiency standards are included in procurement specifications. The Green Fleets process also includes reducing vehicle size and eliminating old and underused vehicles. The effectiveness of the program is measured by fleet energy use and CO2 emissions. Originally the program set targets of 1% and 1.5% annual average reductions in fuel expenditures and CO2 emissions, respectively. After achieving substantial reductions the order was revised in 2000, and new goals were targeted to provide more flexibility.

Denver's Results

- Offset the City's fleet growth by 10 vehicles and downsized 13 others
- Saved $40,000 in operation and maintenance costs
- Saved up to $100,000 in capital costs by not purchasing some of the vehicles requested
- Prevented the emission of 10-15 tons of CO2

4. Implement Biodiesel for Fleet Vehicles

In 2002, the City of Charleston used 182,283 gallons of diesel fuel in fleet vehicles, causing 1,942 tons of CO2 to be emitted. Implementing cleaner burning biodiesel (described below) for municipal purposes would reduce that number by half, preventing 971 tons of CO2 emissions.

Biodiesel is a renewable, non-toxic fuel derived from vegetable oils such as soybean oil and canola oil, as well as recycled cooking oil. It can be blended with diesel fuel in any proportion or used in its pure form, and is commonly used in a 20% blend with petroleum diesel known as B20.

The Department of Energy published a final rule allowing the use of biodiesel credits for the alternative fuel transportation program. This rule allows States to purchase and use

biodiesel as a means of satisfying their Alternative Fuel Vehicle (AFV) purchase requirements.

This would also create a market for public consumption of biodiesel in Charleston. In 2002, travelers used 5 million gallons of diesel fuel, emitting 53,928 MTCDE. By creating a supply for biodiesel, it could then be offered to the public for use in their vehicles.

Introduction

Climate change refers to "any change in climate over time, whether due to natural variability or as a result of human activity" (IPCC, 2001). Variations in climate can be influenced by a variety of natural factors including changes in orbital parameters, volcanic activity, solar irradiance, and changes in the composition of the atmosphere. Some gases in the atmosphere that reradiate escaping heat back to earth are called greenhouse gases. This process keeps the earth's surface about 30°C (54° F) warmer than it would be without an atmosphere (Hinrichs, 2002). Indeed, this phenomenon, known as the "Greenhouse Effect," is a necessary component of the many systems needed to support life on Earth.

However, human activities have led to an "enhanced greenhouse effect," also known as global warming. Considerable evidence indicates that global warming is a significant problem and an area that requires direct action from policymakers. In the past century, the concentration of carbon dioxide in the atmosphere has risen almost 30%, with methane more than doubling, and nitrous oxide increasing 15% (Hinrichs 2002). The increase of atmospheric CO_2 during the 40 years from 1960-2000 was 54 parts per million (ppm), which far exceeded the 36-ppm rise that occurred during the 200 year time span from 1760-1960 (Brown 2001). The majority of greenhouse gas (GHG) emissions are the direct result of burning fossil fuels.

Atmospheric scientists assert that the accumulation of GHG in the atmosphere is responsible for the earth's rising temperature. The United States, with 3% of the world's population, currently contributes 25% of the world's total atmospheric CO_2 emissions (Hertsgaard 2000).

While it is unclear exactly what the impacts of a rapidly warming planet will be, it is clear that there will be significant changes. In fact, the Intergovernmental Panel on Climate Change (IPCC) states that human emissions of greenhouses gases will continue to alter the atmosphere in ways that are expected to affect the climate. There are many gases that contribute to the greenhouse effect, some directly and others indirectly. The most important of these gases have been identified by the IPCC. International agreements such as the Kyoto Protocol focus the attention of the global community on these gases that should be reduced to curb the "enhanced greenhouse effect." The primary anthropogenic greenhouse gases are:

Carbon dioxide	**CO_2**
Methane	**CH_4**
Nitrous oxide	**N_2O**
Halocarbons	**PFCs and HFCs**
Sulfur Hexaflouride	**SF_6**

Carbon Dioxide (CO_2) – Carbon is a continually cycling element that moves between the atmosphere, ocean, land biota, marine biota, and mineral reserves. In the atmosphere, carbon exists primarily as carbon dioxide, which is a part of global biogeochemical

cycling. The atmospheric concentration of CO_2 has increased by 31% since 1750 and is likely the highest it has be in the past 20 million years. About three quarters of anthropogenic CO_2 emissions are from burning fossil fuels; the other quarter from land-use changes, primarily deforestation.

Methane (CH_4) – Methane is produced primarily through anaerobic decomposition of organic matter in living systems. Anthropogenic releases of methane occur from use of fossil fuels, cattle, rice agriculture, and landfill gas emissions. The atmospheric concentration of CH_4 has increased 151% since 1750 and continues to increase. The present concentration has not been exceeded during the past 420,000 years.

Nitrous Oxide (N_2O) – Nitrous Oxide is also produced with the combustion of fossil fuels, as well as in agriculture and some industrial processes. N_2O concentrations have increased 17% since 1750, and current concentrations of N_2O in the atmosphere have not been exceeded in the past thousand years.

Others: Hydrofluorocarbons, Perfluorocarbons, and sulfur hexaflouride (HFC, PFC, SF_6) – Halocarbons are primarily produced for industrial processes. HFCs were introduced as replacements for ozone-depleting substances, primarily as refrigerants. HFCs and SF_6 are used in aluminum smelting, electric power distribution, and magnesium casting. These chemicals are powerful greenhouse gases with long atmospheric lifetimes, and their atmospheric concentrations are increasing (IPCC, 2001).

Global Warming and South Carolina

The EPA (http://yosemite.epa.gov/oar/globalwarming.nsf/content/ImpactsStateImpactsSC.html) has listed seven areas where South Carolina will potentially be adversely affected by global warming, including: local climate change, human health, water resources, agriculture, forests, and ecosystems.

Local Climate Change

Over the last century, the average temperature in Columbia, South Carolina, has increased 1.3°F, and precipitation has increased by up to 20% in many parts of the state. Over the next century, climate in South Carolina may change even more. For example, based on projections made by the IPCC, by 2100 temperatures in South Carolina could increase by 3°F (with a range of 1-5°F) in all seasons, and precipitation could increase by 15% (with a range of 5-30%) in spring, slightly more in summer and fall, and slightly less in winter.

Human Health

Higher temperatures and increased frequency of heat waves may increase the number of heat-related deaths and the incidence of heat-related illnesses. The elderly, particularly those living alone, are at greatest risk. Also, mosquito populations in South Carolina that carry malaria and eastern equine encephalitis in warmer and wetter conditions could increase, thus increasing the risk of transmission if these diseases are introduced into the

area. In addition, warmer seas could contribute to the increased intensity, duration, and extent of harmful algal blooms, also known as red tides. These blooms damage habitat and shellfish nurseries, can be toxic to humans, and can carry bacteria like those causing cholera. Brown algal tides and toxic algal blooms already are prevalent in the Atlantic. Warmer ocean waters could increase their occurrence and persistence.

Coastal Areas

There are 2,876 miles of tidally influenced shoreline in South Carolina. Sea level rise could lead to flooding of low-lying property, loss of coastal wetlands, erosion of beaches, saltwater contamination of drinking water, and decreased longevity of low-lying roads, causeways, and bridges. In addition, sea level rise could increase the vulnerability of coastal areas to storms and associated flooding.

Water Resources

Along the Coastal Plain, increased groundwater pumping in areas such as Hilton Head, Beaufort, and Myrtle Beach has resulted in saltwater intrusion into freshwater aquifers. Increased use of groundwater for irrigated agriculture in the Coastal Plain also has resulted in declining groundwater levels and may have accelerated the formation of sinkholes in the region's limestone terrain. These conditions, particularly if accompanied by sea level rise, could be exacerbated by warmer, drier conditions.

Higher rainfall could mitigate these effects, but would contribute to localized flooding. Higher rainfall also could increase erosion and exacerbate levels of pesticides and fertilizers in runoff from agricultural areas. It also could increase pollution in runoff from urban areas. The effect of buried hazardous wastes on groundwater quality, particularly in Barnwell County and near the Savannah River Plant, is a concern in South Carolina.

Agriculture

The mix of crop and livestock production in a state is influenced by climatic conditions and water availability. As climate warms, production patterns could shift northward. Increases in climate variability could make adaptation by farmers more difficult. Warmer climates and less soil moisture due to increased evaporation may increase the need for irrigation. However, these same conditions could decrease water supplies, which also may be needed by natural ecosystems, urban populations, industry, and other users

Forests

Trees and forests are adapted to specific climate conditions, and as climate warms, forests will change. These changes could include changes in species composition, geographic range, and health and productivity. In South Carolina, longleaf and slash pine forests are likely to expand northward, and could replace some of the forests currently dominated by loblolly and shortleaf pines. Maritime forests, important for their recreational and aesthetic value and for their role in coastal hydrology, could be adversely affected by changes in the frequencies of large storms associated with climate change (hurricanes in the late summer and fall, nor'easters in the winter and spring). Warmer and drier conditions could increase the frequency and intensity of fires, and result in increased

impacts on important commercial timber areas. Even warmer and wetter conditions could stress forests by increasing the survival of insect pests.

