District of Columbia

Greenhouse Gas Emissions Inventory

2006 Calendar Year Baseline

DDOE
DISTRICT DEPARTMENT OF THE ENVIRONMENT

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Credits and Acknowledgements

District of Columbia

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Executive Summary

The District of Columbia—along with community and government leaders locally and around the world—recognizes that human-caused climate change is a reality, the consequences of which present the potential of harm for District residents, institutions, and businesses. Sea level rise and flooding, increased urban heat, changes in weather patterns, and reliability of energy supply are all issues that the District may have to contend with in a changing climate. With this recognition comes the awareness that local governments play a critical role in mitigating the potential impacts of climate change through actions taken to reduce emissions from government operations and from the community as a whole.

This greenhouse gas emissions inventory represents completion of an important first step in the District of Columbia's climate protection initiative. It is essential to quantify our "baseline" emissions so that the District has an understanding of the scale of emissions from various government operations and community sources, as well as a yardstick against which to measure future progress. The estimates of greenhouse gas emissions presented here are for the 2006 calendar year. When selecting a base year, it is preferable to go as far back as possible while still having reliable data. Due to some database changes that occurred between 2005 and 2006, District staff felt the accuracy of the inventory would be compromised by selecting a year prior to 2006.

This inventory includes both **government operations** and **community** sources. The concept of a community inventory is best understood if one imagines placing a "bubble" over the District of Columbia and then counting the emissions that result from relevant activities (such as energy use) that occur within the District boundaries. The community-wide inventory includes estimated emissions from buildings, transportation, and waste. In contrast, the government operations inventory is an in-depth analysis of emissions from the District's local government operations and represents a small subset of the community emissions. With one exception,[1] all emissions estimates in the government operations portion of this report refer to emissions generated from sources over which the District has direct operational control, exclusive of physical location.[2] This includes all government-operated facilities, streetlights, and other stationary sources; vehicle fleet and off-road equipment; and waste generated by government operations.

1 The exception is emissions from employee-owned vehicles that are used by employees during commuting.
2 Facilities, vehicles, or other operations wholly or partially owned by, but not operated by, the District are not included in this inventory. See Appendix A for more details on the boundaries of the inventory.

The District Government operations inventory is one of the first inventories to use a new national standard developed and adopted by the California Air Resources Board (CARB) in conjunction with ICLEI, the California Climate Action Registry, and The Climate Registry. This standard, called the Local Government Operations Protocol (LGOP), provides standardized accounting principles, boundaries, quantification methods, and procedures for reporting greenhouse gas emissions from local government operations. To that end, LGOP represents a strong step forward in standardizing how inventories are conducted and reported, providing a common national framework for all local governments to use in establishing their emissions baselines.

