# MiPlan:

(Credit: Jorge R. Perez, City of Miami)

## City of Miami Climate Action Plan

June 2008

The City of Miami
Mayor Manuel A. Diaz

MiPlan

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## Acronyms And Abbreviations

**BOMA** Building Owners and Manager's Association
**$CO_2$** Carbon dioxide
**$CO_{2e}$** Carbon dioxide equivalents
**EPA** Environmental Protection Agency
**FPL** Florida Power & Light Company
**ESCO** Energy service company
**USGBC** United States Green Building Council
**HVAC** Heating, ventilating, and air conditioning
**ICLEI** Local Governments for Sustainability
**IPCC** Intergovernmental Panel on Climate Change
**KWh** Kilowatt-hour
**LED** Light-emitting diode
**LEED** Leadership in Energy and Environmental Design
**Mtoe** Million tons of oil equivalents
**MWh** Megawatt-hour
**ppm** Parts per million
**PV** Photovoltaic
**SUV** Sports utility vehicle
**UN** United Nations
**VMT** Vehicle miles traveled

# Executive Summary

The City of Miami sits on the frontline of man-made climate change. Over the next century, escalating greenhouse gas emissions threaten to dramatically increase the earth's temperatures and raise sea levels, making Greater Miami one of the most vulnerable urban areas in the world. If climate change proceeds unmitigated, living in Miami will become extremely difficult, if not impossible.

The City of Miami is committed to taking action to reduce and halt global climate change. Miami's greenhouse gas emissions currently exceed 4.8 million metric tons per year and will rise to 5.7 million metric tons by 2020 without action. MiPlan, the City of Miami's Climate Action Plan, outlines how the City will reduce greenhouse gas emissions to 25% below 2006 levels citywide by 2020 and to 25% below 2007 governmental levels by 2015. MiPlan represents a strong first step towards a sustainable future for Miami. The keystones of MiPlan focus on five main areas of sustainability:

- **Buildings:** Buildings are the source of more than half of Miami's greenhouse gas emissions. Buildings consume energy to provide basic functions such as cooling, lighting, heating water, running appliances and computers. Most buildings also waste energy, using 30% of their energy inefficiently or unnecessarily, according to the US EPA. Miami buildings are unique in that they consume almost all of their energy from electricity and use more of that energy for cooling than almost anywhere else in the US. *Miami will reduce annual greenhouse gas emissions by 975,000 metric tons by 2020 through improvements in energy efficiency in both new and existing buildings. This program will emphasize efforts to improve energy efficiency in existing buildings and their cooling and lighting systems, which together can comprise more than half of electricity used in a typical South Florida building.*

- **Energy sources:** Electricity supplies almost all of Miami's energy for buildings. More efficient generation and cleaner fuel sources of electricity can greatly reduce the City's greenhouse gas emissions. Although Miami's greenhouse gas emissions from electricity have been decreasing in recent years through the efforts of the City's utility (FPL), the City seeks to have that trend continue and accelerate. *Miami will reduce annual greenhouse gas emissions by 429,000 metric tons by increasing the use of renewable energy and the use of more efficient, local sources of power.*

- **Transportation:** The transportation sector, predominantly the use of cars and trucks, produces 40% of the City's greenhouse gas emissions. Shifting the means of transportation from single-occupant large cars and SUVs to more efficient cars or alternative methods of transportation can greatly decrease the City's greenhouse gas emissions. Miami-Dade County roads now see over 21 billion miles of driving per year, up 33% from 10 years ago. Increasing commute times and driver frustration heighten the need to improve transportation in the City. By increasing the number of transportation choices to residents and removing barriers to alternative transportation, MiPlan seeks to reduce automobile dependency. *Miami will reduce annual greenhouse gas emissions by 565,000 metric tons by 2020 by reducing vehicle miles traveled, increasing fuel efficiency, increasing the use of alternative transportation, and increasing the use of alternatively-fueled vehicles.*
- **Land use:** Land use contributes to energy consumption in both the building and transportation sectors. Denser, more walkable cities have lower automobile usage and are more energy efficient. Compact, pedestrian-friendly urban planning can contribute not only to decreased energy consumption but also provide sustainable communities for Miami's future. The City is projected to absorb another 50,000 residents by 2020 and the manner in which they are absorbed will impact the City's greenhouse gas emissions. *Miami will reduce annual greenhouse gas emissions by 148,000 metric tons by implementing more efficient land use planning and zoning.*
- **Adaptation:** Some amount of temperature increase and sea level rise is inevitable, even if greenhouse gas concentrations are stabilized at current levels. *Miami will begin to plan for the impacts of climate change and incorporate climate change scenarios into long-range planning*.

Climate change presents one of the greatest challenges of the 21st century, but there is hope for the global environment. As an international city, Miami has the opportunity to lead in developing innovative, sustainable solutions and pushing the frontiers of progress by initiating a program to implement energy efficiency improvements citywide. In doing so, Miami will provide a model that will reap the benefits of innovation through the growth of local green industries, by reducing dependence on foreign energy sources, and by creating a sustainable community that attracts families and businesses.

# 1.0 Introduction

For the City of Miami, South Florida and much of the world, increased climate change due to global warming is the most significant environmental problem of recent times. It will impact residents and visitors alike, with indiscriminant impacts on homes, businesses and public infrastructure. Many of the things that make Miami such a desirable place to live and to visit - its tropical weather, its lush green landscapes, the beaches to the east, and the Everglades to the west - are threatened by the effects of climate change. Rising sea levels have the potential to erode beaches, flood low-lying buildings, and contaminate drinking water.

Awareness of this wide-ranging threat has increased dramatically in recent years. In 2007, the Nobel Peace Prize was awarded jointly to Al Gore and the United Nation's Intergovernmental Panel on Climate Change (IPCC) for their work in the area of climate change. The IPCC's work summarizes scientific knowledge on greenhouse gases, their relationship to human activity, and the potential impacts of increasing concentrations of these gases on the earth, including rising temperatures and sea levels, melting glaciers, and changes in precipitation patterns. Scientific consensus now recognizes that most of these changes are due to human activities. As stewards for current and future generations, dramatic steps must be taken to radically reduce global emissions of greenhouse gases if future climate change is to be limited and its widespread impact on the City and State reduced.

No single government or municipality alone can halt climate change. The solution will require comprehensive, coordinated efforts at the local, state, regional, national, and international levels. The City of Miami must acknowledge the responsibility to lead by example, proactively reducing greenhouse gas emissions, and encouraging residents to do the same. The benefits, in addition to reducing emissions of greenhouse gases, include: reducing energy costs in the wake of skyrocketing costs of fossil fuels, decreasing dependence on other nations for energy supply, creating new jobs and industries in a green economy, and allowing for future sustainable development by providing a model that can be replicated nationwide.

The City of Miami recognizes that the global threat of climate change demands a local response. In 2005, Mayor Manuel A. Diaz signed the US Mayor's Climate Protection Agreement, committing the City to dramatically reduce greenhouse gas emissions, and, in 2007, the City Commission officially adopted the agreement. In response, the City has prepared MiPlan (the City's Climate Action Plan) which provides the framework for local action to address climate change. The Plan includes a description of the impact of climate change on Miami (Section 2.0), baseline data on the City's greenhouse gas emissions (Section 3.0), reduction targets (Section 4.0), a plan to reduce those emissions (Section 5.0), and background information on the science of climate change (Appendix B). This plan is intended to reduce greenhouse gas emissions from both City government operations and the City as a whole. In the next year, the City will use this plan as the framework to develop a specific implementation and financing strategy. MiPlan provides the essential framework required for Miami's efforts to combat global climate change.

# 2.0 Impact on Miami

The City of Miami is located in Southeast Florida, in Miami-Dade County on the Miami River, with the Atlantic Ocean to the east and the Florida Everglades to the west. With a population of 404,048 as of 2006, Miami is the largest city in the greater South Florida area, which is home to 5.4 million people -- the largest metropolitan area in the Southeast US. Miami is a cosmopolitan community, with over half its population born outside the US. The City also attracts tourists from all over the world and is unique in its proximity to two national parks, Biscayne National Park and Everglades National Park.

Historically, Florida has been vulnerable to natural disasters primarily from hurricanes. In 1992, Hurricane Andrew devastated the Miami area, causing $26.5 billion in damages. The unprecedented hurricane activity in the 2004 and 2005 seasons caused further impact to South Florida. Hurricane Wilma (2005) alone caused over $1 billion in damages. Global warming will present a new and greater natural hazard to South Florida through rising sea levels and its impact on the land and drinking water supply. Due to its low elevation, averaging 72 inches (1.8 meters) above sea level, Miami is particularly vulnerable to rising sea levels, as shown in Figure 2.1.

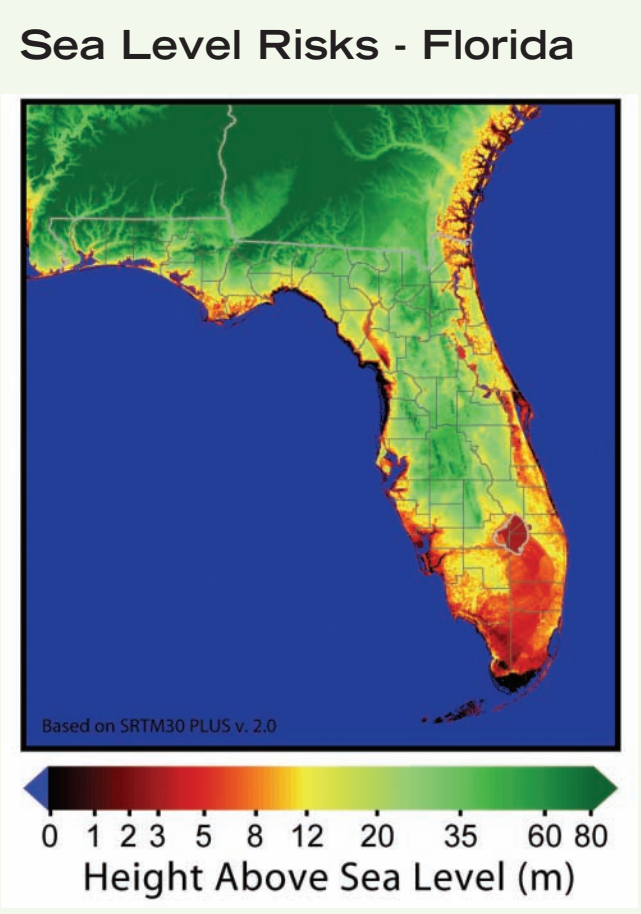


**Figure 2.1:** Height above sea level across Florida in meters (1 meter equals 39 inches).[1]

[1] Robert A. Rhode, Global Warming Art, http://www.globalwarmingart.com/wiki/Image:Florida_Sea_Level_Risks_png. Based on the public domain data set SRTM30 PLUS v.2.0, http://topex.ucsd.edu/WWW_html/srtm30_plus.html. This image is used and licensed under the Creative Commons Attribution-NonCommercial-ShareAlike License Version 2.5, http://creativecommons.org/licenses/by-nc-sa/2.5/.

In 1988, the United Nations (UN) established the Intergovernmental Panel on Climate Change (IPCC). The purpose of the IPCC was to provide policy makers worldwide with an objective overview of the state of scientific knowledge on climate change. In 2007, the IPCC released its Fourth Assessment Report.[1] The major projections of the 2007 report are that:

- Global temperatures will likely rise by between 2.0 and 11.5 degrees Fahrenheit by 2100;
- Sea levels are projected to rise by between 7 and 23 inches by 2100.

It should be noted that the IPCC estimates of sea level rise omitted the impact of melting icepack in Greenland and Antarctica because of concerns about uncertainty in available data and models. However, based on more recent information, other reports have projected substantially greater sea level rises. A task force of Miami area scientists has projected a sea level rise of at least 18 inches in the next 50 years and 36 to 60 inches by 2100.[2]

Due to Miami's low elevation and high density of buildings near the ocean, it has more property at risk from rising sea levels than any other City in the world. A study by the Organisation of Economic Cooperation and Development found that Greater Miami presently has over $400 billion in property at risk from coastal flooding and by the year 2070 that value could rise to over $3.5 trillion.[4] In addition to its property risk, the study also found that Greater Miami is one of the 20 cities with the most population at risk from coastal flooding.

A recent study by Elizabeth A. Stanton and Frank Ackerman of Tufts University ("Florida and Climate Change: The Costs of Inaction") assessed the potential economic impact of global warming on the State of Florida.[5] They reported that statewide the costs of inaction may reach $27 billion in 2025 and $345 billion by 2100. Their analysis assessed potential impacts to the tourism industry, increased hurricane strength, increased costs to the electricity systems, and the value of real estate at risk from sea level rise. The Tufts report does not include estimates of the impact of climate change on agriculture, fishing, insurance, transportation, and water. Inclusion of these impacts would substantially increase estimates of the costs of inaction. The report also projects that, unless steps are taken to reduce greenhouse gas emissions, by the year 2070 the sea level may rise 27 inches and 70% of Miami-Dade County would be vulnerable to flooding. With a sea level rise of that magnitude, life in Miami-Dade County would be extremely difficult.

Clearly, Miami is one of the most vulnerable cities to climate change in the world.

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2 IPCC, (2007), "Climate Change 2007: Synthesis Report. Summary for Policymakers." http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

3 Science and Technology Committee of the Miami Dade County Climate Change Advisory Task Force, (2008), "Statement on Sea Level in the Coming Century". http://www.miamidade.gov/derm/library/08-10-04_CCATF_BCC_Package.pdf.

4 Nicholls, R. J. *et al.* (2008), "Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes: Exposure Estimates", *OECD Environment Working Papers*, No. 1, OECD Publishing. doi:10.1787/011766488208. http://www.oecd.org/dataoecd/16/58/39720578.pdf.

5 EA Stanton, F Ackerman (2007), "Florida and Climate Change the Costs of Inaction." Tufts University. http://www.ase.tufts.edu/gdae/Pubs/rp/Florida_lr.pdf.