Ecosystems

South Carolina is dominated by coastal ecosystems that provide critically important habitat for endangered and threatened species, including: the American alligator, Bachman's warbler, bald eagle, brown pelican, loggerhead sea turtle, piping plover, red-cockaded woodpecker, shortnose sturgeon, and woodstock.

Sea level rise under a changed climate could threaten many low-lying coastal ecosystems. A study in the Cape Romaine National Wildlife Refuge revealed that at the current rate of sea level rise (9 inches per century), the refuge's marshlands and barrier islands could be reduced in size by as much as 58% by 2100. Changes in climate could increase this rate. Endangered birds such as the Bachman's warbler and red-cockaded woodpecker will lose more than 50% of their habitat. The intrusion of seawater from rising seas also will threaten the viability of freshwater systems. Important wetland habitats include Carolina bays and pocosins, both of which contain a number of endangered plants, many with restricted ranges. Extensive human coastal development is an impenetrable barrier to the landward migration of coastal wetland habitats

A 4°F increase in average temperature could substantially reduce brook trout populations in South Carolina, where they are currently at the southern limit of their distribution. Habitat for warm water fish could also be reduced by hotter temperatures. Terrestrial habitats include large areas of oak-hickory-pine forest and the extreme southern part of the Appalachian highlands. In the forests of the western part of the state, pine seeds and seedlings, able to tolerate extreme environmental conditions, may come to dominate hardwood stands at the expense of oak and hickory.

Direct Effects of Global Warming on Charleston

Charleston is in direct danger of feeling the effects of global warming, especially the rise in sea level resulting from the melting of polar ice caps. For example, a one-meter rise in sea level would cause a coastline retreat of 1500 meters, potentially costing the city billions of dollars (Brown 2001). For the Charleston area, scientists have estimated that the total sea level rise since 1922 has been 0.1 in/year (Hicks, 1983). Chart A to the right shows the predicted sea level rise in Charleston, with the high and low probabilities for reference. Even if current atmospheric concentrations of GHG remains constant, sea level in the Charleston area is expected to rise .9-2.1 feet by 2025, and 2.9-7.6 feet by 2075. This rise in sea level will inundate the nearest 250 feet of land by 2025, and up to 4000 feet by 2075. Under this scenario, only the central part of the peninsula would be above the intertidal zone (Kana et. al.). This not only pushes the coastline inwards, it increases city flooding and

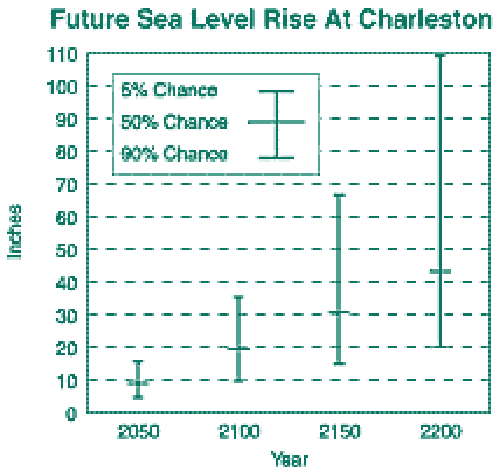


Chart A: Sea Level Rise at Charleston, SC

susceptibility to storm damage.

A rise in sea level would inundate wetlands and lowlands, accelerate coastal erosion, exacerbate coastal flooding, threaten coastal structures, raise water tables, and increase the salinity of rivers, bays, and aquifers (Bath and Titus, 1984, in Titus, et al. 1991). James Titus et al. conducted a nationwide assessment of the primary impacts of a two to seven foot rise in sea level on the United States. Looking at the costs associated with sea level rise including the cost of protecting ocean resort communities by pumping sand onto beaches and gradually raising barrier islands in place, the cost of protecting developed areas along sheltered waters through the use of levees and bulkheads, and the loss of coastal wetlands and undeveloped lowlands, the researches estimate the total cost for a one-meter rise in sea level would be $270-475 billion for the country (Titus et al. 1999). At Charleston, the cumulative cost of sand replenishment to protect the coast of South Carolina from only a 20-inch sea level rise by 2100 is estimated at $1.2-$9.4 billion (EPA).

Intensification of natural disasters and weather anomalies is a second risk of global warming directly relevant to Charleston (IPPC 2001). According to researchers at the National Oceanic and Atmospheric Administration, “The strongest hurricanes in the present climate may be upstaged by even more intense hurricanes over the next century as the earth's climate is warmed by increasing levels of greenhouse gases in the atmosphere” (Knutson, 1998). Most hurricanes do not reach their maximum potential intensity before weakening over land or cooler ocean regions. However, those storms that do approach their upper-limit intensity are expected to be up to 5-12% stronger and have more rainfall in the warmer climate due to the higher sea surface temperatures (Knutson, 1998). Charleston has already experienced the effects of an intensification of weather events with Hurricane Hugo in 1989. Not only does the intensity of weather events increase, there is evidence that there will be an increase in the frequency of extreme weather events as well. With over one billion dollars in damages occurring from Hurricane Hugo, intensification of weather events due to global warming should be a prominent issue on local policymakers’ agendas.

The International Council for Local Environmental Initiatives and the Cities for Climate Protection Campaign

While the United States government has not taken a steadfast approach in curbing GHG emissions, cities and communities across the country have taken their initiative in this direction. Created in 1990 at the United Nations Congress of Cities for a Sustainable Future, the International Council for Local Environmental Initiatives (ICLEI) is an international non-profit association of local governments dedicated to addressing environmental problems through local actions. Currently more than 560 local governments from around the world are participating, implementing innovative environmental management procedures at the local level. ICLEI provides these local agencies with training, technical assistance and information resources and exchange by encouraging the development of a comprehensive framework for addressing regional and global environmental problems.

The Cities for Climate Protection (CCP) Campaign is an ICLEI program that was initiated in January 1993 at the First Municipal Leaders Summit on Climate Change in New York. CCP is a program assisting cities and counties in reducing the emissions that causes global warming and air pollution. Any city or county can join the CCP by passing a legislative resolution. Participants in the CCP commit to reducing local emissions that contribute to global warming by working through five CCP milestones: 1 – conduct a local emissions inventory, 2 – adopt an emissions reduction target, 3 – draft an action plan to achieve the target, 4 – implement the action plan, and 5 – evaluate and report on progress. This document marks the completion of the third milestone.

When CCP began in 1993, 14 cities became pioneers in preventing climate change through local government actions. As of March 31, 2003 over 140 cities and municipalities have passed a resolution to participate in the CCP. During the summer of 2000, Charleston Mayor Joseph P. Riley signed a resolution entitled Cities for Climate Protection Campaign, which was adopted by the City Council at its June 27, 2000 meeting (See Appendix A). This resolution committed Charleston to work through the five-milestone process dictated by the CCP resolution (Cities for Climate Protection Resolution, 2000).

The Cities for Climate Protection Campaign goal is to reduce greenhouse gas emissions resulting from the burning of fossil fuels and other anthropogenic activities that contribute to global warming and air pollution. Actions that reduce these emissions not only protect the global climate but also improve the quality of life in local communities. Improving local air quality is an important concern for the Charleston area. A recent study by the American Lung Association rated Charleston's air quality a "D", one of the lowest scores in the region (Behre, 2000). The negative effects of air pollution range from increased asthma and respiratory conditions to acid rain and increased smog.

Local governments play a key role because they directly influence and control many of the activities that produce these emissions. Decisions about land use and development, investments in public transit, energy-efficient building codes, waste reduction and recycling programs all affect local air quality and living standards as well as the global climate. The CCP Campaign is an opportunity for cities and counties to take practical steps, which reduce greenhouse gas emissions and generate multiple benefits for their communities.

CCP emissions reduction efforts focus on three of the five aforementioned primary greenhouse gases: carbon dioxide (CO_2), methane and nitrous oxide. CO_2 and N_2O are released when fossil fuels are burned, primarily oil for automobile use, and coal and natural gas for electricity production. Methane is emitted in urban areas when garbage and waste products decompose, predominantly in landfills. While the absolute volume of methane molecules produced is not comparable to the volume of CO_2 molecules produced, the relative impact of methane on global warming is much greater. This is because a methane molecule has 21 times the global warming potential (GWP) as a CO_2 molecule (Hinrichs 2002). Similarly nitrous oxide has 310 times the GWP of CO_2. GWP

is related to a given molecule's ability to absorb thermal radiation relative to that of a single molecule of CO_2 (Hinrichs 2002). There is widespread scientific agreement that the increasing quantity of these gases in the atmosphere from human activities is causing worldwide temperatures to rise and increasing the frequency and severity of extreme weather events (ICLEI 2000).