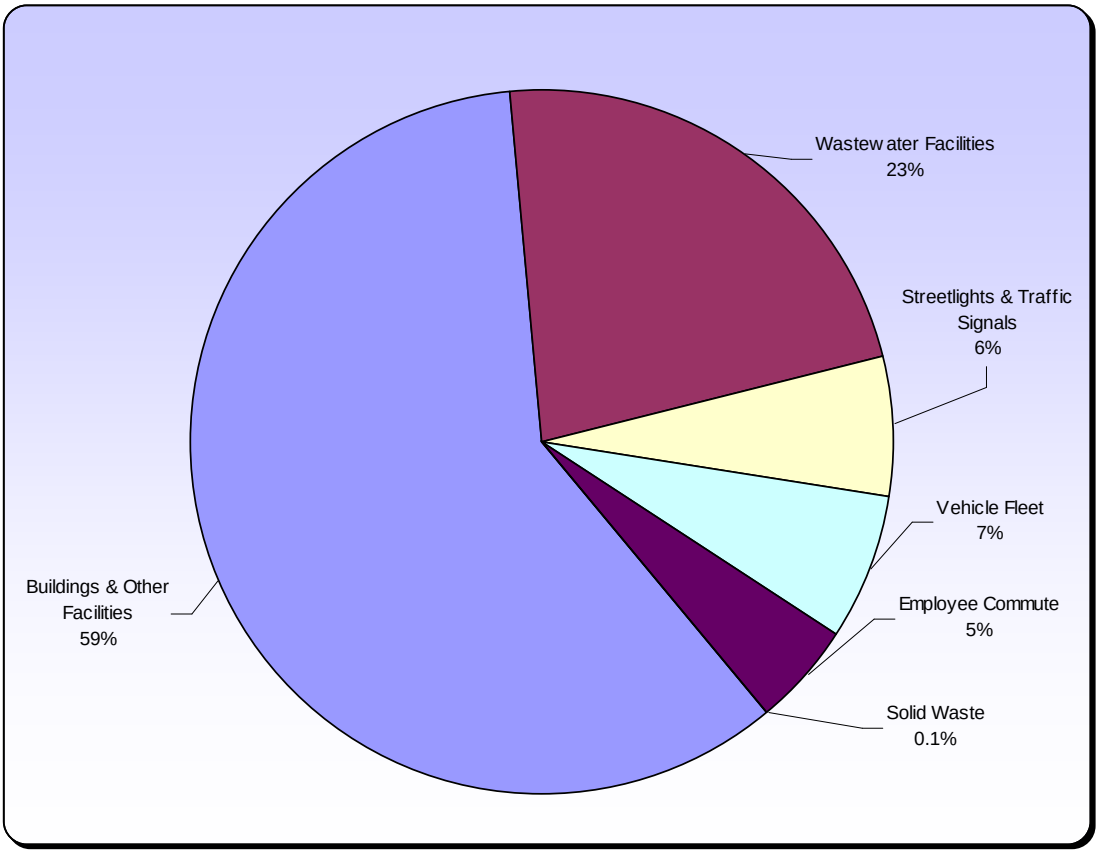
The community emissions sectors reported in this inventory (such as buildings, vehicles, and solid waste) are based on longstanding sectors defined for use by ICLEI for local governments. **This inventory represents an estimate of emissions using the best available data and calculation methodologies.** Emissions estimates are subject to change as better data and calculation methodologies become available in the future. Regardless, the findings of this inventory analysis provide a solid base against which the District can begin planning and taking action to reduce its greenhouse gas emissions.

Government Operations Inventory Results

During the 2006 calendar year, direction emissions from the District government operations, emissions from electricity consumption, and select indirect sources totaled 719,896 metric tons of carbon dioxide equivalent (CO_2e).[3] Of the total emissions accounted for in this inventory, emissions from Buildings & Other Facilities were the largest share (59 percent as shown in Figure ES.1 and Table ES.1), totaling 429,301 metric tons of CO_2e. Wastewater Facilities were responsible for 23 percent of government operations emissions, with a total of 163,454 metric tons of CO_2e. Emissions from the vehicle fleet and mobile equipment were 47,829 metric tons of CO_2e, or 7 percent of the total for government operations. Streetlights & Traffic Signals were six percent of the total, with 45,586 metric tons of CO_2e. Emissions from the Employee Commute sector (personal vehicles used by District staff to commute to and from work) were estimated at 33,101 metric tons CO_2e, or five percent of the emissions accounted for in the inventory. Finally, emissions from Government-Generated Solid Waste accounted for an estimated 625 metric tons of CO_2e, or 0.1 percent of the government operations total. More detailed information on the sources of emissions from each sector of the government operations inventory can be found in Section Three of this report.

3 This number represents a "roll-up" of emissions, and is not intended to represent a complete picture of emissions from the District's operations. This roll-up number should not be used for comparison with other local government roll-up numbers without a detailed analysis of the basis for this total.

Figure ES.1 2006 District Government Operations Emissions by Sector



Cumulatively, District agencies that reported costs spent $98,267,863 on energy for their operations in 2006. The true figure is likely well over $100,000,000, as cost information was not universally reported. Of this total, 85 percent of these energy expenses ($82,953,877) resulted from Buildings & Other Facilities. Electricity consumption in Buildings & Other Facilities accounted for $40,422,830 (49 percent of the sector total), followed by natural gas ($36,811,079 and 44 percent), fuel oil ($2,920,897 and four percent), and steam ($2,799,071 and three percent). Fuel purchases (gasoline, diesel, ethanol, and compressed natural gas) for the vehicle fleet and mobile equipment totaled $8,916,514, or nine percent of total costs included in this inventory. Electricity consumed by streetlights and traffic signals cost the District $6,371,499, or six percent of total costs included in this inventory. Traffic signal conversions to LED were completed in 2006, so these savings were included in the baseline inventory. In addition to reducing greenhouse gases, any future reductions in municipal energy consumption will have the potential to reduce these costs, enabling the District to reallocate funds toward other municipal services or towards a dedicated fund to support future climate protection activities. More detailed information on the cost of energy in each sector of the government operations inventory can be found in Section Three of this report.