# 3.0 Greenhouse Gas Inventory

## 3.1 Methods

The City of Miami has developed **MiPlan** (the City's Climate Action Plan) following the Cities for Climate Protection methodology developed by ICLEI, an international organization of local governments for sustainability. ICLEI includes over 1,000 members, with 350 members in the US. The Cities for Climate Protection Program includes a standard methodology, support from ICLEI staff, a handbook, and software for developing a Climate Action Plan. Specifically, the ICLEI climate action methodology consists of five steps:

1. **Inventory greenhouse gas emissions.** Compile an inventory of greenhouse gas emissions from both citywide activities and government activities.
2. **Target reductions.** Set target reduction levels for greenhouse gas emissions.
3. **Action items.** Develop action items to achieve targeted reductions in greenhouse gas emissions.
4. **Implementation.** Implement the action items.
5. **Monitoring.** Evaluate the reductions achieved by assessing changes in greenhouse gas emissions.

This document addresses the first three steps of the ICLEI process. The last two will be performed subsequent to the completion of this plan and are discussed in Sections 5.3 and 5.4 of this report.

The City's inventory was conducted by compiling the best available data on energy consumption and solid waste disposal, given the time frame and resources of the project, and is intended to identify the City's largest sources of greenhouse gas emissions. For citywide consumption data, city specific data was used where available. If City specific data was not available, relevant values were extrapolated by population ratios from County or State data.[6] For the government inventory, government specific data was obtained from vendors or City departments. In the case of solid waste from government buildings, very few records were kept and total volume was estimated based on the limited records available.[7] The data present in the following sections represents the best estimate of the City of Miami's greenhouse gas emissions given the available data sources.

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[6] Electricity consumption was compiled specifically for the City of Miami from utility provided records. Transportation fuel consumption and solid waste disposal were measured based on state records of county fuel consumption and solid waste generation. However, use of natural gas, propane, and other fuel oils was calculated based on prorated state consumption and may represent an overestimate of their use in Miami since there is very little use of these fuels for heating in Miami compared to the more northern parts of the state.

[7] The City of Miami has over a dozen haulers removing waste from City government facilities. These haulers typically collect City government waste as part of a route where waste from multiple sources are also collected. Hence, the waste solely due to the City of Miami could not be determined directly. Estimates of solid waste were compiled based on size of dumpsters, typical density of waste, and frequency of collection at City of Miami facilities, where available.

This inventory does not include the airport which lies outside the City boundary and is not included in the ICLEI protocol, or the shipping industry, except for activities accounted for in state fuel tax sales.

## 3.2 Citywide Greenhouse Gas Inventory

Greenhouse gas emissions were inventoried from the City of Miami as a whole following the ICLEI protocol. Based on this inventory, the total emissions from the City of Miami for the year 2006 were 4.8 million metric tons of carbon dioxide equivalents ($CO_{2e}$). Comparing only greenhouse gas emissions from residential energy use and transportation, Miami's per capita emissions are in the lowest one-third of the 100 largest metropolitan areas in the US.[8,9] (Figure 3.1.) Miami's per capita emissions were less than all other listed Florida metropolitan areas and well below the US average.

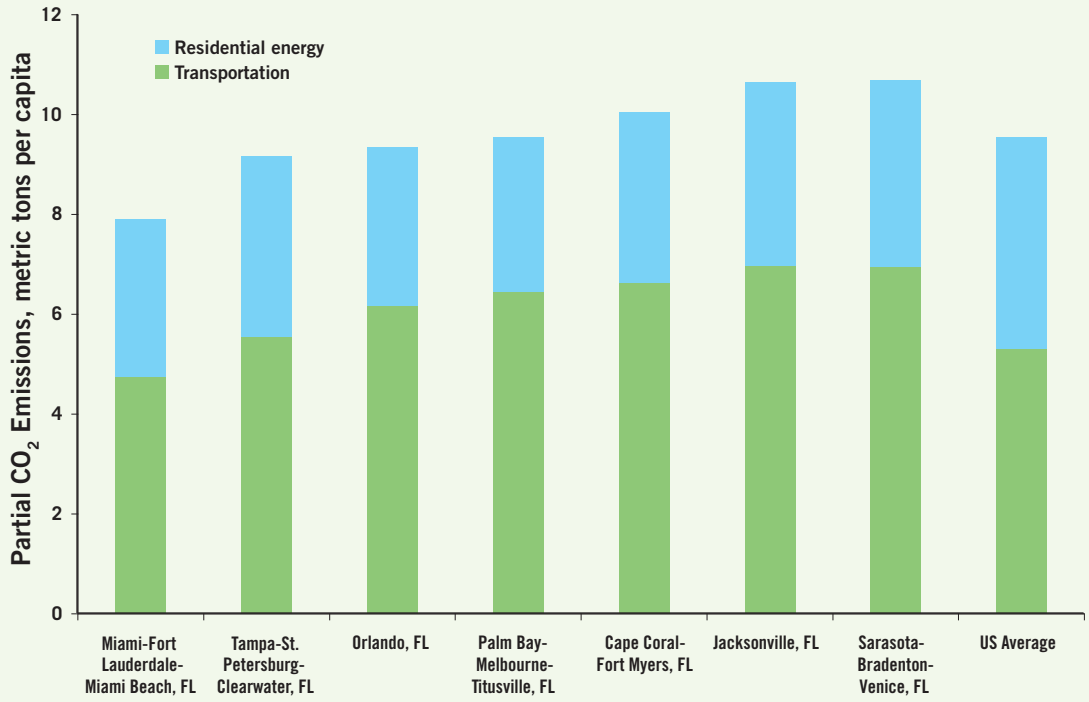


**Figure 3.1:** Partial per capita greenhouse gas emissions at selected Florida metropolitan areas based on residential energy and transportation. Commercial and industrial energy consumption is excluded. Transportation includes only automobiles and trucks.[10,11]

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8 MA Brown, F Southworth, A Sarzynski, (2008), "Shrinking the Carbon Footprint of Metropolitan America." Brookings Institute.

9 Per capita emissions can be a useful metric for measuring progress in reducing greenhouse gases and for comparing one community's emissions with neighboring cities and against regional and national averages. Dividing the total community-wide $CO_{2e}$ emissions by population yields a result of 11.8 metric tons of $CO_2e$ per capita. It is important to understand that this number is not the same as the carbon footprint of the average individual living in Miami and that the per capita values from the City's inventory are greater than those of the Brookings Institute due to differences in methodology.

10 F Southworth, A Sonnenberg, MA Brown, (2008). " The Transportation Energy and Carbon Footprint of the 100 Largest U.S. Metropolitan Areas." Georgia Tech, Ivan Allen College, Working Paper #37.

11 MA Brown, E Logan, (2008), "The Residential Energy and Carbon Footprint of the 100 Largest U.S. Metropolitan Areas." Georgia Tech, Ivan Allen College, Working Paper #39.

Almost all of the City's greenhouse gas emissions (over 90%) can be attributed to buildings and transportation. Figure 3.2 summarizes City greenhouse gas emissions by sector. The transportation sector accounts for 39% of the City's total emissions. The commercial sector produces 34% of the City's emissions and the residential sector produces 20%. The industrial sector in the City of Miami accounts for only 4% of $CO_{2e}$ emissions. Solid waste produces 3% of the City's emissions.

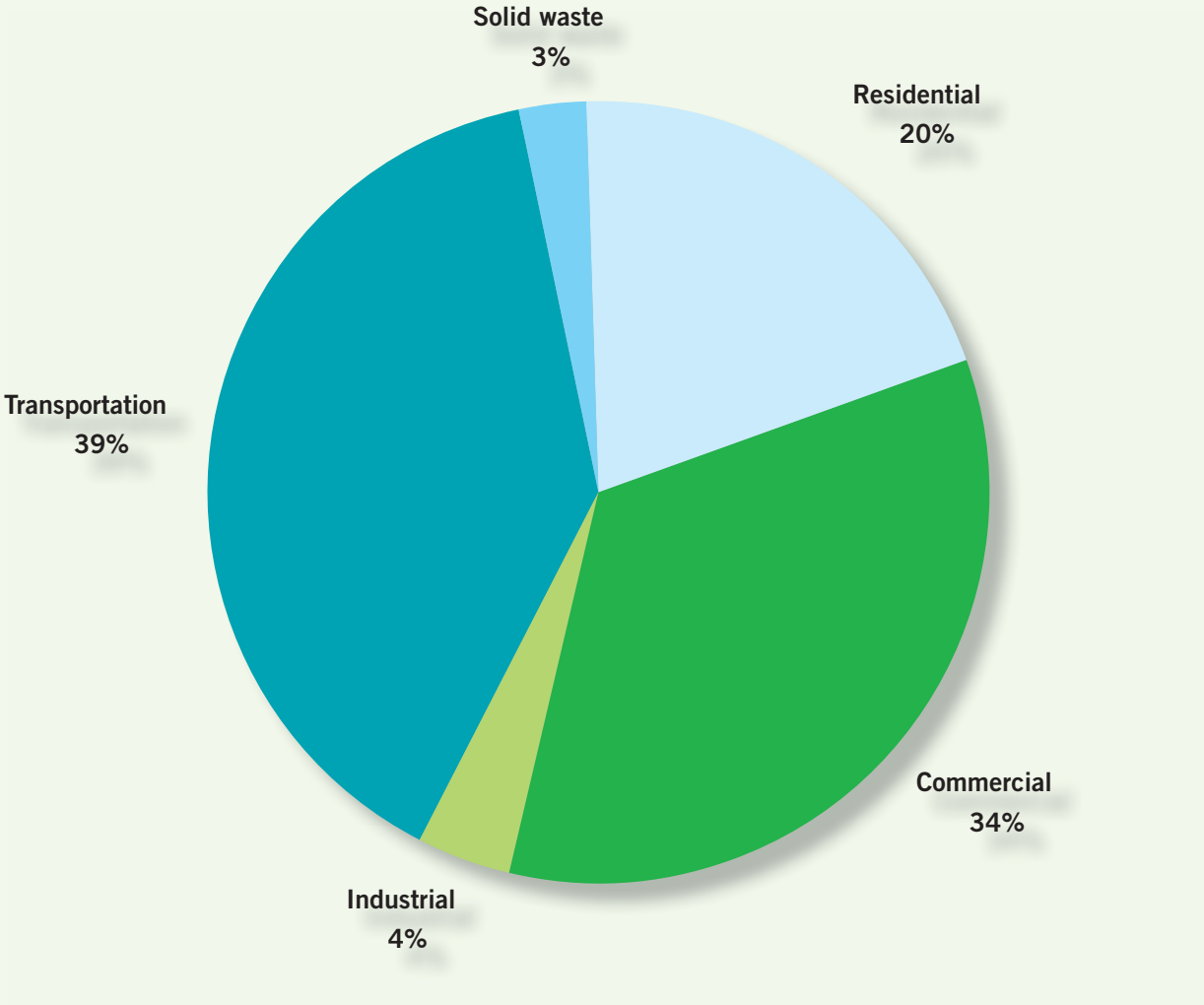


**Figure 3.2:** 2006 Citywide Miami greenhouse gas emissions by sector

Figure 3.3 presents the City's greenhouse gas emissions by source. The majority of the emissions are due to electricity usage at 52%. Transportation fuels, gasoline and diesel, account for another 40%. Solid waste represents 3% of the City's emissions and other fossil fuels, propane, natural gas and light fuel oils, represent the remaining 5%.

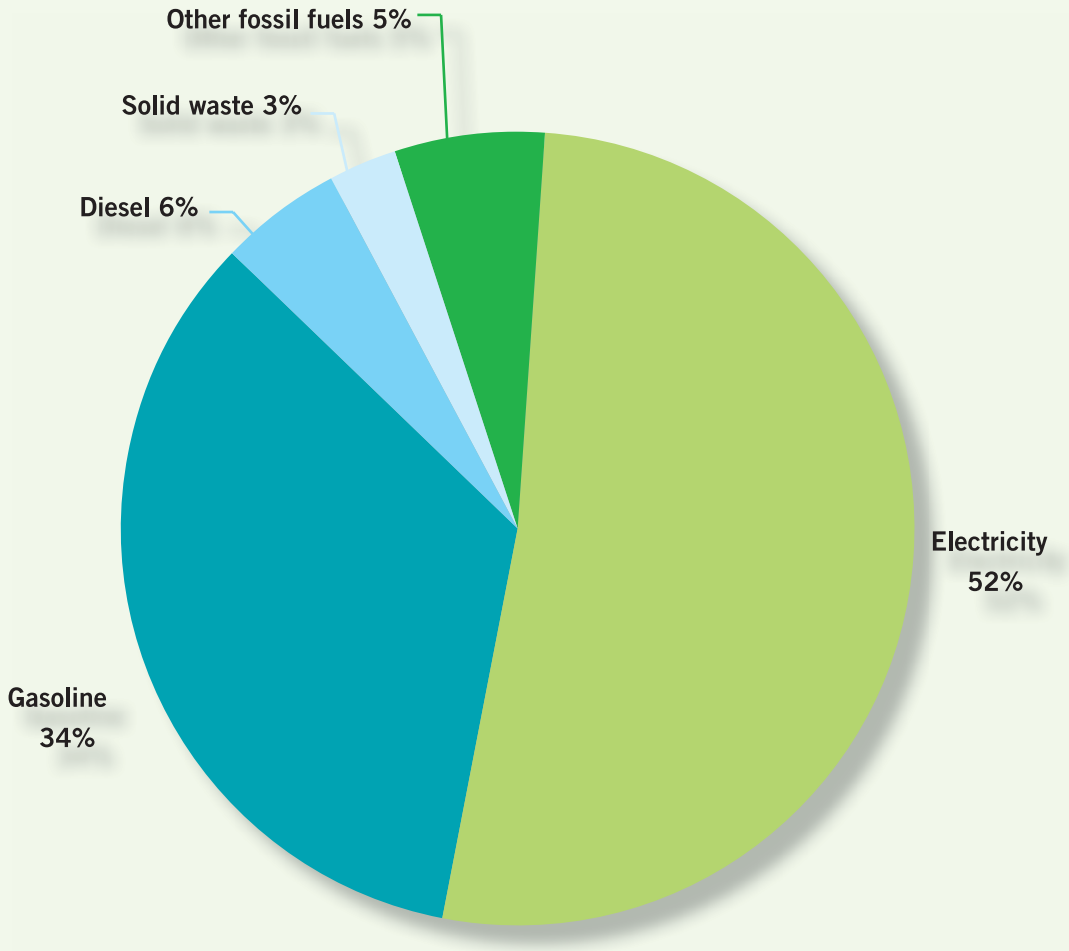


**Figure 3.3:** 2006 Citywide Miami greenhouse gas emissions by source

Miami's profile of energy usage is unique in several respects. Miami's greenhouse gas emissions from electricity consumption have actually decreased in recent years despite increases in consumption. This decrease results from FPL's commitment to reduce its own emissions largely by switching to less carbon intensive[12] fuel sources. (Figure 3.4)

[12] Carbon intensity refers to the amount of carbon dioxide associated with a fuel source. Fuels with high carbon intensity, such as petroleum products, release greater quantities of $CO_2$. Natural gas is less carbon intensive than petroleum fuels but more carbon intensive than most renewable energies.