Charleston has completed the first three milestones of the CCP campaign. This action plan includes the results of the emissions inventory, and explains the reduction target. See Appendix A for how the emissions inventory was conducted.

Overall Results

Charleston's emissions have been growing steadily throughout the past decade (See Figure 1). These emissions are the total carbon dioxide equivalents resulting from residential, commercial and industrial activities, transportation and municipal solid waste.

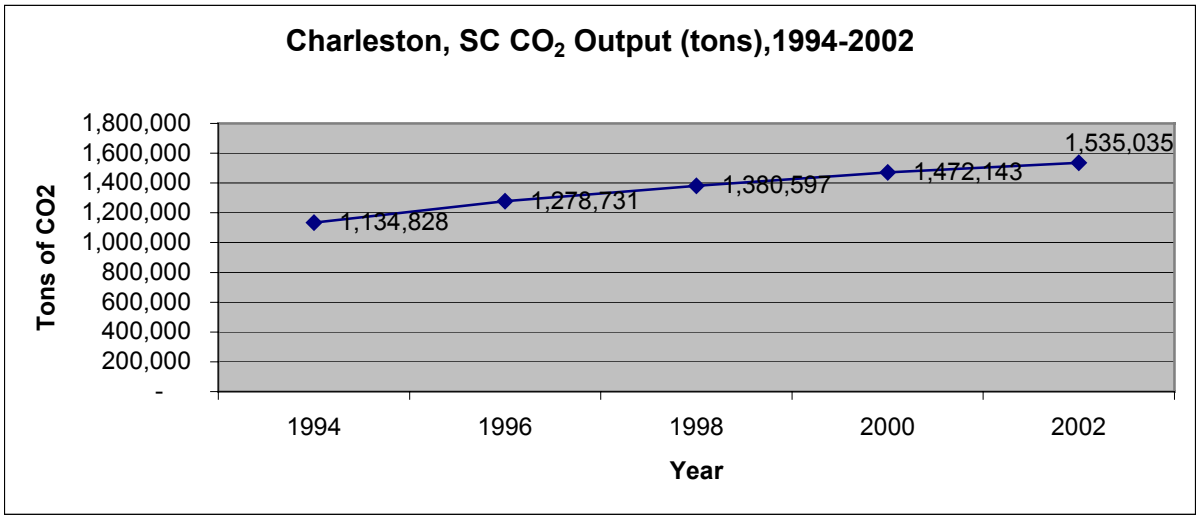


Figure 1: Charleston, SC Greenhouse Gas Emissions in CO_2 Equivalents, 1994-2002.

Population of the City of Charleston increased 13% from 1994 through 2002. However, CO_2 generated far exceeded population increases. Emissions during the same eight years increased 35%, almost triple the rate of population growth. Emissions per capita increased from 13.3 tons of CO_2/person in 1994 to 15.9 tons of CO_2/person in 2002 (see Figure 2).

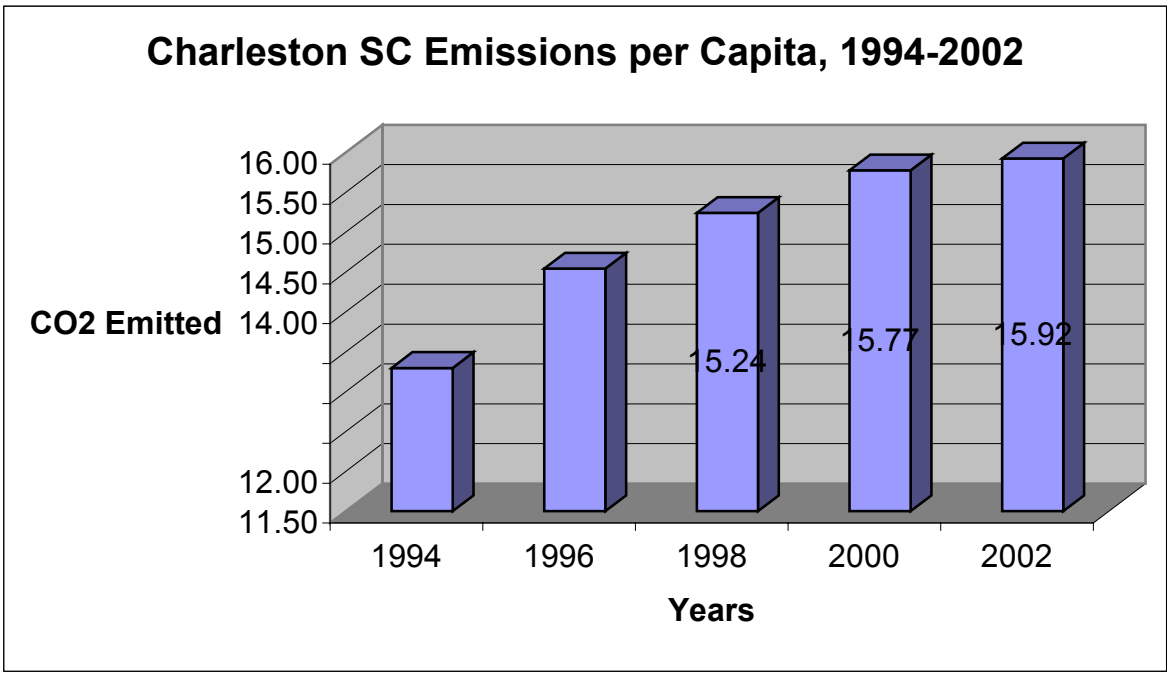


Figure 2: Charleston, SC Emissions/Capita, 1994-2002 (Tons of CO_2/Person)

The primary source of Charleston's GHG emissions stem from the transportation sector (47%, see Figure 3). The commercial sector accounts for 30% of emissions, residential 20%, with industrial and waste responsible for the remaining 3% of greenhouse gas emissions.

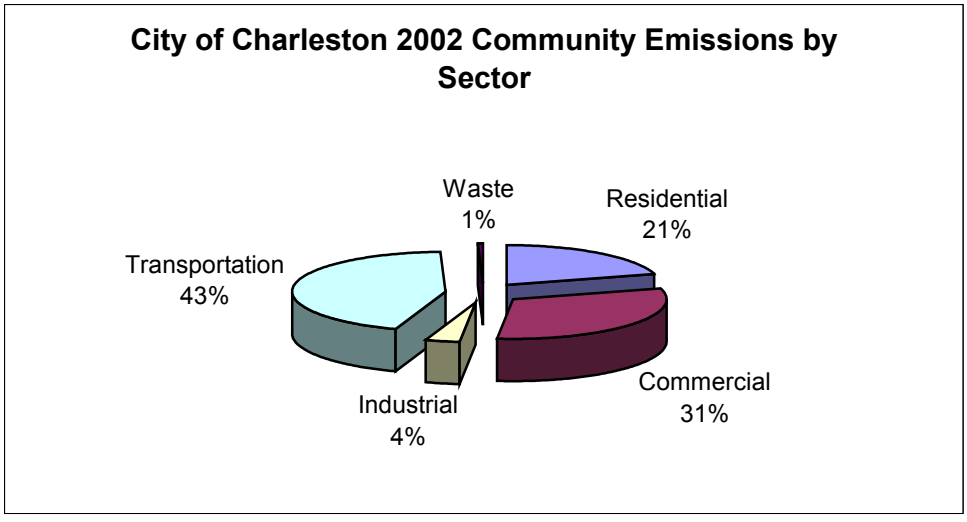


Figure 3: Charleston, SC Emissions by Sector, 2002

One Option for 2010 – Business As Usual

Charleston has seen a trend toward emissions reductions since 1994. Over two year periods, increases in emissions have been on a downward trend. Emissions increased 12.7% from 1994 to 1996, 8% from 1996 to 1998, 6.6% from 1998 to 2000, and finally only 4.3% from 2000 to 2002. While this is a positive trend, 2002 emissions are still 35% higher than 1994 emissions, and emissions per capita were 19.6% higher in 2002 than in 1994 (See Figure 2). Even if Charleston's emissions per two-year period continue to be reduced to 3%/year, emissions in 2010 will be 52.2% higher than 1994 emissions (See Figure 4).