Table ES.1 2006 District Government Operations Emissions by Sector

	Sector Total (metric tons CO_2e)	Annual Cost
Buildings & Other Facilities	429,301	$82,953,877
Wastewater Facilities	163,454	$26,178,745
Streetlights & Traffic Signals	45,586	$6,371,499
Vehicle Fleet & Off-Road Equipment	47,829	$8,916,514
Employee Commute	33,101	n/a
Government-Generated Solid Waste	625	n/a

Community Inventory Results

During the 2006 calendar year, the District's direct emissions, emissions from electricity consumption, and select indirect sources totaled 10,505,946 metric tons of CO_2e at the community level. Of the total emissions accounted for in this inventory, emissions from the Non-Residential sector were the largest (51 percent as shown in Figure ES.2 and Table ES.2). The Residential sector was responsible for 15 percent of community emissions, with a total of 1,517,011 metric tons of CO_2e. Federal facilities managed by GSA accounted for nine percent of emissions, with a total of 963,178 011 metric tons of CO_2e. Between Residential, Non-Residential, and Federal facilities, emissions from buildings consisted of approximately 75 percent of community emissions. Emissions from the Vehicle Miles Traveled sector were 2,261,338 metric tons of CO_2e, or 22 percent of community emissions. Emissions from Metro were culled from the Non-Residential sector and were two percent of the community total, with 176,918 metric tons of CO_2e. Finally emissions from the Solid Waste sector accounted for an estimated 185,991 metric tons of CO_2e, also two percent of the community total. More detailed information on the sources of emissions from each sector of the community inventory can be found in Section Four of this report. District government emissions are a subset of the community emissions, and are embedded in the sector totals. District government emissions are six percent of the community total.

Energy costs are not part of the community inventory assessment, but in addition to reducing greenhouse gases, any future reductions in community energy consumption will have the potential to reduce these costs, enabling District residents and businesses to reallocate energy expenditures to other uses.