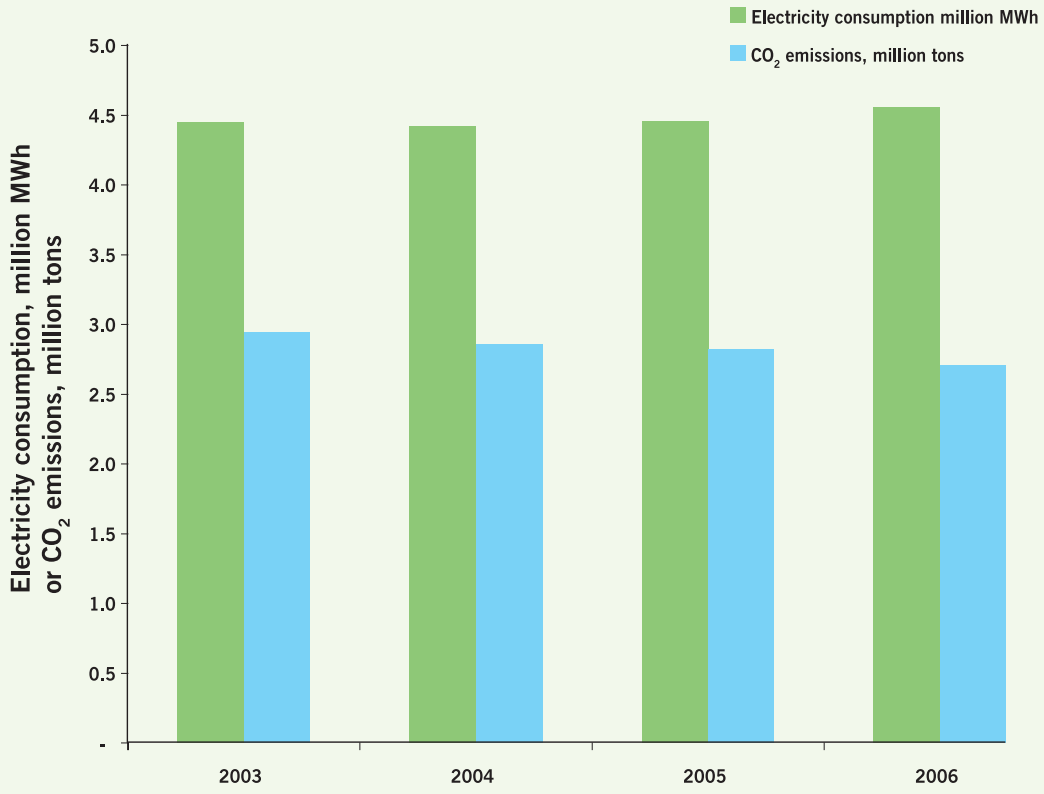


**Figure 3.4:** City of Miami electricity consumption and $CO_2$ emissions from electricity.

Over 90% of the energy for Miami buildings comes from electricity. Nationally, only 66% of residential energy comes from electricity with the remainder coming primarily from heating fuels such as natural gas, petroleum products and wood.[13] Miami's warm weather rarely requires heating and therefore South Florida has little use of heating fuels. In a typical residence in North Florida, cooling and heating consume 20 and 15% of energy usage, respectively, while in South Florida cooling consumes 40% and heating consumes only 2%.[14] Nationally, 47% of energy is used for heating and only 6% for cooling. In a typical South Florida residence, cooling, lighting, refrigeration and water heating account for 77% of electricity consumption. Miami's strategies for reducing energy consumption in buildings are unique in that they will focus almost exclusively on electricity and among electricity uses the largest focus will be on cooling.

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13 Energy Information Administration, US Department of Energy, (2001), "Residential Energy Consumption Survey". http://www.eia.doe.gov/emeu/recs/contents.html.

14 Florida Solar Energy Center, "How Can Home Energy Efficiency Be Improved?" http://www.fsec.edu/en/consumer/buildings/homes/ratings/improve.htm.

Opportunities for energy efficiency improvements are greater in older buildings. Eighty percent of Miami's building stock is more than 20 years old and should be ripe for efficiency upgrades (Figure 3.5). Another opportunity for efficiency gains is in the commercial sector which holds 35% of the built square feet but consumes 60% of the City's electricity. Efficiency improvements in the commercial sector in Miami would have a greater impact per square foot on greenhouse gas emissions than in other sectors.

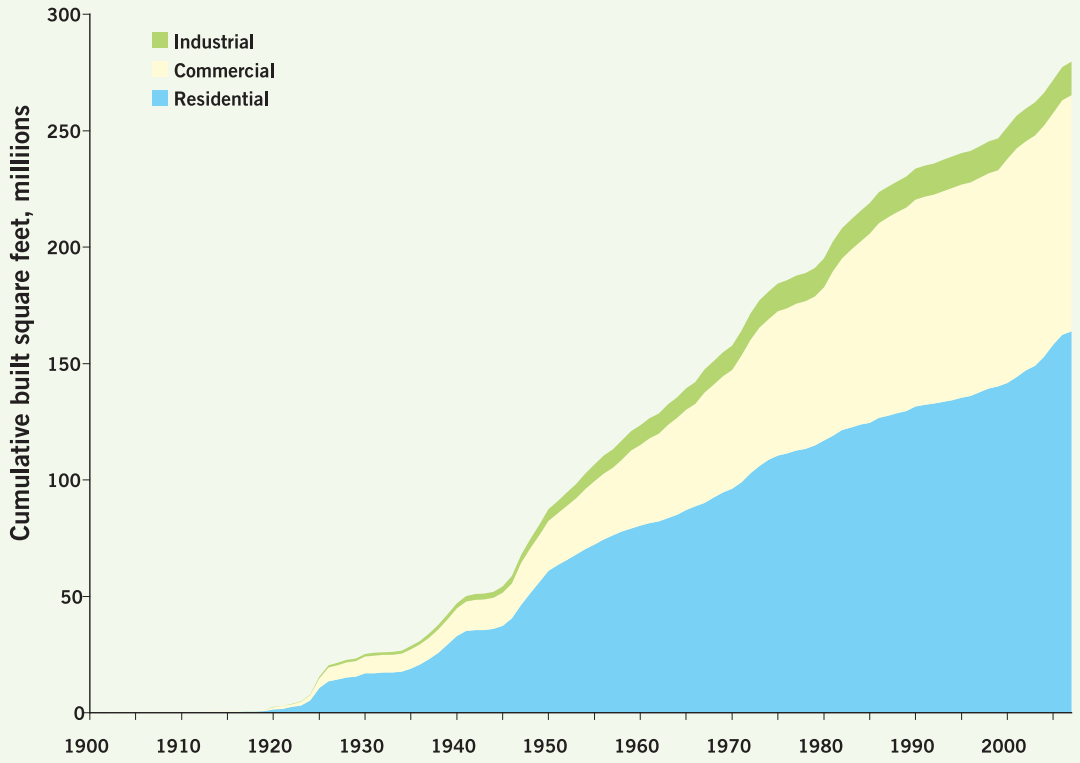



**Figure 3.5:** Cumulative square footage of buildings in the City of Miami over time.

Transportation accounts for 40% of Miami's greenhouse gas emissions and those emissions are likely to increase without action. In Miami-Dade County, vehicle mileage was 14 billion miles in 1997 and reached almost 21 billion miles in 2006. (Figure 3.6) This increasing mileage has taken

its toll on the Miami commute. A recent survey of 10 large cities ranked Miami third in the nation for "commuter pain."[15] The use of alternative transportation is small relative to automobiles. In recent years, Miami-Dade Transit averaged 0.4 billion passenger miles annually and increased more slowly than vehicle miles traveled. (Figure 3.6)

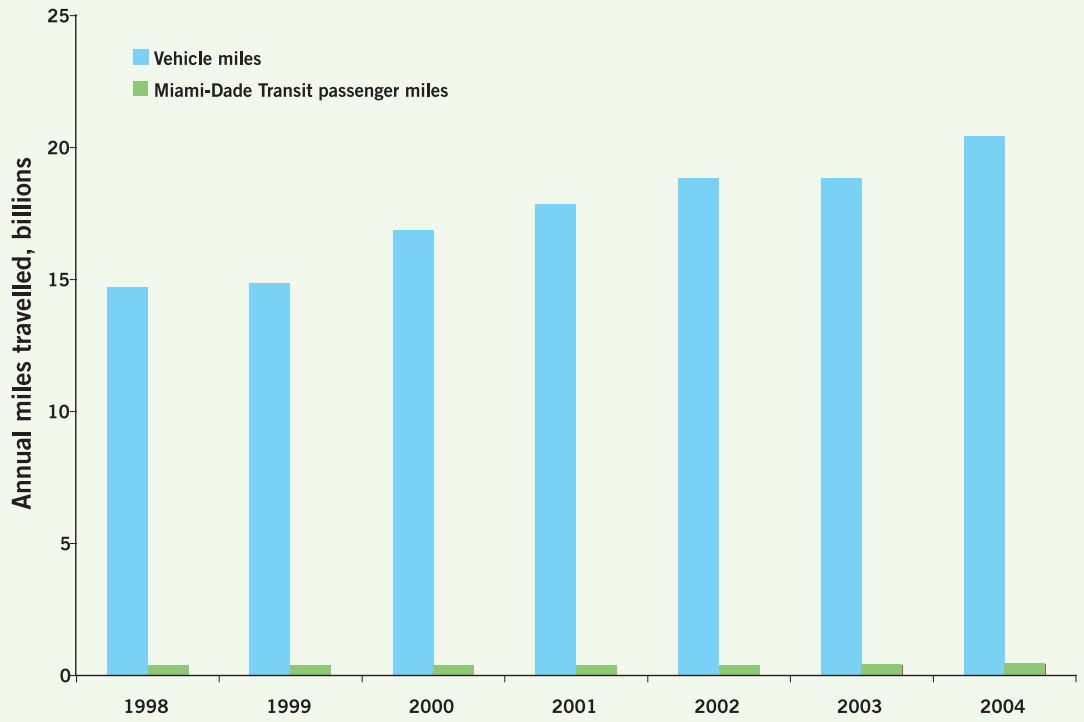



**Figure 3.6:** Miami Dade County vehicle miles traveled and passenger miles traveled on Miami Dade Transit.[16,17]

15 Janet Caldow Institute for Electronic Government, IBM Corporation, (2008). "Feeling the Pain: The Impact of Traffic Congestion on Commuters " http://www-03.ibm.com/press/attachments/IBM_Traffic_Congestion_WhitePaper.pdf.

16 State of Florida. Department of Transportation Planning Office, Public Road Mileage Reports. http://www.dot.state.fl.us/planning/statistics/mileagereports/default.htm.

17 American Public Transportation Association, Public Transportation Ridership Statistics. http://www.apta.com/research/stats/ridership/. Note no mass transit ridership data was available for the year 2000. A value was extrapolated using available data.

## 3.3 Government Emissions

Greenhouse gas emissions from City of Miami government operations totaled 82,414 metric tons of $CO_{2e}$ in the year 2007, which is approximately 1.7% of the City's total emissions. Figure 3.7 presents the distribution of greenhouse gas emissions from City government by sector. Buildings account for 39% of the City government's $CO_{2e}$ emissions. The City's fleet represents 26% of the City's emissions and the employee commute is estimated to contribute 19% of the city's emissions. Electricity used to power streetlights represented 15% of the emissions and solid waste contributed 1%.