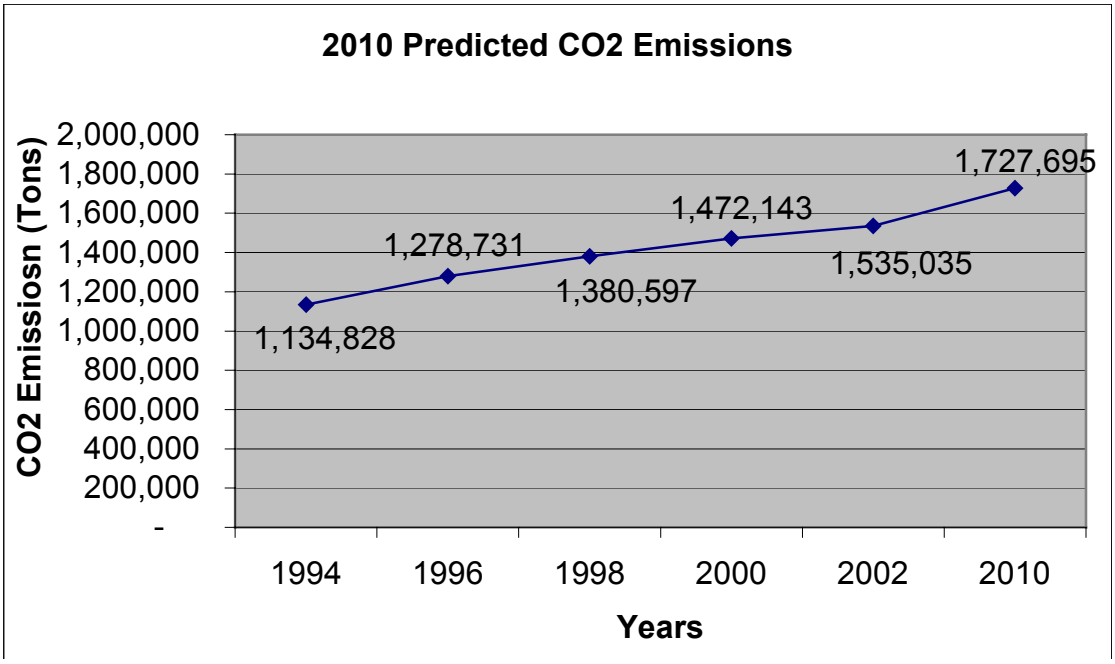


Figure 4: Charleston, SC Predicted 2010 Emissions

Climate Protection Option for 2010 – Target Reduction Goal

A goal of reducing Charleston's greenhouse gas emissions to 10% below 1994 levels is a very ambitions goal, requiring a net decrease of 33.5% of 2002 emissions, and a reduction of 513,690 tons of CO2 equivalents. There are many benefits of a global warming strategy that go beyond environmental concerns. Emission reduction actions complement other economic and environmental goals of the city. In addition to reducing air pollution and improving health, these actions will provide cost-effective electric power and natural gas services, increase reliance on renewable resources, reduce energy bills for businesses and individuals, expand recycling, reduce urban sprawl and traffic congestion, and promote tree planting. All of these benefits enhance the city's livability.

Municipal Emissions

Municipal emissions were calculated using a base year of 2001, as that was the extent of the information available. Two years of data can still give a snapshot of the municipality's emissions, and can serve as an indicator of past growth (See Table 1). Municipal emissions, which include emissions generated by City buildings, vehicle fleet, employee commute, streetlights, and waste, have increased 1.5% from 2001 to 2002. However, costs attributed to the sources of the emissions have increased 7.8%. The costs include electricity and natural gas for buildings, electricity for streetlights, and fuel costs for commuters and the vehicle fleet.

Year	eCO2 Output (Tons)	Cost (in thousands)
2001	21237	$ 2,885
2002	21547	$ 3,111

Table 1: Charleston, SC Municipal Emissions and Cost, 2001-2002

The primary source of Charleston's municipal emissions is buildings, contributing 42% of total emissions (See Figure 5). Streetlights and vehicle fleet each contribute 19%, with employee commute 18% and waste generated by City employees responsible for 2%.

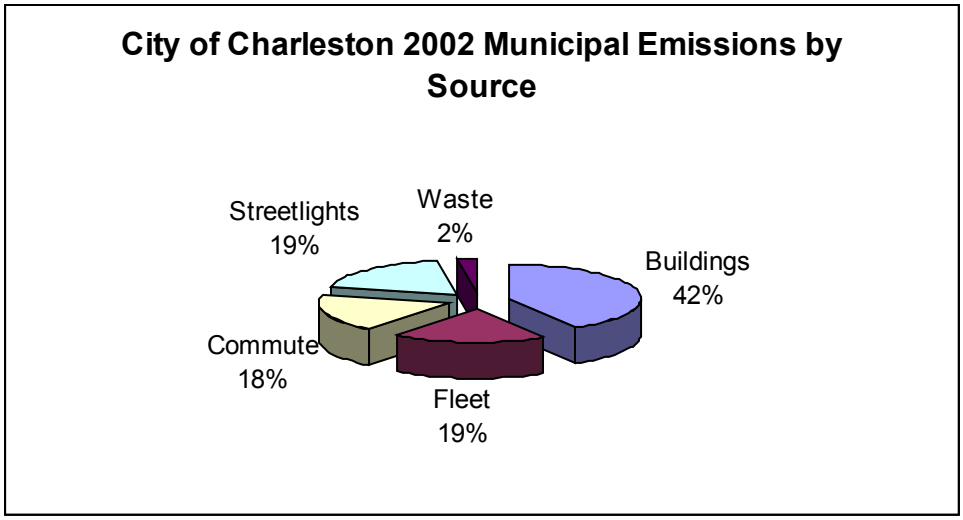


Figure 5: Charleston, SC Municipal Emissions by Source, 2002

Buildings

According to the emissions inventory, buildings are the largest emitter of greenhouse gases for municipal operations. However, there has been a decrease in the amount emitted from 2001 to 2002. This can be attributed to energy efficiency measures taken by the City. Charleston entered into a Contract with Johnson Controls in 2001 to increase energy efficiency of municipal buildings, and there has already been a 1% reduction in

emissions from buildings. A detailed explanation of energy efficiency measures implemented by the City can be found below.

Year	Building Emissions (tons of eCO2)
2001	9057
2002	8980

Scope of Work for Energy Conservation Measures

Lighting Retrofits

Lighting was upgraded in the 20 buildings specified in Appendix II, to include the latest in high efficiency technology, including T8 lamps, electronic ballasts, reflectors, compact fluorescents and exit fixture LED retrofit kits.

Mechanical Retrofits

Provided mechanical retrofits at several facilities as follows:

Gaillard Auditorium – chiller and pump replacements, Ticket Office ventilation, air handler, damper and valve repairs, and ductwork cleaning.

Lockwood Municipal Auditorium – restored outside air ventilation, and air handler, damper and valve repairs.

City Hall – variable frequency drives in the Council Chamber.

Department of Finance and Procurement – replaced flow switch and cleaned duct work.

City Gym – replaced air-handling unit.

Visitor's Center – increased condenser airflow.

Dock Street Theatre – new roof top chiller, replaced air-handling unit, new chilled water pump and piping, duct cleaning and repair.

Controls Retrofits

Provided controls retrofits at several facilities as follows:

Gaillard Auditorium – installed energy management system and work station to manage outside air and start/stop schedule.

Lockwood Municipal Auditorium – installed energy management system to manage outside air and start/stop schedules.

City Hall – installed energy management system to manage outside air and start/stop schedules.

Department of Finance and Procurement – installed energy management system to manage outside air and start/stop schedules including thermostats with night setback.

Eastside Community Center – installed thermostats with night setback.

Coke Building – installed Metasys workstation.

Dock Street Theatre - installed energy management system to manage outside air and start/stop schedules.

City Gym - installed thermostats with night setback.

Water Retrofits

Installed low flow water devices in 20 buildings, including low flow urinals and water closets, low flow shower heads, aerators on sinks, and pedal valves on kitchen sinks.

Other Retrofits

Replaced damaged ceiling tiles at Gaillard Auditorium, and replaced the Mayor's office window.

Vehicle Fleet

The City's vehicle fleet is responsible for 19% of municipal emissions, which grew 6.6% since 2001. Please note, emissions from the Charleston Police Department and Fire Department were not included in the emissions inventory.

Year	Fleet Emissions (tons of eCO2)
2001	3838
2002	4092

Employee Commute

Employee commute contribute 18% of Charleston's municipal emissions. Employee commute emissions was computed through a web survey of City of Charleston employees, detailing daily commute distance, average vehicle fuel efficiency, and fuel type.

	Commute Emissions (tons of eCO2)
2001	3828
2002	3946

Streetlights

Streetlight data was only available for 2002. The same number was used for 2001 for computation purposes, so it is not valid for comparison. However, as there are 8935 streetlights that make up 19% of municipal emissions, they are an important contributing factor.