Figure ES.2 2006 District Community Emissions by Sector

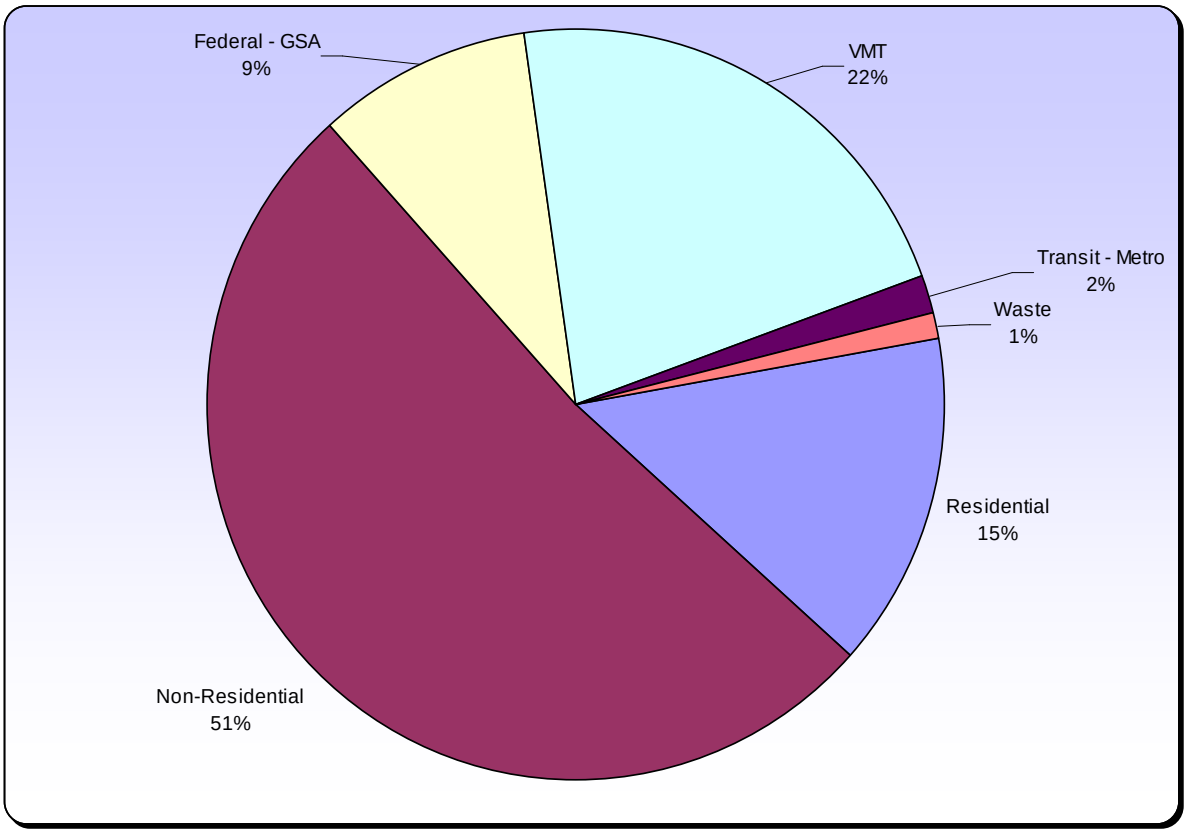


Table ES.2 2006 Community Emissions by Sector

Sector	Sector Total (metric tons CO_2e)
Non-Residential	5,401,510
Vehicle Miles Traveled	2,261,338
Residential	1,517,011
Federal - GSA	963,178
Solid Waste	185,991
Transit – Metro	176,918

Introduction

Local governments play a fundamental role in addressing the causes and effects of human-caused climate change through their actions at both the community and government operations levels. While local governments cannot solve the problems of climate change by themselves, their policies can dramatically reduce greenhouse gas emissions from a range of sources and can prepare their communities for the potential impacts of climate change.

Within the context of government operations, local governments have direct control over their emissions-generating activities. They can reduce energy consumption in buildings and facilities, reduce fuel consumption by fleet vehicles and off-road equipment, reduce the amount of government-generated solid waste that is sent to a landfill, and increase the amount of energy that is obtained through alternative energy sources. By quantifying the emissions coming from its operations, this report will enable the District to choose the most effective approach to reducing its contribution to climate change. Emissions from District Government operations account for 6 percent of the total community emissions, so a strategy to reduce emissions will need to address emissions resulting from government operations as well as from the entire community.

1.1 Climate Change Background[4]

A balance of naturally occurring gases dispersed in the Earth's atmosphere determines its climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence suggests that modern human activity is artificially intensifying the greenhouse gas effect, causing global average surface temperatures to rise. This intensification is caused by activities that release carbon dioxide and other greenhouse gases into the atmosphere—most notably the burning of fossil fuels for transportation, electricity, and heat generation.

Rising temperatures affect local and global climate patterns, and these changes are forecasted to manifest themselves in a number of ways that might impact the District. Climate change in the District of Columbia is evident now and predicted to progress further in the future. This section summarizes the records and trends of environmental variables such as temperature and precipitation in and around the District.

[4] The information contained in this section is taken from the draft "Climate Change Resiliency and Adaptation in the District of Columbia" completed for DDOE by Sean Williamson and Catherine Kendig in August 2008.

Over the past 100 years, there have been noticeable effects of global climate change (GCC) in the District of Columbia. Increasing temperatures, altered precipitation, sea level rise, and more frequent and severe storms have all been recorded in the District. Since 1907, average annual temperatures in the District have increased by approximately 3.3°F, with the most drastic increases occurring in the summer months (0.41°F per decade) and lesser increases occurring in the winter months (0.29°F per decade). These local temperature trends coincide with regional trends, although the magnitude of change in the DC metro area is greater. In Maryland, over the last century, the average annual temperature has increased by about 2°F.

There has been very little change in the amount of precipitation in the District over the last 100 years; however, less precipitation is falling as snow. Both Maryland and Virginia have experienced a trend of increasing precipitation over the past 100 years with growth rates of 0.27 inches per decade and 0.31 inches per decade, respectively. Sea level rise is another ongoing implication of GCC. The global rate of sea level elevation is 0.08 inches per year, while the Chesapeake Bay rate is 0.14 inches per year. The higher rate of sea level rise is the result of land subsidence or the erosion of land into the sea, which accounts for roughly half the Mid-Atlantic regional sea level rise. The Potomac River has risen about one foot since 1933 – this is most noticeable around the Tidal Basin, near the Jefferson Memorial. Finally, the increasing intensity and frequency of extreme weather events may be the most dramatic indicator GCC. Relative to the previous century, there have been 12-20 percent more major weather events in the Mid-Atlantic region.