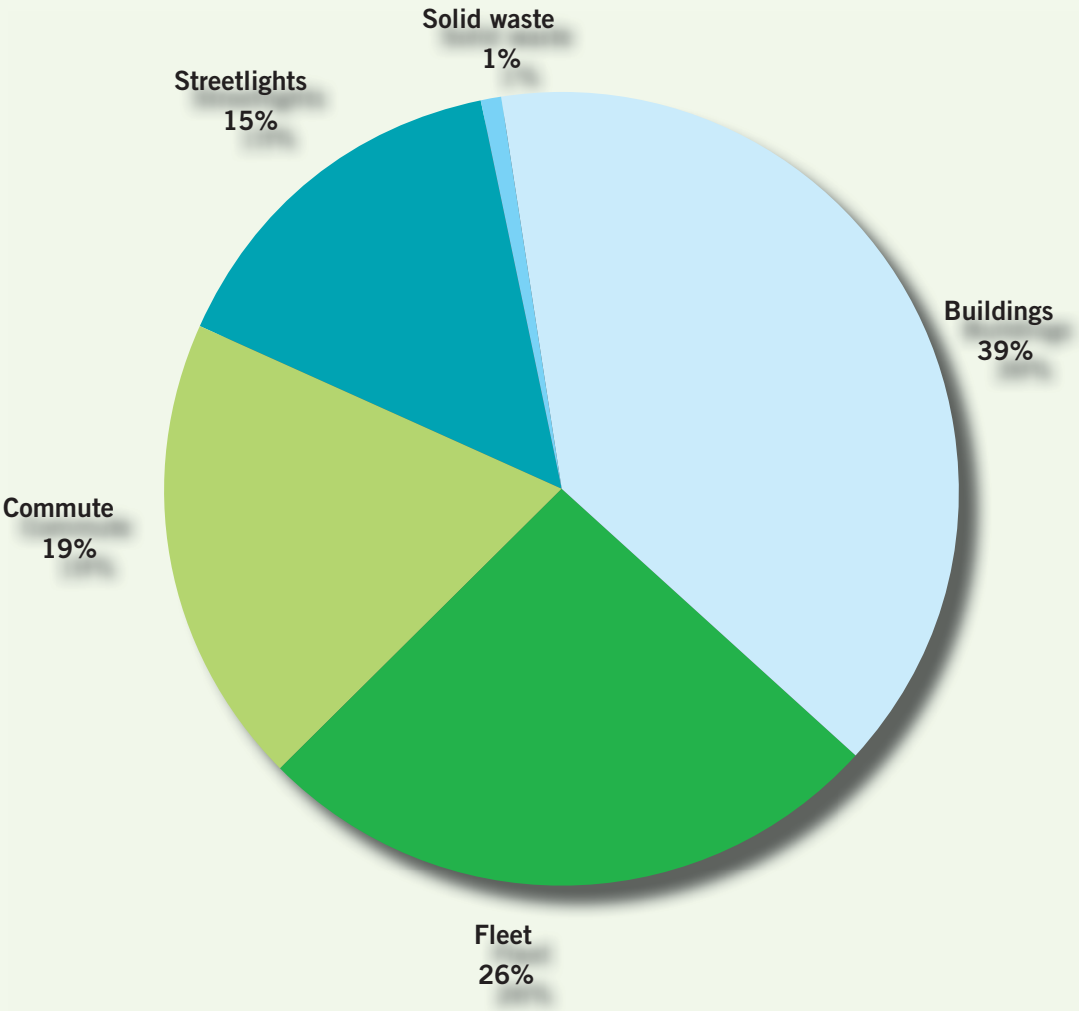



**Figure 3.7:** 2007 Miami government greenhouse gas emissions by sector.

Figure 3.8 presents the City government greenhouse gas emissions by source. Electricity comprises 54% of City government's greenhouse gas emissions. Transportation fuels represent 45% of the City's greenhouse gas emissions. Solid waste comprises 1%.

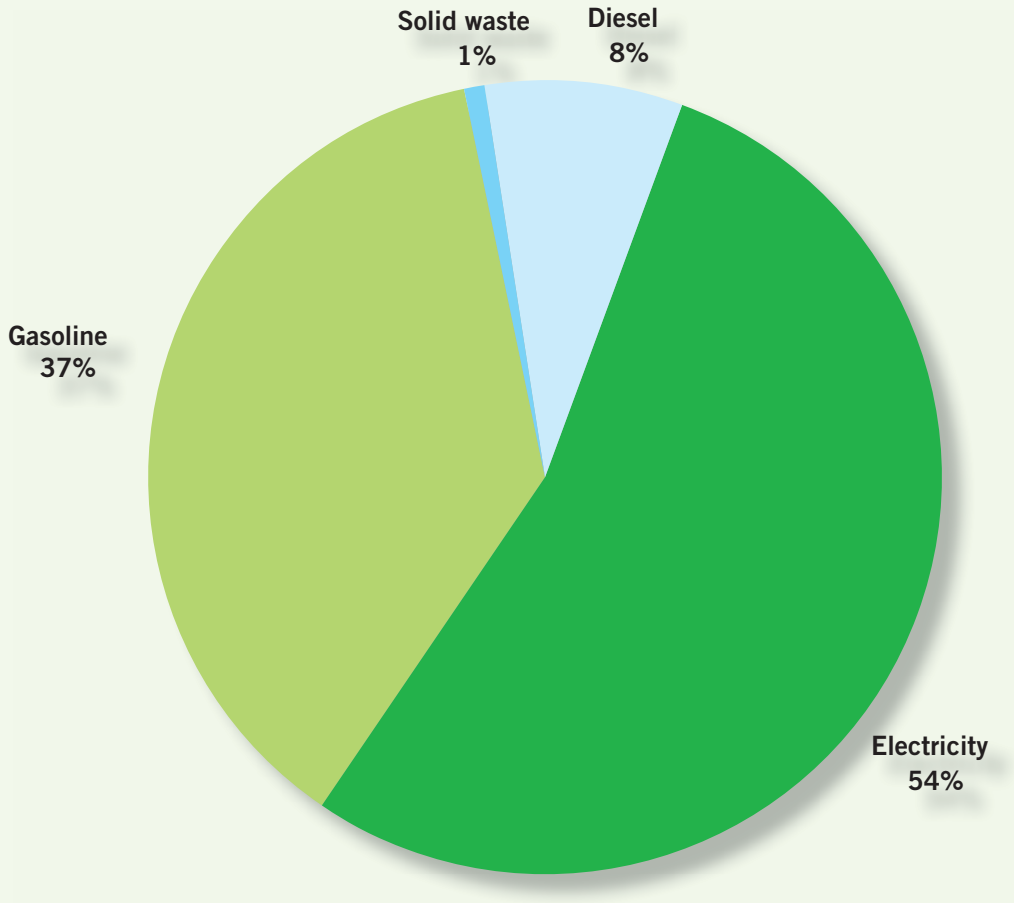



**Figure 3.8:** 2007 Miami government greenhouse gas emissions by source.

Like buildings citywide, government buildings consume almost exclusively electricity. The distribution of consumption among City government departments is shown in Figure 3.9. The largest fraction is consumed by the City's Public Facilities (38%), Parks (16%) and Off-Street Parking facilities (11%). This group of the City's publicly used properties totals 65% of the City's emissions from buildings. The Police and Fire departments combined account for 19% of the City's emissions form electricity. The City's own administration buildings are responsible for 11% of the emissions from electricity.

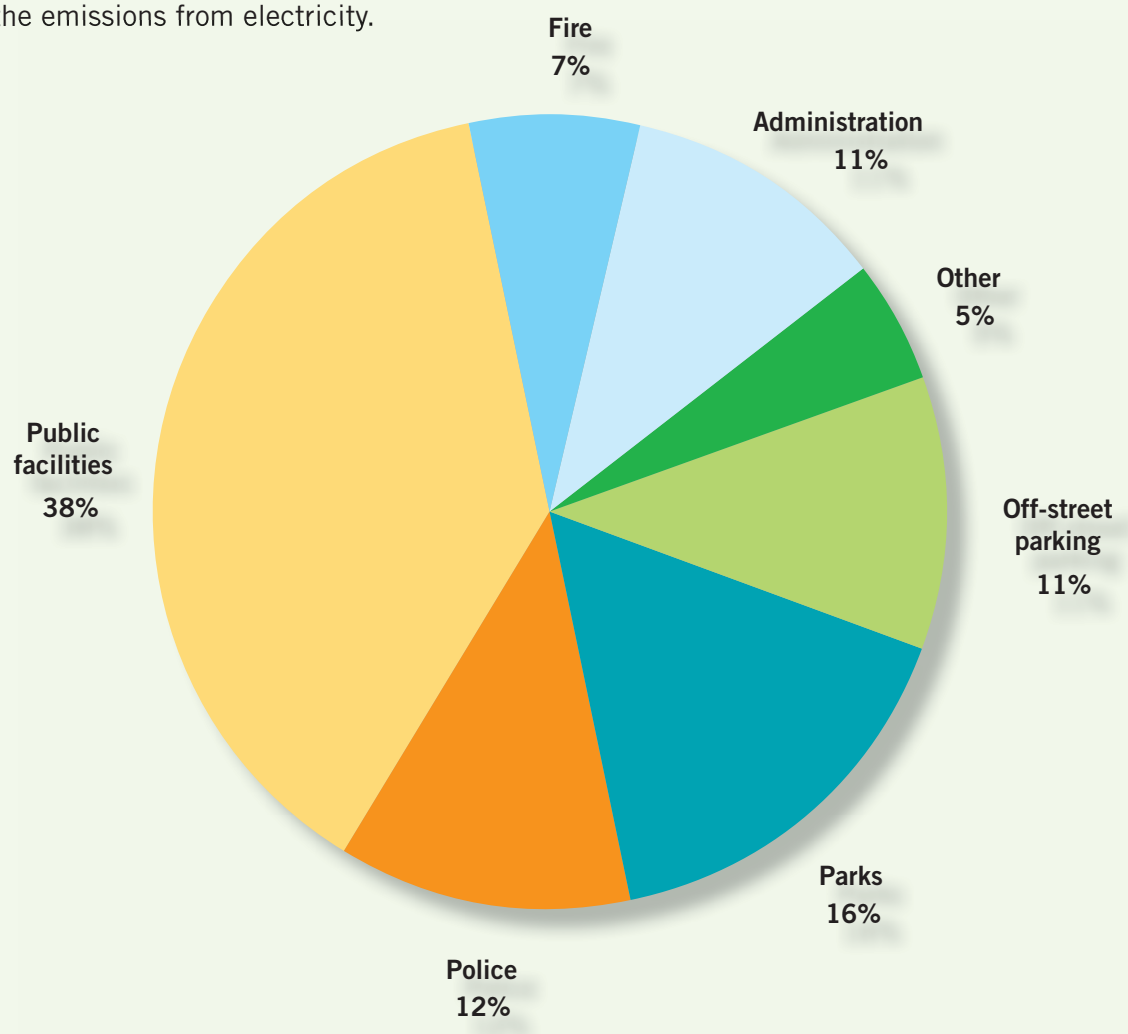



**Figure 3.9:** Distribution of greenhouse gas emissions from building electricity consumption by government department.

In 2006, the City government used over 600,000 gallons of diesel fuel and almost 1,600,000 gallons of gasoline. Over three-quarters of the gasoline was consumed by the Police Department. Almost all of the diesel fuel was used by the Fire and Solid Waste Departments.

Employee commutes generated almost as much greenhouse gas emissions as the City government fleet. A survey was conducted of City of Miami employees to determine how they travel to work. Of the almost 500 respondents, 82% drive alone, 9% car pool, 7% take mass transit, and 1% walk or bicycle. (Figure 3.10) Nationally, only 75% of Americans drive alone and 12% car pool.[18] This reflects the car dependence of Miami.

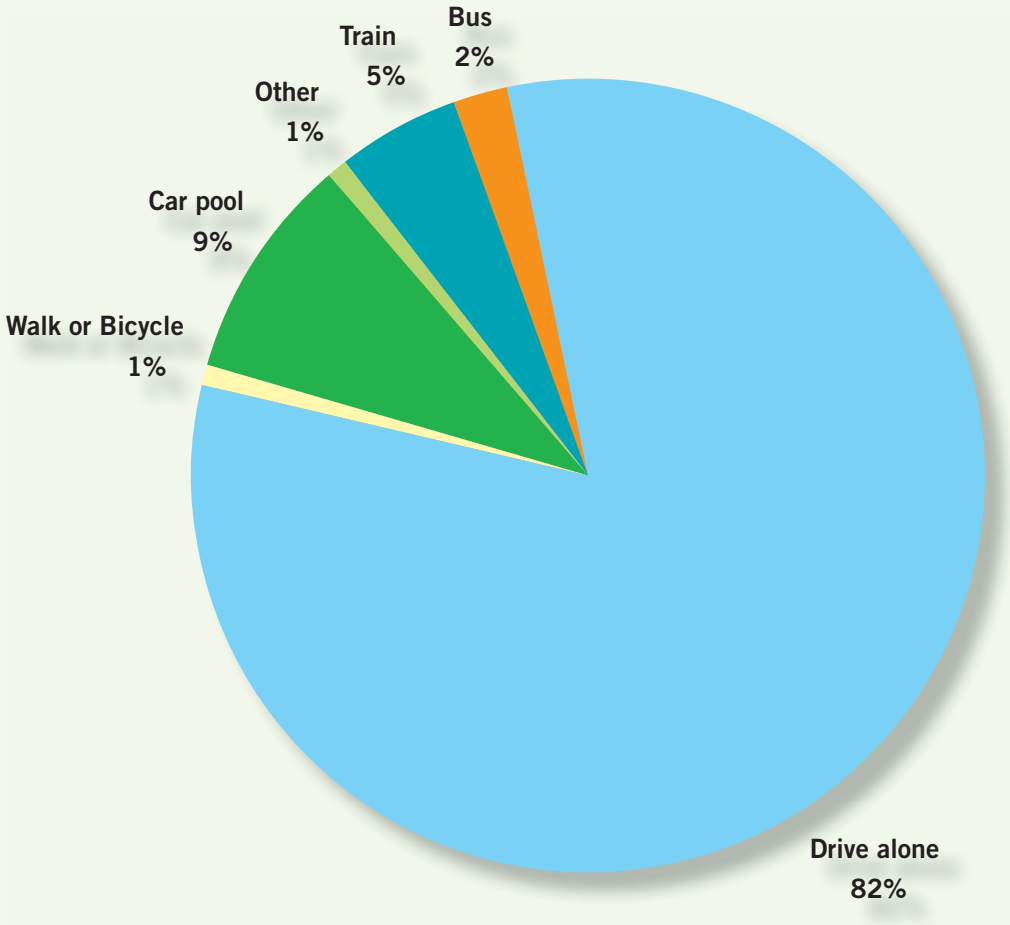



**Figure 3.10:** Primary means of commuting for City of Miami government employees.

[18] Transportation Research Board of the Americas, (2006), "Commuting in American III: The Third National Report on Commuting Patterns and Trends". http://onlinepubs.trb.org/onlinepubs/nchrp/CIAIII.pdf.

# 4.0 Reduction Targets

Data for the City of Miami's past greenhouse gas emissions was not directly available. However, an estimate of City growth was derived from review of current and past inventories for the State of Florida and Miami-Dade County. In recent years, the County population increased by an annual rate of 1.4% and per capita greenhouse gas emissions increased by an annual rate of 0.5%, while the population of the City of Miami increased at a rate of 0.8% per year.[19,20] The growth of City of Miami $CO_{2e}$ emissions were estimated by combining the City's population growth rate with the County's per capita greenhouse gas emissions growth rate. Based on these projections, under a business-as-usual scenario, the City's greenhouse gas emissions would increase from 4.8 to 5.7 million metric tons per year by 2020.