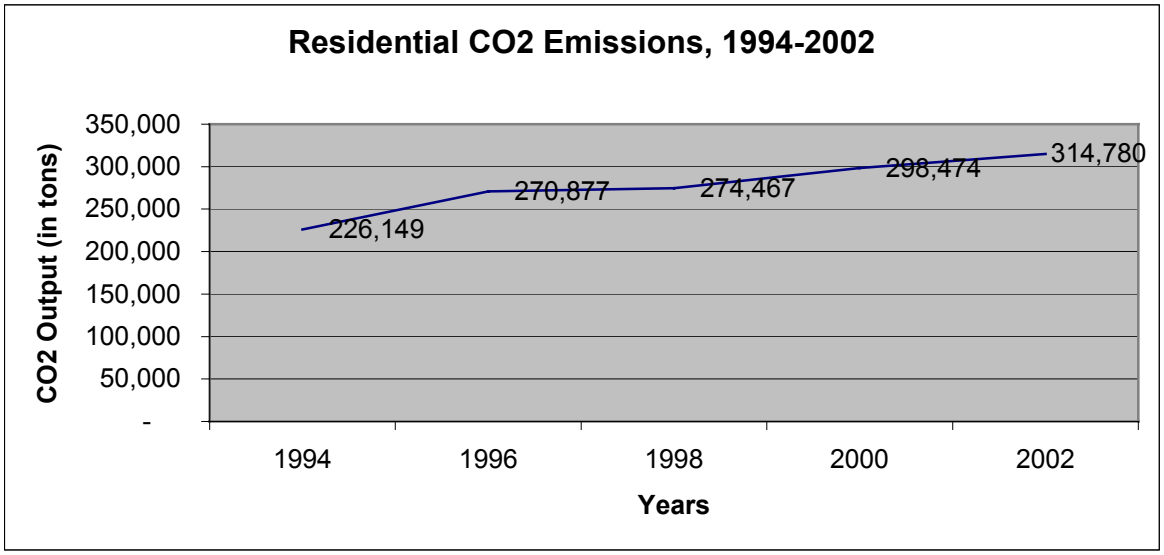
Waste

Waste numbers were unavailable for City of Charleston employees, so national averages provided by ICLEI were used. The waste was calculated on a per employee basis, so the increase in waste is attributed to an increase in employees.

Community Emissions

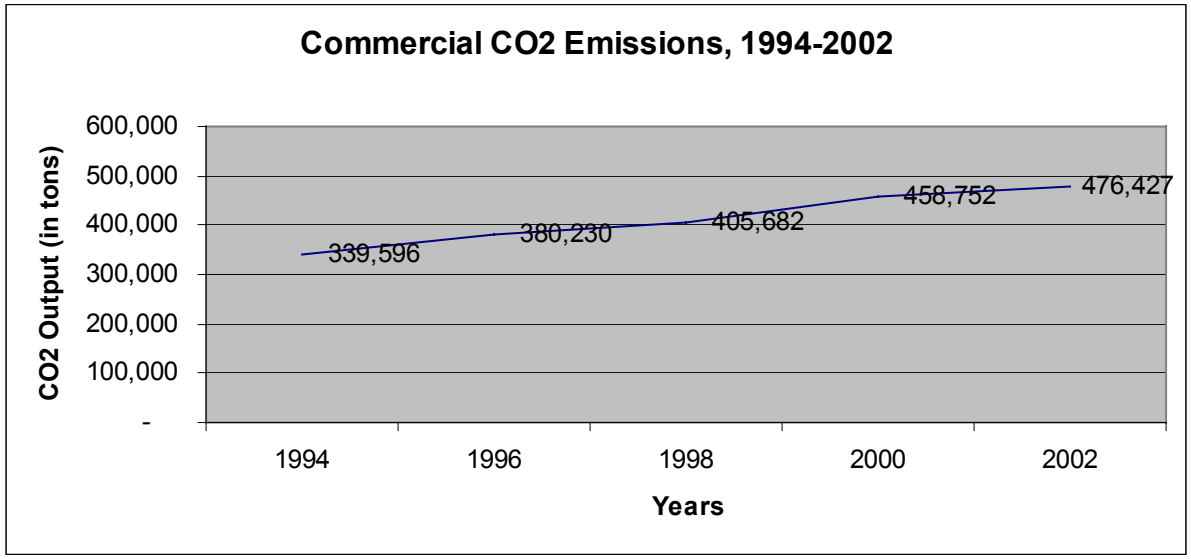
Residential

Residential CO_2 emissions have increased 40% since 1994, while the number of households has only increased 1.6%.



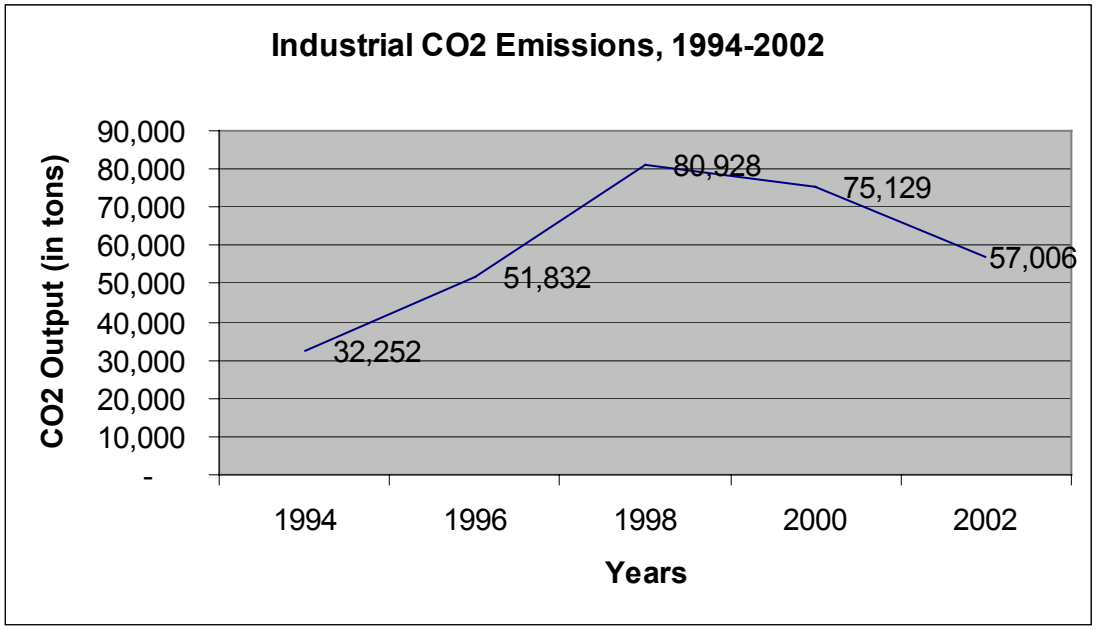
Commercial

Commercial CO_2 emissions have increased 40% since 1994, while the number of commercial customers increased only 3%.



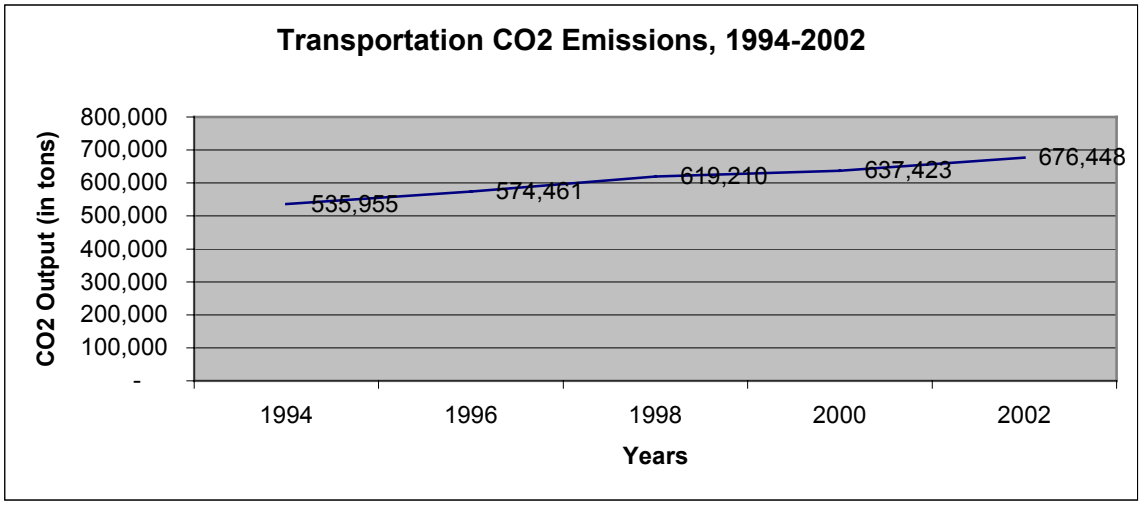
Industrial

Industrial CO_2 emissions peaked in 1998 with a 150% increase over 1994 emissions. Emissions have since decreased, but are still 77% higher than 1994 emissions, and still exceeded the 41% increase in industrial consumers during the same time period.