The current trends of increasing temperatures, altered precipitation, sea level rise, and increasing frequency and intensity of major weather events are projected to continue into the future. Based on the average temperatures and depending on the emissions scenario, the entire Mid-Atlantic region is expected to warm by 2-3°F by 2030 and 4-10°F by the end of the century. By 2025, average annual temperatures in Maryland are expected to increase by at least 2°F, regardless of mitigative action. A low-emissions scenario is expected to result in an increase of 4°F during the winter and 4.8°F during the summer by the end of the century. A high emissions scenario in Maryland could result in an increase of 7°F during the winter and 9°F during the summer by the end of the century, and temperature increases in the District of Columbia could likely be higher than temperature increases in the surrounding region because of the urban heat island effect.

Sea level rise is projected to increase by 24-48 inches over the next century along the Chesapeake Bay as a result of the melting of polar ice caps combined with the thermal expansion of sea water. A commensurate rise in sea level will occur along the Potomac and Anacostia Rivers as well as Rock Creek over the next century, as all three waterways are tidal and respond to rises in sea levels. Along Maryland and the Chesapeake Bay the sea level will rise about 7.2-15.6 inches (0.18-0.40 meters) by 2050 and 32.4-40.8 inches (0.82-1.04 meters) by the end of the century, depending on emissions scenarios and other factors of uncertainty such as non-linear increases in sea level. Between 1.74-2.55 square miles of District land lies below 40 inches in elevation. Land below 40 inches in

elevation is highly vulnerable to sea level rise and could potentially become inundated by 2100. A total of 3.42 square miles are below 140 inches in elevation – this land will be more susceptible to episodic flooding and storm surges. For instance, land around the Tidal Basin, the Jefferson Memorial in particular, is in danger of inundation if long-term projections are realized.

In response to this threat, many communities in the United States are taking responsibility for addressing climate change at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around sustainable land use patterns, transportation demand management, energy efficiency, green building, and waste diversion, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts. As the effects of climate change become more common and severe, local government adaptation policies will be fundamental in preserving the welfare of residents and businesses.

1.2 Purpose of Inventory

The objective of this greenhouse gas emissions inventory is to identify the sources and quantities of greenhouse gas emissions resulting from government operations and community activities in the District during the 2006 calendar year. This inventory is a necessary first step in addressing greenhouse gas emissions, serving two purposes:

- It creates an emissions baseline against which the District can set emissions reductions targets and measure future progress
- It allows the District to understand the scale of emissions from the various sources within its operations and from the community

While the District of Columbia has already begun to reduce greenhouse gas emissions through a variety of actions (See Section 1.3 for more detail), this inventory represents the first step in a comprehensive approach to reducing the District's emissions. This approach, developed by ICLEI, is called the Five Milestones for Climate Mitigation. This Five-Milestone process involves the following steps:

Milestone One: Conduct a baseline emissions inventory and forecast

Milestone Two: Adopt an emissions reduction target for the forecast year

Milestone Three: Develop a local climate action plan

Milestone Four: Implement the climate action plan

Milestone Five: Monitor progress and report results

Figure 1.1 ICLEI's Five Milestones for Climate Mitigation

1.3 Climate Change Mitigation Activities in the District of Columbia

The District of Columbia has already begun to take action against climate change through the landmark Renewable Portfolio Standard and Green Building Act. These first steps have demonstrated that the District is committed to both conserving energy use and to developing the market for clean energy. Green building projects abound in the District, from the new Nationals Park to the LEED Silver Stoddert Elementary School. Other measures already underway that are helping to reduce the District's carbon footprint include:

District Government Energy Use:

- Installation of 16,500 square feet of green roof space at One Judiciary Square and the Frank D. Reeves Center
- Retrofitting of lighting systems at fire stations throughout the District
- Under the Municipal Aggregation Program, District agencies buy electricity at reduced rates, including renewable electricity.
- The District is undertaking a large-scale effort to retrofit and modernize all public schools.