Based on this analysis, on the feasibility of likely reductions, and on the risks of climate change, the City of Miami has selected a target of reducing its greenhouse gas emissions 25% below 2006 levels by the year 2020, to 3.6 million metric tons, as shown in Figure 4.1. To provide leadership and demonstrate the feasibility of its goals, the City will set target reductions of its government emissions by 25% below 2007 levels by 2015.

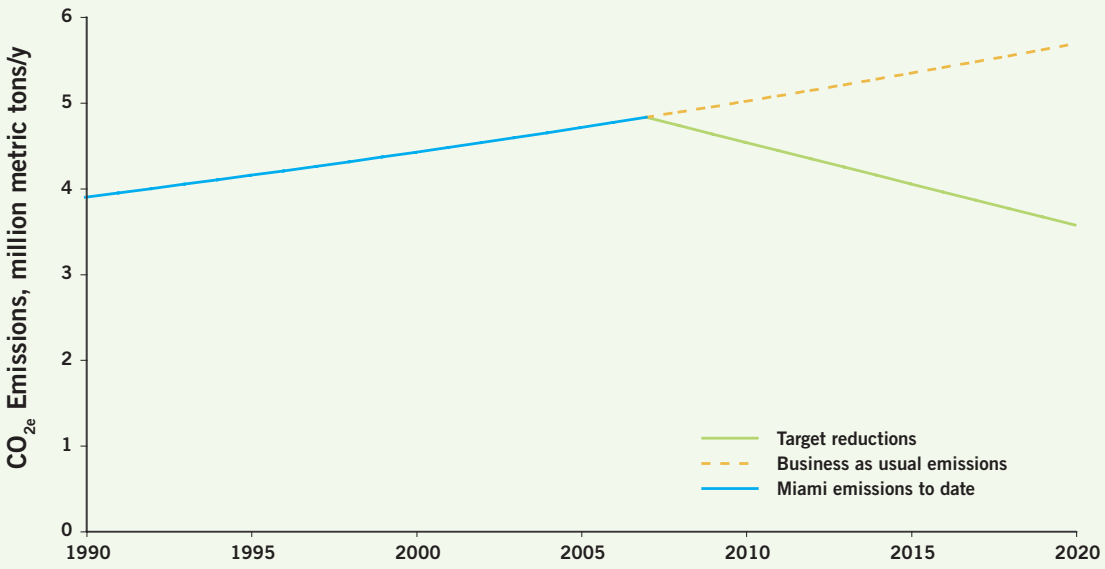



**Figure 4.1:** Projected greenhouse gas emissions and target reductions for the City of Miami.

[19] Miami-Dade County, (2006), "A long term $CO_2$ Reduction Plan for Miami-Dade County, Florida". http://www.miamidade.gov/derm/climate_change_urban_CO2_reduction_plan.asp.

[20] Governor's Action Team on Energy and Climate Change, 2007. Phase 1 Report: Florida's Energy and Climate Change Action Plan Pursuant to Executive Order 07 128. http://www.dep.state.fl.us/climatechange/files/20071101_final_report.pdf.

# 5.0 Recommendations

## 5.1 General Recommendations

The City of Miami's goal of reducing its greenhouse gas emissions by 25% by the year 2020 will require widespread efforts across all sectors of the economy, including substantial reductions within the building, energy, transportation, and land use sectors. Estimates of reductions were assigned to each sector based on potential reduction opportunities. There is no single action or regulation that will achieve the targeted reductions, although the most important efforts will focus on the buildings, energy, and transportation sectors which comprise over 90% of the City's total greenhouse gas emissions. Figure 6.1 shows target greenhouse gas reduction citywide and for different sectors.

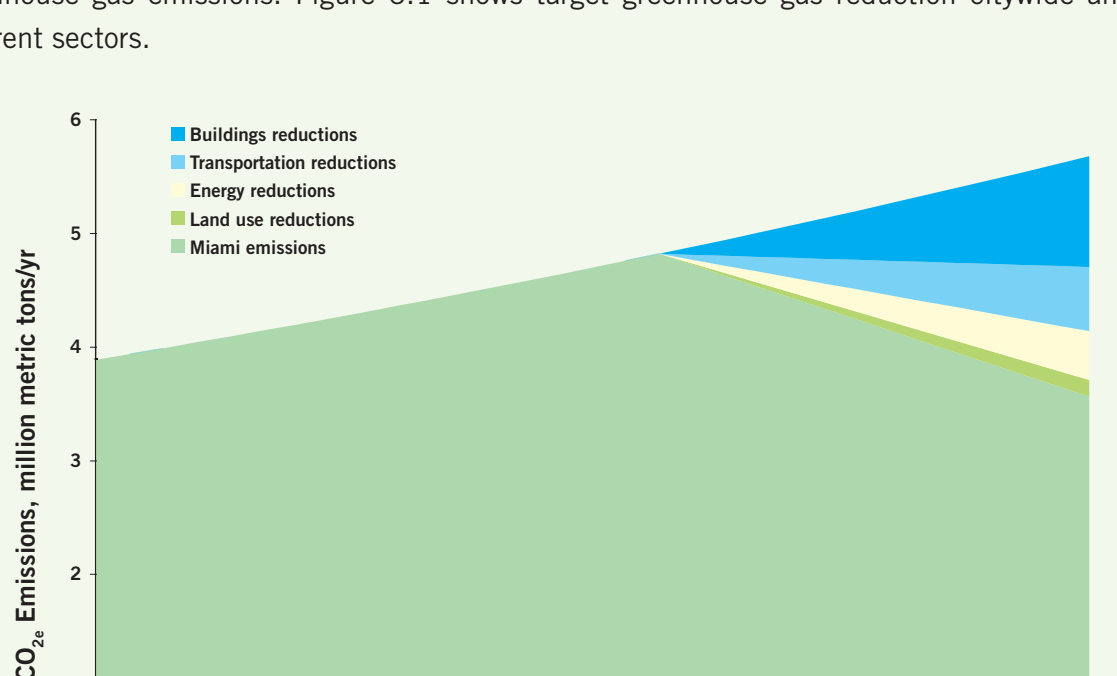



**Figure 5.1:** Target reductions in greenhouse gas emissions for the City of Miami from the buildings, transportation, energy, and land use sectors. If no reductions are achieved, emissions levels will increase to a business as usual level of 5.7 million metric tons of $CO_{2e}$ by 2020. However, if all the targeted reductions are achieved in all sectors, then emissions will drop to 3.6 million metric tons $CO_{2e}$ by 2020, which is the City's goal of 25% of 2006 levels by 2020.

As described in further detail in the sections that follow, the City will reduce greenhouse gas emissions citywide by 25% by the year 2020 by addressing four primary sectors:

- **Buildings:** Buildings are responsible for over 50% of the citywide greenhouse gas emissions. The City will reduce 975,000 metric tons of $CO_{2e}$ by 2020 primarily through improvements in building energy efficiency.
- **Energy:** Electricity from a single utility (Florida Power & Light (FPL)) supplies almost all of Miami's non-transportation energy. The City will reduce 429,000 metric tons of greenhouse gas emissions primarily by increasing the use of renewable and cleaner energy sources and the use of more efficient, local sources of power.
- **Transportation:** The transportation sector produces 40% of the City's greenhouse gas emissions. The City will reduce 565,000 metric tons of greenhouse gas emissions by 2020 by reducing vehicle miles traveled, increasing fuel efficiency, increasing the use of alternatively fueled vehicles, and increasing the availability and use of alternative transit options, such as bicycle lanes and mass transit.
- **Land Use:** Land use contributes to energy uses in both the building and transportation sectors. The City will reduce 148,000 metric tons of greenhouse gas emissions by absorbing new residents in accordance with Smart Growth land planning principles. Such planning would create walkable cities with alternative transportation modes and efficient land-use zoning regulations that create nodes of intensity and have lower uses of automobiles.

To meet the targets set in the plan, many of the recommendations below will require cooperation of the City with its residents, with other governments and agencies, with utilities, and with the private sector. The City cannot accomplish these tasks alone. A successful Climate Action Plan and also a successful effort to limit greenhouse gas emissions require cooperation across many borders.

The scope of this climate action plan is limited to actions which will most significantly mitigate emissions of greenhouse gas from the City of Miami. Because of this scope, MiPlan plan does not address, or mentions only briefly, many other related environmental issues such as tree planting, water conservation, waste reduction, and recycling, among others, which are all still strongly supported by the City.

## 5.2 Specific Recommendations

This section outlines recommended actions for reducing greenhouse gas emissions within the City of Miami. By the middle of 2009, Phase II of the Climate Action Plan will develop specific cost estimates, an investment/financing plan, and specific implementation plans for recommended actions. However, the most significant initiatives will be started shortly after completion of MiPlan. Some actions are already being implemented while others may change in response to new circumstances. **It is recommended that efforts in years 1 through 5 focus primarily on Initiative 1: Increase energy efficiency in buildings.**

### Initiative 1: Increase energy efficiency in buildings

Buildings in the City of Miami total over 280 million square feet, have an assessed value greater than $53 billion, and consume over 5 million MWh of electricity per year. The building sector represents almost 50% of Miami's greenhouse gas emissions and almost all building energy comes from electricity, unlike most other cities which have significant quantity of heating supplied by natural gas and heating oil. Future reductions in greenhouse gas emissions must address energy efficiency in new and existing buildings.


**Photograph 5.1:** Miami buildings at night

The energy efficiency of current buildings can be increased dramatically simply by improving the operation of existing systems. The US EPA estimates that 30% of energy in US buildings is used inefficiently or unnecessarily, such as for the lighting or cooling of unoccupied spaces.

Simple improvements, which can be implemented by homeowners or property managers, may include occupancy sensors or programmable thermostats. Increasing air conditioning set points by 1 degree Fahrenheit are estimated to decrease energy consumption by 3%.

For larger or more complex buildings, a professional commissioning study can fully assess the operational performance of buildings. Commissioning refers to the process of verifying that a building is operating as designed. If a building is not operating as designed, significant amounts of energy can be wasted, due to improper set points, disabled control systems, or poorly installed equipment. The proper sizing and installation of residential HVAC systems, as another example, can greatly reduce unnecessary energy use. Studies have shown that commissioning of operations and maintenance can reduce building energy consumption 5 – 20% with a payback in less than 2 years.[21]

In addition, substantial reductions of greenhouse gas emissions can be achieved by retrofits, which replace older, inefficient equipment with newer more efficient models. Energy retrofits often address motors, controls, lighting, air handling systems, and insulation, among others. Older equipment can be replaced by newer, more efficient equipment, often at a net negative cost, when energy savings are included. Eighty percent of the City's building stock is more than 20 years old and thus ripe for energy improvements. Some mechanisms for energy efficiency, such as performance contracting, provide guarantees that the cost of a project will not be more than the resulting energy savings. Retrofits of air conditioning and refrigeration equipment should also ensure that refrigerants, which are powerful greenhouse gases, causing many times more harm than the same amount of emitted $CO_2$, are reclaimed and recycled in accordance with US EPA rules.

### Action 1-1: Form an alliance to address energy efficiency in buildings.

The City will form an alliance with other government and non-profit organizations, including universities, schools, and hospitals, to aggregate resources for the financing, implementation, and purchasing of services related to increasing energy efficiency in South Florida buildings. In the City of Miami, over 33 million built square feet, or almost 12% of all buildings, belong to government or non-profit groups.

**Specific actions:**

- Create alliance of local building owners in government and non-profit sector to address energy efficiency in buildings by February 2009.
- Identify and implement strategies for the financing and performance of energy

[21] Mills, Friedman, Powell, Bourassa, Claridge, Haasl, Piette, (2004), "The Cost-Effectiveness of Commercial-Buildings Commissioning: A Meta-Analysis of Energy and Non-Energy Impacts in Existing Buildings and New Construction in the United States" Lawrence Berkeley National Laboratory. http://eetd.lbl.gov/Emills/PUBS/PDF/Cx-Costs-Benefits.pdf .

efficiency and renewable energy upgrades in South Florida buildings.

- Use this alliance for increased purchasing power of energy efficiency related financing, services and products.

### Action 1-2: Reduce energy consumption in existing government buildings.

The City will develop a program to substantially decrease energy consumption in its own government buildings. The City government currently spends over $10 million per year on electricity costs with a substantial electricity rate increase likely in the next few months. The program will seek to address energy efficiency in all City government buildings and those of its partners, using tools such as commissioning, energy audits, and retrofits to increase efficiency in the City government's building stock.

**Specific actions:**

- Maintain inventory of all government buildings in an energy portfolio tool, such as Energy Star Portfolio manager.
- Perform commissioning and energy audits of all large city government buildings.
- Perform retrofits of inefficient equipment identified during energy audits, using performance contracting or other appropriate mechanisms.
- Require the City to follow best industry practices in all energy upgrades, including the US EPA Energy Star Quality Installation Program to ensure proper equipment sizing and selection, refrigerant charge, air flow and minimal duct leakage.
- Retrofit all City owned outdoor lighting to high efficiency lighting technologies based on feasibility and life-cycle analysis. High efficiency light options to be considered may include: Light emitting diodes (LEDs,) induction lighting, and solar powered lights.
- Require any energy service companies (ESCOs) seeking to do business with the City that include guaranteed energy performance savings contracts to achieve a minimum of 25% in efficiency savings. Contract preferences should be given to ESCOs that utilize distributed generation, co-generation and renewable energy systems as outlined in Initiative 2.
- Lobby the Florida Public Service Commission and FPL to adopt more energy efficient technologies for street lighting and other applications.
- Require purchasing of Energy Star rated equipment in City operations.

### Action 1-3: Reduce energy consumption in existing private buildings.

Based on the City's efforts to increase efficiency in existing government buildings, the City will develop a program to address energy efficiency in the City's private building stock. Despite recent building booms, over 80% of the City's building stock is greater than 20 years old. The program will apply the same tools as used for government buildings to the private building stock: commissioning, energy audits, and quality equipment retrofits.