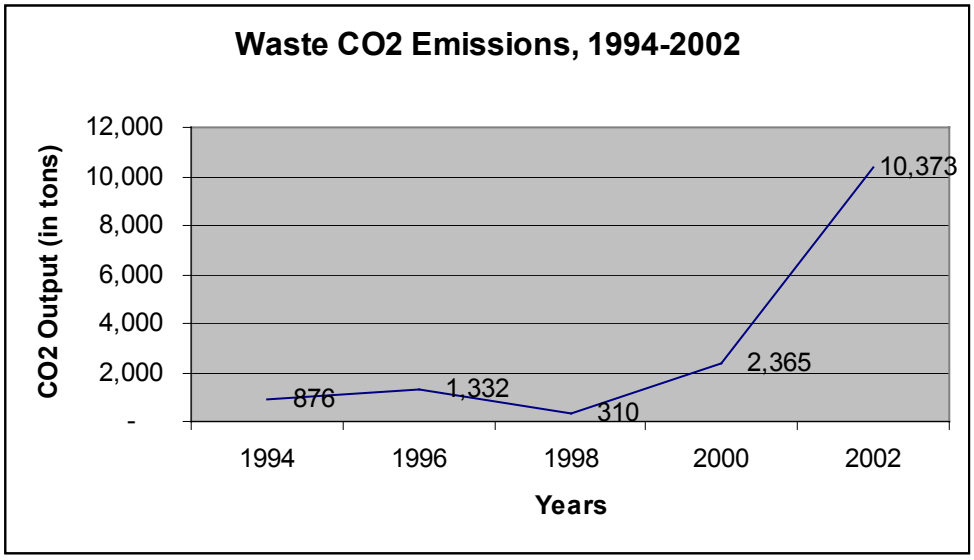
Transportation

Transportation emissions have increased 26% since 1994, and are the leading source of Charleston's GHG emissions. This emphasizes the dependence on automobiles in the Charleston area, leading not only to increased CO_2 emissions, but also to parking problems and more traffic congestion, a leading factor in lost work time. Automobile emissions are also a leading contributor to increasing asthma rates.



Waste

Waste emissions, while being a minor contributor to Charleston's greenhouse gas emissions, have increased over 1000% since 1994. This is due to the City having to landfill more trash as the incinerator reaches the last legs of useful life. Emissions generated by municipal solid waste will become a much larger portion of Charleston's GHG emissions as tonnage landfilled increases in the coming years.



Proposed Reduction Measures

It is important to note that the quantification of reduction measures is a difficult and highly variable process. It is also important to note that as an outside individual trying to work within the City, my resources were very limited, which further hinders my ability to accurately quantify the effectiveness of reduction measures. This being so, the following reduction measures are all options the City should consider implementing upon further review. Provided here is an overview of the options, as well as case studies from other cities to illustrate the feasibility of the various measures. Many of these options come directly from other Cities for Climate Protection members' Local Action Plans. When enough information was known, measures were quantified to determine the amount of CO2 reductions that will occur upon implementation.

1. **Creation of an Office of Energy Efficiency.**

This office will oversee all the recommendations included in the Local Action Plan, as well as become a central source for energy tracking throughout all sectors of the community. They will also create an energy policy. A comprehensive energy policy can help to galvanize support for energy conservation in all sectors of the community. By adopting an energy policy, the local government goes formally on record in support of conservation measures, and promotes future efforts to integrate them in building and planning decisions. The current structure provides no tracking system to monitor energy/fuel use and cost, preventing effective planning and reduction strategies from being implemented. This office can also seek out grants to continue to improve Charleston's greenhouse gas reduction programs while improving residents' quality of life.

2. **Lifecycle purchasing**

Each year a city or county may buy millions of dollars worth of energy using equipment, including items such as motors, pumps, lighting devices, air conditioners, office machines and so forth.

Energy efficient equipment is usually more expensive than less efficient equipment, and thus the biggest obstacle to purchasing it is often by price. Since local governments are frequently bound by law to take the lowest bid, they often do not end up buying the more efficient products. To overcome this hurdle, some communities have introduced the concept of lifecycle costing.

Under this principle a local government bases its buying decisions not only on an item's purchase price, but also the cost of operating the item during its expected lifetime. It takes into account the purchase price, number of years of expected use, the cost of electricity needed to operate it during those years, and any other quantifiable maintenance costs. In this way, energy efficient equipment, which may be a wiser long-term

investment, is more competitive during the bidding process when compared to equipment that is less expensive but also less efficient.

3. Environmentally Preferable Products Procurement Program

U.S. State and local governments spend $30 to $40 billion a year on energy consuming products and equipment. By ensuring that these products are energy efficient, governments can reduce their energy bills while also cutting pollution from electricity generation. Energy Star is a voluntary labeling partnership between the U.S. EPA and industry certifying and promoting energy efficient products. The Energy Star label makes it easy to identify products that save money and prevent pollution, and Energy Star products are available from almost all manufacturers at the same cost as more energy-intensive models. Thus advocating EnergyStar products in the City's procurement policy protects the environment without compromising quality or price.

Results

- Each Energy Star computer and monitor that replaces a non-Energy Star unit saves nearly 1 ton of CO2 per year
- Each Energy Star office product saves $15 to $25 per year in energy costs

4. Low Income Energy Efficiency Subsidies (Light Bulb Exchange Program)

Implementing a program to benefit underprivileged families in Charleston who cannot afford to invest in energy efficiency measures would not only improve the quality of life and save those families money, it would decrease greenhouse gas emissions stemming from electricity generation. If the City were to distribute 10,000 23-watt compact florescent light bulbs (CFL), which are the equivalent of 100-watt light bulbs to 2,000 low-income households, those households would save a total of $134,904 per year (an average of $67.45/household, at $0.08/ kWhr). 1,686 tons of CO2 would also be prevented from entering the atmosphere. This program would cost between $50,000-$150,000, though community savings would be realized year after year. This cost is a mere 1.5%-4.8% of what the City of Charleston pays to supply electricity and gas to their buildings.

5. Implement Biodiesel for Fleet Vehicles

In 2002, the City of Charleston used 182,283 gallons of diesel fuel in fleet vehicles, causing 1,942 tons of CO2 to be emitted. Implementing cleaner burning biodiesel (described below) for municipal purposes would reduce that number by half, preventing 971 tons of CO2 emissions.

Biodiesel is a renewable, non-toxic fuel derived from vegetable oils such as soybean oil and canola oil, as well as recycled cooking oil. It can be blended with diesel fuel in any proportion or used in its pure form, and is commonly used in a 20% blend with petroleum diesel known as B20.

The Department of Energy published a final rule allowing the use of biodiesel credits for the alternative fuel transportation program. This rule allows States to purchase and use biodiesel as a means of satisfying their Alternative Fuel Vehicle (AFV) purchase requirements.

This would also create a market for public consumption of biodiesel in Charleston. In 2002, travelers used 5 million gallons of diesel fuel, emitting 53,928 MTCDE. By creating a supply for biodiesel, it could then be offered to the public for use in their vehicles.

6. Green Fleets

The City and County of Denver operates a combined fleet of 3,500 vehicles. Faced with rising fuel costs, increased air pollution, and Federal mandates to clean the city's air, Denver enacted the "Green Fleets" executive order on Earth Day in 1993.

Elements of a Green Fleet: As a result of this order, fleet managers must purchase the most cost-effective and lowest emission vehicle possible, while meeting operational requirements of the agency. In order to accomplish this goal, fuel efficiency standards are included in procurement specifications. The Green Fleets process also includes reducing vehicle size and eliminating old and underused vehicles. The effectiveness of the program is measured by fleet energy use and CO2 emissions. Originally the program set targets of 1% and 1.5% annual average reductions in fuel expenditures and CO2 emissions, respectively. After achieving substantial reductions the order was revised in 2000, and new goals were targeted to provide more flexibility.

Denver's Results

- Offset the City's fleet growth by 10 vehicles and downsized 13 others
- Saved $40,000 in operation and maintenance costs
- Saved up to $100,000 in capital costs by not purchasing some of the vehicles requested
- Prevented the emission of 10-15 tons of CO2

7. Switch to Energy Efficient LED Traffic Signals and Exit Signs

Light Emitting Diode (LED) technology for traffic signals and exit signs offers big energy savings over traditional incandescent lamps. LED signals use less electricity to produce the same amount of light output as traditional traffic signals. Furthermore, the lifetime of an LED signal is more than ten times that of an incandescent bulb signal, reducing maintenance and replacement costs drastically. A third advantage is that LED signals are made up of hundreds of small diodes rather than a single light source, so the signal is less likely to burn out and cause traffic delays or accidents. These factors, combined with technological advances that have driven the cost of LED signals down by 50% in the last few years, make LEDs a logical and cost effective choice. Local governments using this technology are showing short payback periods. Additionally,

local governments can put together group purchases to further reduce initial costs. More cost-effective green and orange signals are also constantly being developed.