Residential and Commercial Energy Use:

- Free home energy audits for single family and row houses, and implementation of selected energy saving and weatherization measures for qualifying residents
- Renewable energy incentive program provides a rebate for renewable energy generation in the amount of $3/watt for the first 3,000 watts (W) or W-equivalent, $2 for the following 7,000 watts (W) or W-equivalent, and $1 for the following 10,000 watts (W) or W-equivalent

- Reduction of energy use in public housing buildings through improvements to heating and cooling systems, roofing, windows, lighting, and boilers

Waste:

- Piloting a comprehensive recycling program in seven schools and the Downtown DC and Capitol Hill Business Improvement Districts, and expanding the list of acceptable recyclables for the residential recycling program

Forestry:

- WASA and DDOT are planting thousands of trees around the District, to beautify the streetscapes and to capture stormwater runoff and reduce greenhouse gas emissions

Wastewater Treatment:

- The Blue Plains enhanced bubble diffuser system allows for more efficient energy use and enhanced de-nitrification systems to reduce pollution into the Potomac River.
- The Blue Plains biosolids recycling program reduces CO_2e by an average of 3,000 tons per month by sequestering carbon and replacing man-made fertilizer.

Transportation:

- The District's light vehicle fleet is being reduced by 360 vehicles through the fleet sharing program.
- Increased bike lanes and implementing SmartBike Program.
- Alternative fuel use in the District vehicle fleet, including biodiesel and ethanol.

Methodology

The government operations portion of this greenhouse gas emissions inventory follows the standard methodology outlined in LGOP, which was adopted in 2008 and serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. The methodology for the community inventory is based on the guidance provided by ICLEI and the longstanding sectors used by local governments around the country. This chapter outlines the basic methodology utilized in the development of this inventory to clarify how the inventory results were reported. Specifically, this section reviews:

- What greenhouse gases were measured in this inventory
- What general methods were used to estimate emissions
- How emissions estimates can be reported (the scopes framework, roll-up numbers)
- How emissions estimates were reported in this inventory

A more detailed account of LGOP and the methodology used in this inventory can be found in Appendices A and B.

2.1 Greenhouse Gases

According to LGOP, local governments should assess emissions of all six internationally recognized greenhouse gases regulated under the Kyoto Protocol. These gases are outlined in Table 2.1, which includes the typical sources of these gases and their global warming potential (GWP). Global warming potential (GWP) is a measure of the level of potency of a particular greenhouse gas, as measured against CO_2. Methane (CH4) is a relatively weak greenhouse gas with a GWP of 21, whereas sulfur hexafluoride (SF6) is 23,900 times more potent than CO_2. It is important to note that not all of these sources of emissions are relevant to the District.

Table 2.1 Greenhouse Gases and Associated Global Warming Potential

Gas	Chemical Formula	Typical Activity	Global Warming Potential (CO_2e)
Carbon Dioxide	CO_2	Combustion	1
Methane	CH_4	Combustion, Anaerobic Decomposition of Organic Waste (Landfills, Wastewater), Fuel Handling	21
Nitrous Oxide	N_2O	Combustion, Wastewater Treatment	310
Hydrofluorocarbons	Various	Leaked Refrigerants, Fire Suppressants	12–11,700
Perfluorocarbons	Various	Aluminum Production, Semiconductor Manufacturing, HVAC Equipment Manufacturing	6,500–9,200
Sulfur Hexafluoride	SF_6	Transmission and Distribution of Power	23,900

2.2 Calculating Emissions

LGOP outlines specific methods for quantifying emissions from local government activities. The methods a local government can use to quantify emissions vary largely by how it gathers data, and therefore what data were available. In general, emissions can be quantified in two ways:

1. Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions from a monitoring system. Emissions measured this way may include those emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This method is the most accurate way of inventorying emissions from a given source, but is generally available for only a few sources of emissions.

2. Calculation-based methodologies refer to an estimate of emissions calculated based upon some measurable activity data and emission factors. Table 2.2 demonstrates some examples to illustrate how common emissions figures were calculated for this report. For a detailed explanation of the methods and emissions factors used, see Appendix A. Unless otherwise noted, this inventory used calculation-based methodologies for both the government operations and community inventories.