**Specific actions:**

- Develop citywide energy upgrade program which addresses financing and mechanisms to allow performance of energy audits, commissioning, performance contracting, and other energy efficiency and renewable energy upgrades in citywide buildings. This program should mandate energy improvements during major renovations and/or a point of sale and should require that all energy upgrades follow industry best practices such as the US EPA Energy Star Quality Installation.
- Develop financial incentives for energy efficiency improvements and disincentives for energy inefficiency. Mechanisms for these incentives and disincentives may include permitting fees and property taxes. A measure of efficiency, such as kilowatt hours per square foot, should be selected to determine inefficiency.
- Require a certificate certifying compliance with the refrigerant reclamation and recycling requirements of Section 608 of the Clean Air Act of 1990 and associated US EPA regulations for all HVAC system replacement projects performed in citywide buildings and for all commercial refrigeration replacement projects performed in citywide grocery stores and restaurants.
- Work with local utilities, retailers, and contractors to promote energy efficiency efforts and ensure best practices are utilized .
- Develop policy for minimum efficiency standards in affordable housing program.
- Develop a program to encourage energy conservation in the homes of part-time residents while their units are vacant.
- Incorporate strategic tree planting for energy efficiency into the Green Miami tree planting campaign.

### Action 1-4: Reduce energy consumption in all new construction.

Over the last 10 years, the City has added 36 million square feet of new construction. Implementation of green building strategies is cheapest at the time of construction. The City will require that both government and citywide new construction are built to green building standards.

**Specific actions:**

- Develop mandates and incentives for green buildings.
    - All buildings over 50,000 square feet should meet Leadership in Energy and Environmental Design (LEED) silver requirements.
    - Provide density bonuses and expedited permitting for green buildings.
- Require all City government buildings over 5,000 square feet to be built to a minimum LEED silver certification.
- Promote improvement of energy codes and energy efficiency of new construction, such as the "30% Solution" proposed by the Energy Efficient Codes Coalition and the "2030 Challenge" by American Institute of Architects.

### Action 1-5: Reduce the heat island effect.

Urban areas are known to have temperatures elevated by as much as 10 degrees Fahrenheit relative to rural areas. This is referred to as the heat island effect. The primary causes of the heat island effect are removal of trees and vegetation, trapping of air by buildings and narrow streets, and waste heat from buildings and vehicles. Strategies to reduce the impact of the heat island include increasing shade by tree cover and/or increasing the reflectiveness of materials in the built environment. In urban areas, the US EPA estimates that 3-8% of energy consumption is due to the heat island effect. Strategic tree planting can reduce energy consumptions by up to 25% in some buildings. Addressing the heat island effect can have the dual benefits of reducing the City's cooling load and increasing carbon sequestration through tree planting.

**Specific actions:**

- Require roofs on new construction to be designed to mitigate the heat island effect through high solar reflectiveness, green roofs or other means.
- Provide incentives for existing buildings to increase the solar reflectiveness of their roofs or to convert to green roofs.
- Implement the City's Tree Master Plan to increase the City's tree canopy to 30% by 2012 and to ensure that trees are planted in a manner which promotes tree survival and benefit to the environment. Currently, the tree canopy is as low as 10% in some areas and the City is determining the amount of trees needed to bring the canopy to 30% coverage.
- Hire an Urban Forester to promote tree plantings and build the city's tree infrastructure.

- Require the reduction of paved surfaces and where paved surfaces cannot be avoided require pervious and/or highly reflective paving. Where the city does not directly control paved surfaces, the City should encourage other authorities to utilize cool pavement technologies.
- Promote the construction of carport canopies to be used for shading and distributed renewable energy generation.

### Action 1-6: Educate the business sector and the public on energy efficiency in homes and businesses.

Efforts at increasing energy efficiency in the City's buildings must be coupled with culturally competent educational efforts dedicated to improving acceptance of energy efficiency efforts and to making the community aware of the resources available for energy efficiency improvements. Efforts should address the barriers to energy efficiency and promote behavior change through social marketing techniques.

**Specific actions:**

- Develop green building lab, "Miami Green Lab", as a resource and demonstration site for commercial, government, and residential communities.
- Develop educational programs on energy efficiency, distributed generation, and renewable energy systems in buildings for homeowners, businesses, government staff, and those in the building industries, partnering with the US Green Building Council, Florida Green Building Coalition, BOMA, FPL and other relevant organizations.
- Encourage maximum participation by residents and business owners in the City's energy efficiency programs through marketing and education.
- Educate government purchasing agents in each City department regarding the benefits of Energy Star rated equipment, including the cost savings to the city.
- Encourage community input on strategies for improving energy efficiency in buildings

**Action 1-7: Review progress on increasing energy efficiency in buildings.** The City will review its energy efficiency progress annually.

**Progress indicators**

- Consumption of energy by City government buildings.
- Consumption of energy by citywide buildings.

## Initiative 2: Reduce greenhouse gas emissions from energy generation

Significant long-term reductions in greenhouse gas emissions will also require substantial changes in the sources of the City's energy. For instance, FPL reduced their $CO_2$ emissions per KWh by over 10% between 2003 and 2006 by changing their energy mix. In those years, they have halved their use of oil and increased their use of more efficient natural gas by over 40%. To meet MiPlan reduction goals, the City will need to develop distributed power and cogeneration, and substantially increase the use of renewable energy sources such as solar or wind power, as well as more efficient fossil fuel sources, such as natural gas.

### Action 2-1. Increase the use of distributed generation and cogeneration.

Distributed local power can offer several benefits, including greater efficiency and greater reliability because the impact of a system failure is smaller in scale than with a centralized power system. Cogeneration can offer substantially greater efficiency by reclaiming waste heat from electricity generation to generate cooling.

**Specific actions:**

- Identify barriers to cogeneration and lobby the state to remove barriers.
- Develop or provide incentives for distributed cogeneration projects in the City.
- Encourage expansion of natural gas service areas to facilitate additional distributed generation.
- Identify and encourage multi-building district heating and cooling systems.
- Encourage co-generation projects in the City that utilize emissions-free power generation.

### Action 2-2. Increase the use of renewable energy sources.

The most significant reductions in greenhouse gas emissions can be obtained by switching to renewable energy sources, such as solar, wind power, geothermal, methane extraction, and hydropower both at the retail and wholesale level. Solar, wind power, geothermal and hydropower offer the benefit of zero emissions energy. The City will monitor the increasingly competitive costs of renewable energy technologies that are available relative to conventional energy technologies. Because of their future importance in reducing greenhouse gas emissions, it is imperative that the City take steps to foster the future development of renewable energy. This should be done by both encouraging local sources of alternative energy and by encouraging utilities to increase their use of renewable energies.

Solar energy is one of the most promising renewable energy technologies, particularly for South Florida. In South Florida, solar water heating is currently the most economically feasible of renewable energy technologies. With current state and federal incentives, solar water heating has a payback period of 3 to 5 years. South Florida also has great potential for generating electricity form solar photovoltaic (PV) cells. The Florida Solar Energy Center has found that Florida has better potential than most of the nation for use of PV.[22] Currently, state rebates and federal tax incentives are available for PV. As technologies evolve, more renewable energy sources will become feasible in South Florida. Currently, the use of wind, geothermal, and biomass to energy are gaining ground in some areas and the City has an opportunity to capitalize on the growth of these green industries.

**Specific actions:**

- The City should develop a policy to foster the growth and remove barriers for all renewable energy development within the City.
- Support all appropriate changes to the Florida Building Code that are both safe and contribute to the development of renewable energy.
- Implement the use of solar hot water heating within City government facilities by replacing existing hot water systems.
- Promote the installation of distributed, renewable energy systems for citywide homes and businesses through the City's energy efficiency programs.
- Encourage local adoption of solar systems through additional tax incentives and/or rebates.
- Explore facilitation of bulk purchases of solar equipment for businesses.
- Develop additional on-site generation projects at City facilities and other locations in the alliances formed in Action 1-1.
- Encourage companies engaged in the manufacture of PV systems and other renewable energy industries to open offices in the Miami area.

[22] Florida Solar Energy Center, (2007), "Does the "Sunshine" State have a sufficient solar resource to support solar energy applications?" http://www.fsec.ucf.edu/en/media/enews/2007/2007-04_Sunshine_state.htm.

### Action 2-3: Encourage utilities to further decrease greenhouse gas emissions.

FPL has reduced its emissions per unit of energy generated by over 10% between 2003 and 2006 as shown in Figure 3.4. This is promising but further reductions are needed.

**Specific actions:**

- Lobby local utilities and the Florida Public Service Commission to increase the use of renewable and less carbon intensive energy sources within the State of Florida and to change rate structures to further allow utilities to profit from efficiency rather than consumption.

### Action 2-4: Education on alternative energy.

The residential and business community needs more information about renewable energy sources, their availability, costs, and financial incentives.

**Specific actions:**

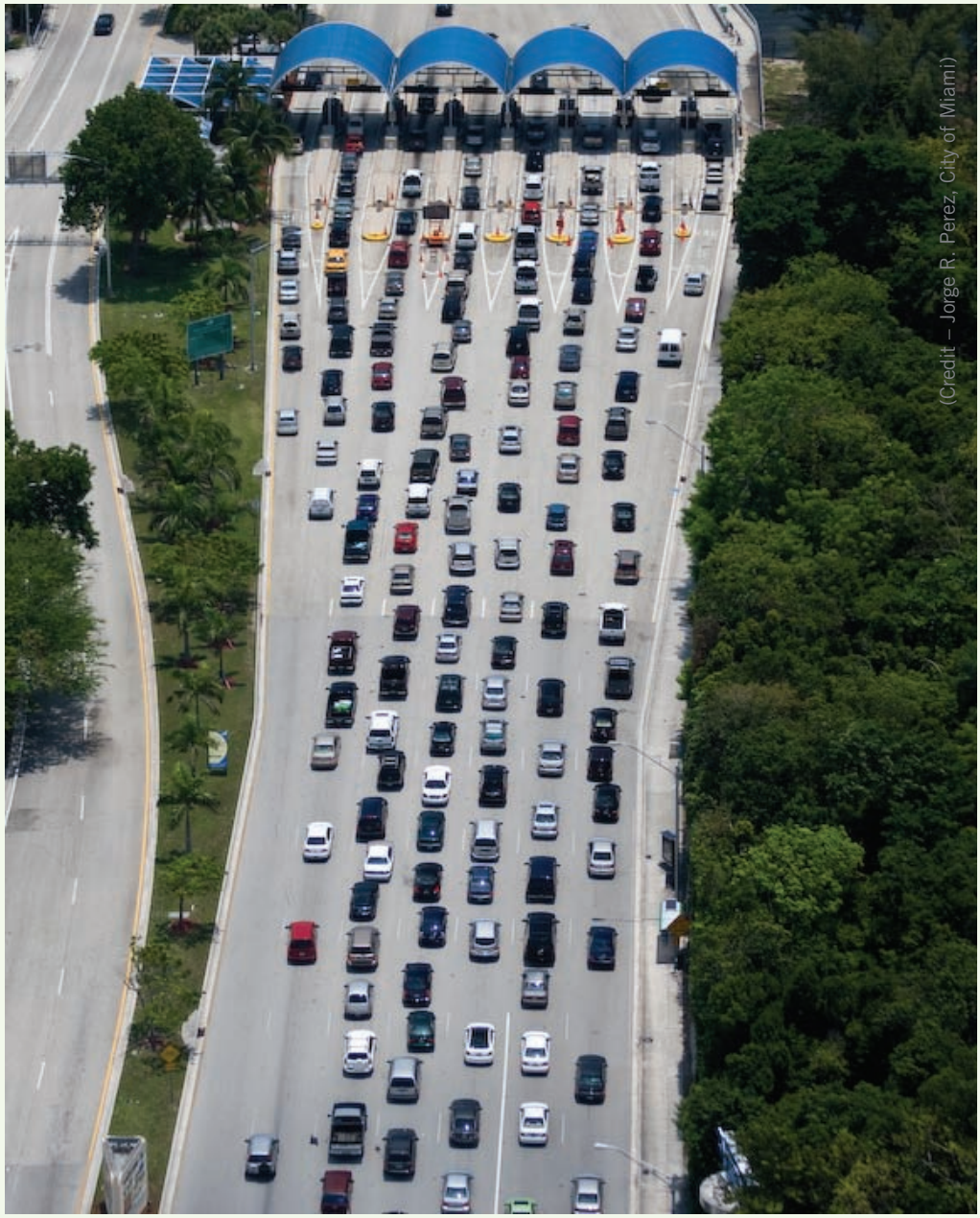
- Develop targeted campaign to remove the barriers to solar use and promote current and future tax incentives and rebates.
- Promote the benefits of solar water heating and other renewable energy sources through a targeted media campaign, including increasing awareness of the state net-metering laws.
- Encourage community input on strategies to utilize renewable energy in Miami.

### Action 2-5: Review progress on reduction of greenhouse gas emissions from energy generation.

Annually, the City will review its progress in this area, by evaluating the following parameters.

**Progress indicators**

- Reduction in City's greenhouse gas emissions per unit of energy produced.




**Photograph 5.2:** Traffic approaching Rickenbacker Causeway Tollbooth.

## Initiative 3: Reduce emissions from transportation

Transportation accounts for approximately 40% of the City's greenhouse gas emissions. Greenhouse gas emissions from transportation will be accomplished primarily through three strategies: (1) reducing vehicle miles traveled by encouraging alternative transportation and reducing worker commutes; (2) increasing fuel efficiency of vehicles; and (3) switching to less carbon intensive fuel sources.

### Action 3-1: Facilitate and encourage alternative means of transportation.

The City should facilitate and encourage the use of public transportation, walking, carpooling, and bicycling. The City should develop a program that supports these means of transportation and removes barriers to their adoption for its own employees, City residents, and for local businesses.