Case Study 1: After a successful pilot project, the City of Philadelphia decided to install red LEDs in all 2,900 intersections (28,000 traffic signals). The new signals used 83% less energy and required six times less maintenance than incandescent lights. These savings amount to $800,000 annually and have a simple payback of about 4 years. The City has also installed 3-color LED signals at two major intersections and is planning to install them at 30 more intersections this year.

Case Study 2: In 1996, the City and County of Denver began replacing traditional incandescent bulb traffic and pedestrian signals with LED signals. Each installation replaces a 150 watt or 69 watt incandescent bulb with LEDs requiring only 14 watts or 8 watts of electricity. So far, only the red traffic lights and orange pedestrian signals have been replaced, but replacement of the green traffic lights is underway. Approximately 20,500 traffic signals in the Denver area have been replaced with LEDs. This project was the recipient of EPA's 1997 Outstanding Project of the Year award, and helped Denver to win the 1997 Government Partner of the Year award from EPA's Green Lights Program.

Case Study 3: Lit exit signs are required in all public buildings. Today over 100 million exit signs are in use throughout the U.S. consuming more than 30-35 million kWh of energy and costing $1 billion to operate annually. The City of Overland Park changed from incandescent lights to LED exit signs in all its municipal buildings. This project saves the City 41,000 kWh and $2,750 annually.

Case Study 4: The City of Saint Paul, MN negotiated with its utility company and received a 0% loan to finance their LED projects. In addition, Saint Paul staff coordinated a group purchase with neighboring municipalities, obtaining the lowest LED signal prices in the country.

Annual Results

Philadelphia's LED Traffic Signals

- Energy use cut by 83%, saving 64 million kWh annually
- CO2 emissions reduced by 41,490 tons
- Maintenance requirements reduced by 6 times
- Energy savings of $800,000 annually

Denver's LED Traffic Signals

- Electricity savings of 9.4 million kWh
- CO2 emissions reduced by 53,000 tons
- Energy savings of $276,000 annually
- Material and labor savings of $154,000 annually

Overland Park's LED Exit Signs

- Electricity savings of 41,000 kWh
- CO2 emissions reduced by 35 tons
- Energy savings of $2,750 annually

8. Earth Force Environmental Education Collaboration

Lowcountry Earth Force is already an established nonprofit organization dedicated to educating today's youth about environmental concerns. The City can collaborate with Earth Force to create a curriculum that will be effective to inform students of the concerns of global warm: what the causes are, what the effects are, and what they can do to make a difference.

Case Study: The City of Chula Vista includes a bilingual (English-Spanish) Global Warming Curriculum as an important part of its elementary school education program. Focusing public education on school children is critical, as these children will become tomorrow's decision makers. They are the ones who will be most affected if global warming is not addressed in the immediate future.

*Teaching the Students:*The curriculum introduces school children to the issue of global warming and how it affects daily life in Chula Vista. Lessons help students identify how they and their families can alleviate global warming. Students' families are also invited to take a pledge to reduce carbon dioxide emissions in their own homes. Each lesson addresses a different topic, with Activity Sheets suggesting ways for students to keep their home and school cool. The final lesson focuses on how the City of Chula Vista is addressing climate change and gives students a chance to participate in a mock city council. Students are also encouraged to sign and send a petition against global warming to their Mayor.

To Teach the Community: To give the students an opportunity to apply their knowledge on global warming, Chula Vista's 6th-graders are encouraged to prepare exhibits for World Environment Day, focusing on global warming as a theme. Students present their exhibits as policy options to City Council—the best exhibits receive awards from the City, and both students and teachers appear on a San Diego television show.

Results

Who is Using the Curriculum?
No. of schools 32
No. of teachers 78
No. of students 2,566

9. Improve Streetlight Efficiency

The City of Charleston is responsible for 8,935 streetlights. Of these, only 1201 are high efficiency high-pressure sodium lights. The remaining 7734 are less efficient mercury vapor lights.High-pressure sodium streetlights use on average 54.91% less electricity than do mercury vapor lights. Implementation of this measure could result in annual savings of $15,673 and in the elimination of 97 tons of CO_2. The City of Burlington, VT estimates that the conversion of 10,000 streetlights to high-pressure sodium fixtures will save 4 million kWh of electricity per year and result in annual financial savings of $675,000.

10. Reduce Urban Heat Sinks

The Urban Heat Island Effect
Large amounts of paved and dark colored surfaces in our built-up communities absorb rather than reflect the sun's heat, causing urban temperatures to be higher than in nearby rural areas. City temperatures in late summer afternoons are on average 5ºF higher than in the adjacent countryside. This phenomenon is called the Urban Heat Island (UHI) Effect and it intensifies heat waves, causes smog, raises energy costs, and adds to global warming pollution.

Local governments around the country are beginning to adopt UHI mitigation strategies to counter some of these effects, with Salt Lake City and nearby Highland, UT taking the lead in ensuring that new developments make use of "heat reduction" techniques, such as using reflective roofing, light-colored parking lots, and strategic tree planting.

Case Study 1: Salt Lake City recently enacted an ordinance requiring that commercial property owners retrofitting or constructing new buildings in a revitalized downtown area use light colored roofs and parking lots and strategic tree planting in their plans. Salt Lake City has also amended the City's existing landscaping ordinance to ensure that trees are planted in the interior of commercial parking lots to shade pavements, vehicles, and pedestrians.

Case Study 2: Highland, located south of Salt Lake City, encompasses all 3 aspects of heat abatement strategies in its Town Center's Master Plan. The progressive plan requires all parking lots to be paved in light-colored concrete, or possess 20% more trees to compensate. Roofing materials for low-sloped or flat roofs must have 75% reflectivity and high emissivity. Breaks and skylights are encouraged where appropriate. Specific guidelines for strategic tree planting specify species of trees, and where and how they should be planted for optimal shading. Highland found little objection from property owners and developers to the ordinance.

11. Park and Ride Stations

Creating park and ride stations at critical locations throughout the City, including at the James Island Connector, West Ashley Bridge, and Cooper River Bridge will decrease the flow of traffic coming in and out of the peninsula, decreasing congestion while also decreasing emissions stemming from personal vehicles. The program would also give a boost to Charleston's struggling mass transit system, increasing ridership and generating revenue. According to a 2000 Texas Transportation Institute study, Charleston is more congested than other cities of similar size. Eliminating the amount of single occupancy drivers by providing park and ride stations would greatly improve the congestion and emission problems stemming from these automobiles.

12. Comprehensive Commuter Trip Reduction Program

In order to alleviate traffic congestion, the City of Los Angeles devised a commuter trip reduction program aimed at discouraging solo personal vehicle use and encouraging

transit, car- and vanpooling. The commuter program is offered to 38,000 City employees with a budget of about $1.6 million a year. The program operates in over 40 City departments, including 110 vanpools, 1,000 carpools and the City Telecommuting Program.

Innovative Financing: The Rideshare Trust Fund

The City of Los Angeles and its employee bargaining units agreed to a unique arrangement regarding commuter benefits and employee parking. Basically, it rewards the "good guys" (those who rideshare) and penalizes the "bad guys" (solo drivers). Parking fees from solo drivers are used to support rideshare programs. Parking permit fees go to the interest-earning Rideshare Trust Fund. Unlike typical "use-it-or-lose-it" budgets, unspent funds in one fiscal year carry over into the following fiscal year. The Commuter Services Office (CSO) then applies these monies to its entire program; the initiative is thus relatively insulated from the effects of year-to-year tax revenue shortfalls in the General Fund. Trust Fund expenditures are primarily directed toward subsidizing vanpools and employee transit passes. They also cover producing carpool matchlists, purchase and installation of bicycle lockers, and office expenses.

Annual Results

- Carpool program: 500,000 trips and 3,836 tons CO2 reduced
- Vanpool program: 233,000 trips and 7,696 tons CO2 reduced
- Transit incentives: 418,500 trips and 6,050 tons CO2 reduced
- Telecommute program in 1998-99: 7,800 trips and 194 tons CO2 reduced

Highlights of LA's Program

Parking policies in Civic Center

- free permits for carpool vehicles
- preferential parking for car- and vanpools
- 17-year wait list for seniority parking permits for solo drivers

Transit, car- and vanpool incentives

- $15 cash back to transit users
- subsidized vanpool vehicle
- rideshare matching service
- guaranteed ride home

Bicycle, pedestrian incentives

- bike and clothes lockers, showers at some city facilities

Work time adjustments

- flex time in most departments
- compressed work week

telecommuting—work at home up to one day a week

13. Pay As You Throw Waste Management Practices.

As solid waste costs have continued to rise through this past decade, increasing greenhouse gas emissions, communities have increasingly explored Pay-As-You-Throw (PAYT) programs. With this system, residents buy bags, tags, stickers, or punch cards for

their trash, each typically costing between $.30 and $2.00. A few towns use weight-based programs where residents are charged by the pound. In almost all programs, recycling is free. As a result, people only pay for what they throw out, and are provided with incentives for reducing solid waste generation and increasing recycling.