Table 2.2 Basic Emissions Calculations

Activity Data	Emissions Factor	Emissions
Electricity Consumption (kilowatt hours)	CO_2 emitted/kWh	CO_2 emitted
Natural Gas Consumption (therms)	CO_2 emitted/therm	CO_2 emitted
Gasoline/Diesel Consumption (gallons)	CO_2 emitted /gallon	CO_2 emitted
Waste Generated by Government Operations (tons)	CH_4 emitted/ton of waste	CH_4 emitted

2.3 Reporting Emissions

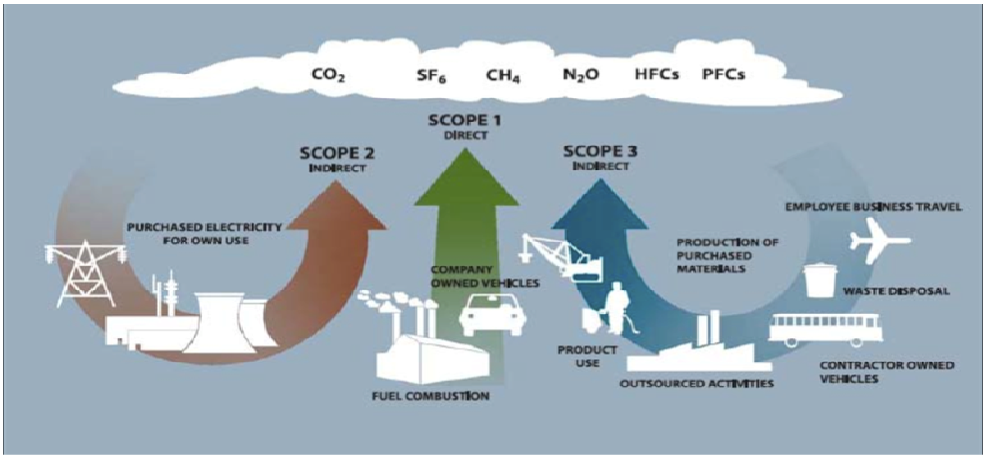
LGOP provides two reporting frameworks: reporting by scope and reporting by sector. This section defines the two reporting frameworks and discusses how they are used in this inventory. It also discusses the concept of "rolling up" emissions into a single number. This can assist local governments in communicating the results of the inventory and using the inventory to formulate emissions reductions policies.

2.3.1 The Scopes Framework

For local government operations, LGOP categorizes emissions according to what degree of control local governments have over the emissions sources. These categorizations (developed by the World Resources Institute and the World Business Council for Sustainable Development) are called *emissions scopes.* The scopes framework helps local governments to:

- Determine which emissions should be inventoried
- Organize emissions by degree of control and therefore the potential for reduction of these emissions
- Avoid "double counting" of emissions (i.e., summing up of different emissions sources that may result in reporting these emissions twice)

Figure 2.1 Emissions Scopes



Source: WRI/WBCSD GHG Protocol Corporate Accounting and Reporting Standard (Revised Edition), Chapter 4.

The emissions scopes are defined as follows:

Scope 1: Direct emissions from sources within a local government's operations that it owns and/or controls. This includes stationary combustion to produce electricity, steam, heat, and power equipment; mobile combustion of fuels; process emissions from physical or chemical processing; fugitive emissions that result from production, processing, transmission, storage and use of fuels; leaked refrigerants; and other sources.

Scope 2: Indirect emissions associated with the consumption of electricity, steam, heating, or cooling that are purchased from an outside utility.

Scope 3: All other emissions sources that hold policy relevance to the local government that can be measured and reported. This includes all indirect emissions not covered in Scope 2 that occur as a result of activities within the operations of the local government. Sources over which the local government does not have any financial or operational control over would be accounted for here. Scope 3 emission sources include (but are not limited to) tailpipe emissions from employee commutes, employee business travel, and emissions resulting from the decomposition of government-generated solid waste.

Table 2.3 Inventoried Emission Sources by Scope[5]

Scope 1	Scope 2	Scope 3
Fuel consumed to heat/cool facilities	Purchased electricity consumed by facilities	Solid waste generated by government operations
Fuel consumed for vehicles and off-road equipment	Purchased electricity consumed by electric vehicles	Fuel consumed for employee vehicles used for commuting
Fuel consumed to generate electricity	Purchased steam for heating or cooling facilities	
Leaked refrigerants from facilities and vehicles		
Leaked/deployed fire suppressants		
Wastewater decomposition and treatment at a municipal wastewater treatment plant		
Solid waste in government landfills		

2.3.2 Double Counting and Rolling Up Scopes

Many local governments find it useful for public awareness and policymaking to use a single number (a "roll-up" number) to represent emissions in its reports, target setting, and action plan. A roll-up number allows local governments to determine the relative proportions of emissions from various sectors (e.g., 30 percent of rolled-up emissions came from the vehicle fleet). This can help policymakers and staff identify priority actions for reducing emissions from their operations.