**Specific actions:**

- The City should work with Miami-Dade County and State of Florida to increase funding for mass transit.
- Develop and implement Bicycle Action Plan, which will include increases in the total bicycle lane miles within the city.
- Create parking demand strategies which encourage the use of efficient vehicles, carpools, and alternative transportation. This plan should address City government facilities, on street parking, and commercial parking.
- Work with the county and state plans to create a road pricing plan which encourages the use of efficient and alternative transportation.
- Lobby the county, state, and federal governments to increase funding for mass transportation and to make funding for public transportation a budgetary priority.
- Provide and encourage local shuttles, jitneys, trolleys, and people mover (where appropriate) to connect public transportation systems.
- Encourage employers and local governments to subsidize mass transit usage and fees.

### Action 3-2: Increase telecommuting, compressed workweeks and flexible hours.

Many businesses and governments now offer their employees the opportunity to work from home, to work compressed work weeks, and/or to work flexible hours. These strategies can reduce and eliminate trips to the office, reduce traffic congestion, and can be considered a benefit for employees.

**Specific actions:**

- The City of Miami should develop a program to offer compressed work weeks, telecommuting, and flexible hours for applicable City government employees.
- The City should promote the use of telecommuting, compressed work weeks, and flexible hours by local businesses.

### Action 3-3: Encourage higher fuel efficiency in vehicles.

The automobile will be a significant fixture of modern society for the foreseeable future. Efforts to reduce greenhouse gas emissions from the transportation sector must include increasing the fuel efficiency of automobiles. Current federal standards will increase the fuel economy of new cars to an average of 35 mpg by the year 2020. However, it should be noted that federal fuel economy standards by themselves are unlikely to decrease greenhouse gas emissions below current levels, given current trends of increases in vehicle miles traveled (VMT). Therefore, increases in fuel efficiency must be paired with efforts to reduce VMT and utilize alternative fuels. The City should take steps to encourage the use of fuel-efficient vehicles within the City of Miami, including:

**Specific actions**

- Provide preferred parking, reduced parking fees, reduced tolls, and sales tax incentives for fuel-efficient vehicles.
- City government operations should purchase additional fuel-efficient vehicles for its own fleet, increasing the fuel efficiency of new vehicles by 5% each year. Where feasible, the City should purchase alternatively fueled vehicles, such as hybrid, electric and/or biofueled.
- Lobby federal and state governments to further increase fuel efficiency standards for automobiles.
- Develop a policy to require City government vendors and contractors to utilize environmentally friendly vehicle fleets for their City work.

### Action 3-4: Encourage uses of alternative fuels in transportation.

For vehicle transportation, there are currently multiple alternative fuel technologies being explored. These include electric cars, plug-in cars, biofuels, and hydrogen fuel cells. All offer the potential for substantial greenhouse gas reductions. Emissions associated with both electric cars and hydrogen fuel cells can approach zero emissions if a wind or solar source is used to charge these vehicles. Biofuels derived from waste products can have substantially lowered emissions relative to conventional fossil fuels. The manufacture of biofuels is constantly evolving. At present, there is some uncertainty about the environmental benefits of biofuels, particularly those derived from food sources grown on land which could otherwise be used for food production, or which use substantial quantities of fossil fuel in their production. However, the use of biofuels derived from waste products such as waste vegetable oil or from cellulosic materials clearly reduces greenhouse gas emissions. These more sustainable means of producing biofuels, which are currently available, have not yet been implemented on a widespread basis.

**Specific actions:**

- Provide preferred parking, discounted parking, reduced tolls, access to express lanes, and support reduced sales taxes for plug-in, electric, and fuel cell vehicles.
- Promote the use of sustainably sourced biofuels. Encourage the use of local waste oils as fuels.
- Increase use of sustainably sourced biofuel in City fleet to 20% by 2015.

### Action 3-5: Education and Outreach.

The City will provide educational programs in the area of transportation.

**Specific actions:**

- Work with partner organizations to promote awareness of commuter programs and benefits.
- Develop educational campaign to promote high fuel efficiency and alternative vehicles.
- Partner with South Florida Commuter Services to promote commuting options to City employees and City businesses.
- Encourage community input on strategies for reducing greenhouse gas emissions from transportation.

### Action 3-6: Progress indicators.

The City will conduct an annual review of its efforts to reduce greenhouse gas emissions from the transportation sector. Items to be reviewed will include:

**Progress indicators**

- City government's annual reduction in fuel consumption.
- Citywide annual reduction in fuel consumption
- Annual increase in the number of bike paths across City.
- Annual reduction in vehicle miles traveled within the City.

## Initiative 4: Land Use.

Greenhouse gas emissions per capita are lowest in cities which have the densest populations and are built around public transportation, such as New York and London. Development should emphasize access to public transportation, walkability, bicycle access, decreased parking, and mixed-use zoning. Over the next 12 years at recent growth rates, the City would absorb another 50,000 residents, representing a 12% increase in the City's population. How the City absorbs these future residents will significantly affect the carbon footprint citywide. The principles of smart growth embodied in Miami 21 include growth by infill and redevelopment, new development focused on nodes of transportation, and access to alternative means of transportation.

### Action 4-1: Adopt land use strategies which encourage Smart Growth.

Miami 21, a rewrite of the City's zoning code, follows the principles of Smart Growth land use which encourages energy efficient transportation by development which lessens dependence on cars.

**Specific actions:**

- The approval of Miami 21 would transform the built environment to support Smart Growth and energy-efficient living. Specifically, Miami 21 would:
    - Coordinate land use and zoning to encourage Smart Growth techniques to facilitate living, working, and conducting daily service activities within a ¼ mile of most residents.
    - Improve the built environment through redevelopment creating pedestrian-friendly shaded sidewalks.

### Initiative 5: Adaptation planning.

Based on current scientific predictions that a rise in sea level is inevitable in the next century and because of Miami's low elevation, even a small sea level rise will have an impact on the City, including the flooding of some areas and saltwater intrusion on the drinking water supply. It is imperative that City government begin to consider the impact of climate change in future planning and land use decisions.

#### Action 5-1: Begin process of planning for climate change impacts.

**Specific actions:**

- Incorporate climate change into long-term planning, including the likely impacts of sea level rise on current and future infrastructure, flood mitigation, water supply risk, and health impacts of increased temperatures.
- Increase water management efforts including water conservation, pollution prevention, and water resource planning.

## 5.3 Implementation

Over the next six months to one year, the City will develop a plan for the implementation of the Climate Action Plan. The plan will address the specifics of implementation including responsible parties, timelines, likely quantity of $CO_{2e}$ reductions, financing strategies, costs of implementation, as well as revenues and staffing needs. The City will work closely with other local governments to implement MiPlan, including Miami-Dade County, which has a long history of working on climate change issues, and the State of Florida, which has established a strong climate change initiative.

## 5.4 Monitoring

Annually, the City will review its greenhouse gas emissions and the reductions achieved by its actions. Where reductions appear to be falling short of goals, the City will review its action plan and make revisions where appropriate to improve attainment of reduction goals. The results of this monitoring will be compiled in an annual written report which should be included among the City's annual goals.

# APPENDIX A - Acknowledgements

This plan was prepared by the collaboration with many members of the City government and the community over a very short period of time. We would like to thank them all for their assistance and apologize to any whose names were omitted.

**Photograph A.1:** Meeting of Green Commission MiPlan Subcommittee

Mayor Manuel A. Diaz
Commissioner Angel Gonzalez
Commissioner Tomas P. Regalado
Commissioner Joe M. Sanchez,
*Chair of the Green Commission*
Commissioner Marc Sarnoff,
*Chair of the MiPlan Committee*
Commissioner Michelle Spence-Jones
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Lissette Lopez
Donald Lutton
Steven Margolis
Judy Marsie-Hazen
Julia Martin
Alex Martinez
Anna Medina
Lilia Medina
Chris Morales
Victor Morales
Keith Ng
Dorcas Perez
Jorge R. Perez
Haydee Regueyra
Gisela Rodriguez
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Andrew Vera
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## APPENDIX B – Background Information on Climate Change

According to the US EPA, climate change refers to measurable changes in the earth's climate (such as temperature, wind, or precipitation) which extend over periods of decades or greater.[23] Global warming refers to a specific type of climate change, the increase in temperature of the Earth's atmosphere.[24] Historically, the earth's climate has changed dramatically, from warm periods where the majority of Florida was underwater to the most recent ice age where glaciers covered what are now New York and Chicago. However, these changes occurred gradually and were due to natural causes. Although climate change and global warming can occur from a variety of causes, both natural and manmade, for the purposes of MiPlan, these terms will refer to climate change and global warming due to greenhouse gas emissions associated with human activity.

Today, much of the current climate change can be attributed to human activity and is occurring far more rapidly than in any known era. Greenhouse gases occur naturally in the atmosphere, however, human activity is dramatically increasing their concentration in the atmosphere. Figure B.1 summarizes the greenhouse effect. The term "greenhouse gases" refers to gases in the atmosphere which absorb infrared radiation emitted from the earth. As the amount of greenhouse gases in the atmosphere increases, the fraction of infrared radiation absorbed in the atmosphere increases, which in turn increases the earth's temperature. The increase of global temperature has already started to produce related climate effects such as rising sea levels and melting ice. The greenhouse gas which has the greatest impact on global warming is carbon dioxide ($CO_2$) because it is emitted in much greater quantities than any other greenhouse gas. Other significant greenhouse gases include methane, nitrous oxide, and fluorinated gases. Considered as a group, greenhouse gas concentrations are often reported as carbon dioxide equivalents ($CO_{2e}$).

[23] US EPA, "Climate Change: Basic Information", http://www.epa.gov/climatechange/basicinfo.html.
[24] Ibid.

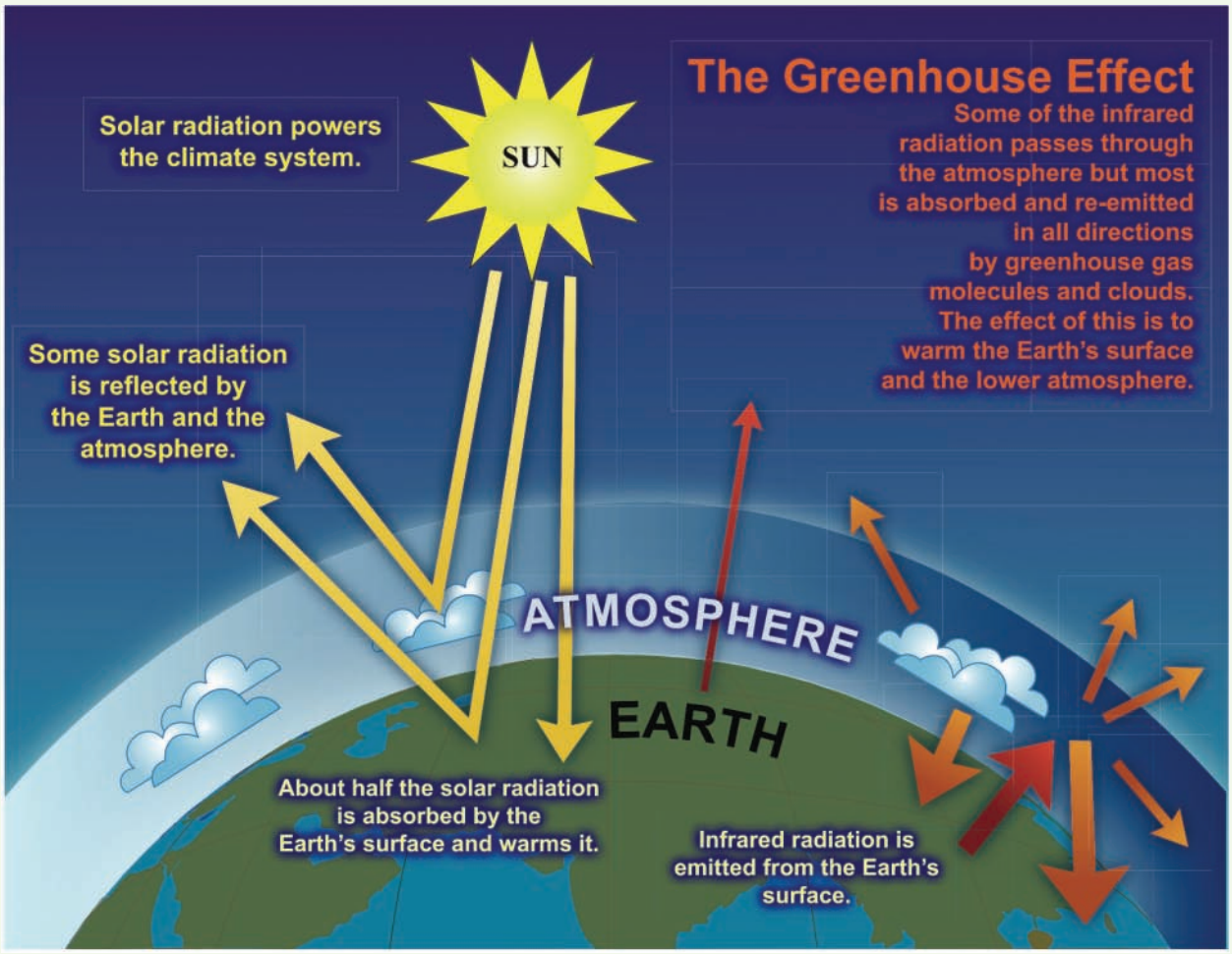


**Figure B.1:** An idealized model of the natural greenhouse effect.
(See referenced IPCC 2007 text for explanation.)[25]

Carbon dioxide (the primary greenhouse gas) concentrations are strongly linked to energy consumption. Approximately 80% of US greenhouse gas emissions are $CO_2$ emissions produced by the combustion of fossil fuels.[26] Since the industrial revolution in the mid-1800s, both the world's

[25] IPCC, "Climate Change (2007) The Physical Science Basis, a report accepted by Working Group I of the Intergovernmental Panel on Climate Change. Frequently Asked Question 1.3: What is the Greenhouse Effect?", http://ipcc-wg1.ucar.edu/wg1/FAQ/wg1_faq-1.3.html.