Case Study: Between 1995 and 1997, 24 communities in Maine adopted a PAYT program. An additional 31 communities adopted PAYT programs between 1998 and 2000. The following is feedback from various communities in Maine in response to the PAYT programs implemented.

- Increased recycling by 50% -- reduced waste by 35% (Falmouth, MA)
- Total waste volume down 60% (Calais, MA)
- Trash volume down 50%, recycling way up (Pleasant River Solid Waste Disposal District, MA)
- Recycling has tripled! Through the roof! (North Berwick,MA)

EPA estimates that for each person participating in a PAYT program, greenhouse gas emissions are reduced by an average of 0.088 metric tons of carbon equivalent (MTCE, the basic unit of measure for greenhouse gases). This means that a community of 100,000 people could potentially reduce greenhouse gas emissions by 8,800 MTCE by implementing a PAYT program. This calculation is based on the assumption that residents in PAYT communities recycle a mix of the most common recyclable materials (e.g., plastic bottles, newspapers, steel and aluminum cans). .

14. Local Housing/Building Code Changes.

Conserving energy reduces greenhouse gas emissions, creates big savings on utility bills, improves home comfort, and increases worker productivity. Local governments can make energy conservation happen through their building codes—requiring basic measures such as improved insulation and efficient lighting and appliances.

Case Study 1: The City of Berkeley, CA, has demonstrated that energy savings can be achieved with off-the-shelf technologies and need not be confined to new buildings. In 1981, Berkeley passed its Residential Energy Conservation Ordinance (RECO) requiring energy efficiency upgrades in existing residences. The law includes a dollar cap on owners' obligations, but these typically inexpensive upgrades often pay for themselves rapidly in the form of lower energy bills. RECO's success led the City of Berkeley to extend its mandate to businesses, enacting its Commercial Energy Conservation Ordinance (CECO) in 1993.

Support from the Community: While new building requirements often face initial resistance, home- and business-owners also value the benefits that conservation measures create, such as improved real estate and lower utility bills. The City worked hard to bring the business community into the decision-making process before enacting CECO. As a result, RECO and CECO are turning emissions reduction into a painless and

economically beneficial process for the City of Berkeley, its property owners and residents.

Results

- Over 20,000 residences (50% of Berkeley's housing stock) improved
- Over 130 commercial buildings (10% of City's total) improved
- Residential natural gas use has declined 18% per capita

Sample Home Improvements under RECO

- Insulate water heaters and hot water pipes
- Improve ceiling insulation
- Install fluorescent lighting and weather stripping
- Seal chimneys and furnace ducts against hot air leakage
- Replace showerheads with low-flow models that conserve hot water

Case Study 2: In the state of Arizona, all buildings must meet the Model Energy Code (MEC) of 1995, a national standard for minimum insulation, window glazing, lighting, and other similar features related to energy efficiency. In 1998, the City of Tucson decided to set the bar even higher than the MEC. Since then, all construction and renovation of municipal buildings has been placed under Tucson's own "Sustainable Energy Standard," which requires an impressive 50% greater energy efficiency than that of the Model Energy Code.

Builders found the savings surprisingly easy to achieve, convincing Tucson that the standard could work in all city construction. The Sustainable Standard suggests various conservation measures but allows architects freedom in choosing exactly how to meet the higher efficiency standard. Designers must detail conservation strategies and perform an energy analysis early in the design process. The City then monitors energy efficiency throughout the contracting, inspection, and testing phases. This process ensures that all involved, from design to construction, understand the importance of energy efficiency and ensures that the savings are realized.

A. Annual Results
- $73,000 a year saved through avoided utility costs
- 784 tons of CO2 reduced annually

B. Annual savings will grow as more renovation and construction is completed

The Sustainable Energy Standard now applies to the roughly 50,000 square feet of new City construction and 50,000 square feet of space the City renovates each year. Tucson is also looking beyond municipal buildings for more energy savings. The City is applying the Sustainable Energy Standard citywide as a voluntary standard and hopes to begin a citywide training program for architects and contractors in applying energy codes and standards. These policies are helping Tucson reduce pollution, stimulate business in energy services, and save money on City operations.

Appendix A

Data/Methodology

In determining what policy approaches the City of Charleston need to incorporate to meet the requirements of ICLEI's Cities for Climate Protection Campaign, various methods were used to obtain relevant data. Personal collaboration between pertinent City of Charleston employees and myself occurred in order to determine appropriate sources of information. Anonymous standardized surveys delivered via email were sent to city employees examining commuting methods and distances. Phone, email and personal interviews were conducted to obtain city electric and gas usage. Content analysis was performed to analyze the data. Once baseline emissions data was acquired, CCP software computed Charleston's emissions and identified the primary emissions sources. Case studies were used to demonstrate nationwide examples of policy approaches that were used to reduce ghg emissions in other cities and which may be applicable to Charleston. Economic and lifecycle analysis was used to determine economically feasible methods for curbing GHG emissions.

Two sectors were examined to determine Charleston's emissions. First was the city government – the municipality and its operations. The years examined for this sector were from 2001-2002. This was based on the limited amount of information that the City could provide for the respective categories. Categories examined for their impact on ghg emissions were building electricity usage, streetlight electricity usage, wastewater treatment electricity usage, municipal fleet fuel consumption, employee commute, and waste production.

Electricity and gas usage of buildings was collected, as well as electricity consumed by streetlights. This information was provided Amy Riley of Johnson Controls. Johnson Controls is a consulting company hired in 2001 by the City of Charleston to advise on areas of potential energy efficiency options. Johnson Controls took the electricity and gas bills for each City building and the bills for streetlights each month during the years of 2001-2002 and consolidated them into a yearly figure for me. These figures were then used by the CCP software, which calculates emissions based on kilo-watt/hours of electricity used by computing the total electricity used with EPA-determined emissions coefficients. These coefficients are localized to the region of South Carolina where Charleston's energy is connected to the electrical distribution grid. These coefficients take into consideration SCE&G's fuel mix of coal, natural gas, nuclear, and hydropower.

Emissions from the vehicle fleet are calculated based on gallons of unleaded gasoline and diesel fuel consumed. The City of Charleston's contracted fuel supplier, Pacific Pride, provided printouts of every fleet vehicle account, which specified every refueling transaction's total fuel consumption. The total amount of fuel for each transaction was summed for the years 2001-2002.

Employee commute was also factored into municipal emissions. A survey, delivered via email to all city employees, was utilized to determine employee commute distance, number of trips made per week, type of fuel consumed for the commute, and estimated

fuel efficiency (See Appendix B). Respondents followed a link in the email to a form website, where they completed the survey and submitted it anonymously. An average commute distance was computed from the responses, as well as an average fuel efficiency for City employees. This average fuel consumption was then extrapolated across the total number of staff employed by the City from 2001-2002. The total annual estimated amount of fuel consumed for the employee commute was then entered into the CCP software.

The total tonnage of waste produced and sent to landfills for City operations was unavailable, so national averages for waste generated per municipal employee was utilized. These average numbers were multiplied by the number of employees for 2001 and 2002 to produce a single tonnage of waste produced by municipal operations per year. The software computed GHG emissions from waste based on a predetermined percentage composition of waste landfilled. This total includes only municipal solid waste, and does not include construction debris, or dry trash.

The second sector examined is the community sector, consisting of Charleston's residential, industrial, and commercial electricity and gas consumption, vehicle miles traveled within the city, and total amount of waste sent to landfills. The years used for this sector were from 1994-2002, as that amount of data was available for analyzation.

Representatives at South Carolina Electric and Gas supplied electricity and gas usage for the residential, commercial and industrial sectors. GHG emissions were then calculated using the same coefficients as for the governmental sector.

Annual vehicle miles traveled in Charleston were provided through Phillip Overcash, a City Planner for the City of Charleston. The software then used national average vehicle distribution to estimate the variance in fuel efficiencies for standard vehicle types, and factors that percentage with the total vehicle miles traveled to estimate the types and annual amounts of fuel consumed by vehicles within the city. Emissions were calculated based on the amounts of each type of fuel consumed and the emissions coefficients associated with each fuel type.

Total tonnage of waste produced and sent to landfills by the community sector was computed for methane released over the life of each year's waste totals. Total annual tonnage of waste to landfill data for the community sector was obtained through the Mary Dellucci at the City of Charleston Solid Waste Department.