[26] US EPA, 2008. "Inventory of US Greenhouse Gas Emissions and Sinks: 1990 – 2006." EPA 430-R-08-005. http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf.

population and its energy consumption have increased exponentially (Figure B.2.). As society has become technologically advanced, more and more energy has been consistently needed to build homes, offices, and factories, to transport people, food, and goods, and to power air conditioners, refrigerators, televisions, computers and cell phones. Currently, over 85% of world energy is derived from fossil fuel sources (crude oil, coal, and natural gas) and trends suggest that consumption of energy will continue to increase sharply.

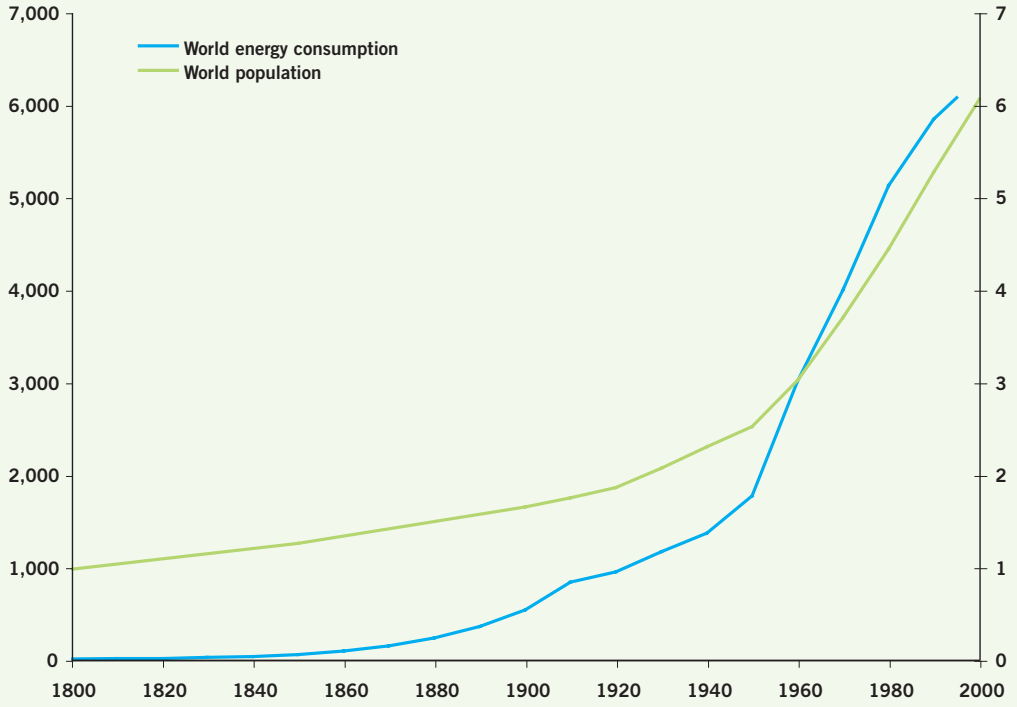


**Figure B.2:** World energy consumption and population over time.[27,28] (Mtoe: million tons of oil equivalents.)

[27] Population Division, Department of Economic and Social Affairs, United Nations Secretariat, (1999), "World at Six Billion". http://www.un.org/esa/population/publications/sixbillion/sixbilcover.pdf.

[28] Netherlands Environmental Assessment Agency, History Database of the Global Environment (HYDE Database) http://www.mnp.nl/en/themasites/hyde/index.html.

Increasing demand for energy has driven a corresponding increase in emissions of $CO_2$ and the concentrations of $CO_2$ in the atmosphere, as shown in Figure B.3. Since the pre-industrial era, $CO_2$ concentrations in the atmosphere have averaged below 275 parts per million (ppm). However, in the last 150 years, $CO_2$ concentrations have increased exponentially to present levels of over 375 ppm, with the greatest increase seen in the last 50 years. Currently, atmospheric $CO_2$ concentrations are increasing at the rate of almost 2 ppm per year.

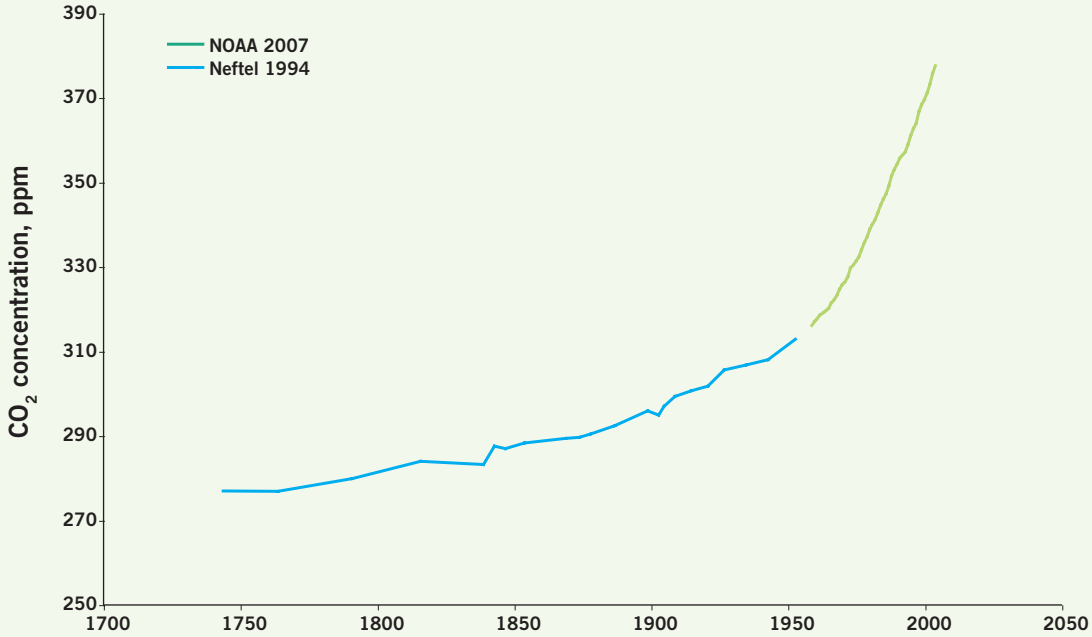


**Figure B.3:** Atmospheric surface $CO_2$ concentrations over time.[29,30]

The world's leading scientific body on climate change believes that evidence of global warming of the earth's temperatures is now unequivocal.[31] As atmospheric $CO_2$ concentrations have increased, a corresponding increase in the earth's global temperature has also occurred, as shown in Figure B.4. Globally, the average surface temperatures have increased by 1 degree Fahrenheit since the 1970s. As with global energy consumption and atmospheric $CO_2$ concentrations, the rate of global temperature change increased sharply after 1950.

29 Neftel, A., H. Friedli, E. Moor, H. Lötscher, H. Oeschger, U. Siegenthaler, and B. Stauffer, (1994), "Historical $CO_2$ record from the Siple Station ice core. In Trends: A Compendium of Data on Global Change." Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. http://cdiac.esd.ornl.gov/trends/co2/siple.htm.

30 National Oceanic and Atmospheric Administration (NOAA), Earth System Research Laboratory, Global Monitoring Division, (2007), "Monthly Mean $CO_2$ concentrations from Mauna Loa, Hawaii." (Accessed May 29, 2007). http://www.esrl.noaa.gov/gmd/ccgg/trends/co2_mm_mlo.dat.

31 IPCC, (2007) "Climate Change 2007 – The Physical Science Basis", Contribution of Working Group I to the Fourth Assessment Report of the IPCC.

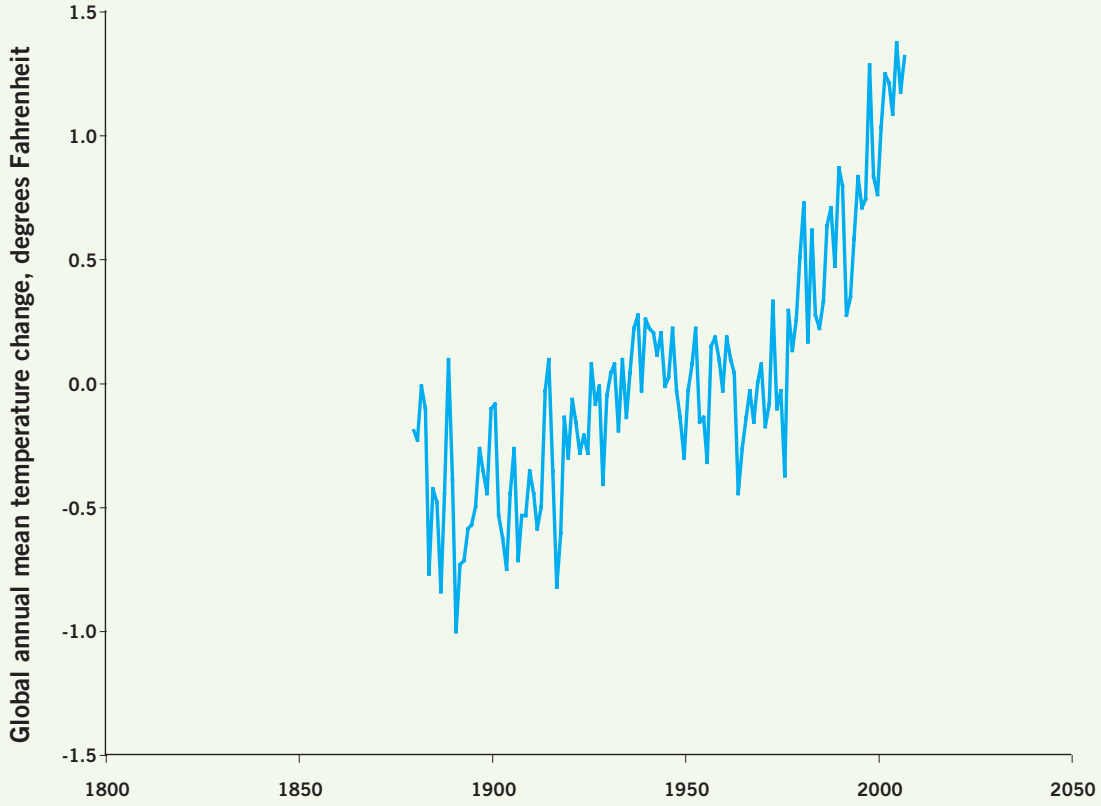


**Figure B.4:** Global annual temperature change over time.[32]

Scientists predict increased temperatures will result in increased sea levels by two mechanisms. First, sea levels will rise due to thermal expansion. As water is warmed, the volume the body of water occupies will also increase, causing sea level rise. Second, as temperatures increase, more

[32] National Aeronautics and Space Administration, Goddard Institute for Space Studies, (2008), "Global Annual Mean Surface Air Temperature Change", http://data.giss.nasa.gov/gistemp/graphs/.

ice in the Arctic and Antarctic regions will melt, increasing the total amount of water in the oceans and increasing sea level. Figure B.5 presents historical sea level measurements at Key West, Florida, which has been steadily increasing since 1920.

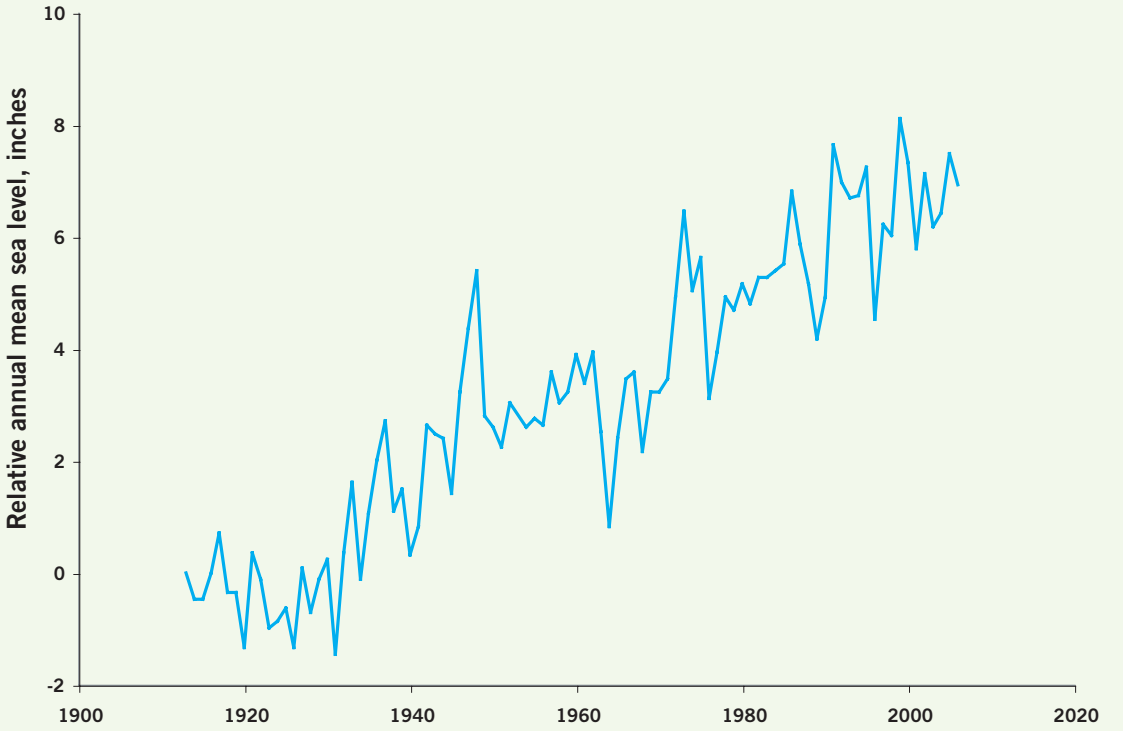


**Figure B.5:** Mean annual sea level rise in Key West, Florida over time.[33]

To limit the impact of global warming, the IPCC and other scientists have recommended dramatic reductions in $CO_2$ emissions by 2050.[34] Most are targeting reductions of 80% or greater by the year 2050 to stabilize the earth's climate.

[33] Proudman Oceanographic Laboratory. "PSMSL Monthly and Annual Mean Sea Level Station Files", http://www.pol.ac.uk/psmsl/psmsl_individual_stations.html.

[34] IPCC, (2007), "Climate Change 2007: Synthesis Report. Summary for Policymakers." http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

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