5 This only represents a list of emissions that were inventoried for this project, and is not meant to be a complete list of all emissions that can be inventoried in a government operations inventory.

For these reasons, this report includes a roll-up number as the basis of the emissions analysis in this inventory. This roll-up number is composed of direct emissions (Scope 1), all emissions from purchased electricity (Scope 2), and indirect emissions from employee commutes and government-generated solid waste (Scope 3). While this report uses a standard roll-up number, these numbers should be used with caution, as they can be problematic for three reasons:

First, a roll-up number does not represent all sources of emissions from within the District, only a summation of inventoried emissions using available estimation methods. Reporting a roll-up number can be misleading and encourage citizens, staff, and policymakers to think of this number as the local government's "total" emissions. Therefore, when communicating a roll-up number it is important to represent it only as a sum of inventoried emissions, not as a comprehensive total.

Second, rolling-up emissions may not simply involve adding emissions from all sectors, as emissions from different scopes can be double-counted when they are reported as one number. For example, if a local government operates a municipal utility that provides electricity to government facilities, these are emissions from both the power generation and facilities sectors. If these sectors are rolled-up into a single number, these emissions are double counted, or reported twice. For these reasons, it is important to be cautious when creating a roll-up number to avoid double counting; the roll-up number used in this report was created specifically to avoid any possible double counting.

Third, local governments often wish to compare their emissions to those of other local governments. It is very difficult to use a roll-up number as a common measure between local governments, for a number of reasons. First, as of now there is no national or international standard for reporting emissions as a single roll-up number. In addition, local governments provide different services to their citizens, and the scale of the services (and thus the emissions) is highly dependent upon the size of the jurisdiction. For these reasons, comparisons between local government roll-up numbers should not be made without significant analysis of the basis of the roll-up number and the services provided by the local governments being compared.

2.3.3 Emissions Sectors

ICLEI recommends that local governments examine their emissions in the context of the part of their operations (sector) that is responsible for those emissions. This is helpful from a policy perspective, and will assist local governments in formulating sector-specific reduction measures and climate action plans. This inventory uses LGOP sectors as a main reporting framework, including the following sectors:

- Buildings and other facilities
- Streetlights, traffic signals, and other public lighting
- Water facilities

- Wastewater facilities
- Solid waste
- Vehicle fleet and off-road equipment
- Government-generated solid waste
- Emissions from employee commutes

The community portion of the inventory also examines emissions in the context of the sector that is responsible for those emissions. Community sectors include:

- Residential
- Non-Residential
- Federal - GSA
- Vehicle Miles Traveled
- Transit - Metro
- Solid Waste

2.3.4 Baseline Year Selection

The 2006 baseline was selected following some initial meetings with key data providers within the District Government, such as the Department of Real Estate Services and Department of Public Works. The 2006 base year was the earliest year in which key departments were confident in the accuracy of their databases due to process changes that occurred during 2005 and 2006.

Government Operations Inventory Results

This chapter provides a detailed description of the District of Columbia's government operations emissions during 2006, rolling-up and comparing emissions across sectors and sources as appropriate. This chapter also provides details on the greenhouse gas emissions from each sector, including a breakdown of emissions types and, where possible, an analysis of emissions by agency. This information identifies more specific sources of emissions (such as a particular building) that can help staff and policymakers in the District to best target emissions reduction activities in the future.

For a report of emissions by scope, and a detailed description of the methodology and emission factors used in calculating the emissions from the District's operations, please see Appendix B: LGOP Standard Report.

In 2006, the District's government operations direct emissions, emissions from electricity consumption and select indirect sources totaled 719,896 metric tons of CO_2e.[6] In this report, this number is the basis for comparing emissions across sectors and sources (fuel types), and is the aggregate of all emissions estimates used in this inventory.

3.1 Summary by Sector

Reporting emissions by sector provides a useful way to understand the sources of the District's government operations emissions. By better understanding the relative scale of emissions from each of the sectors, the District can more effectively focus emissions reductions strategies to achieve the greatest emissions reductions.[7] As visible in Figure 3.1, the Buildings & Other Facilities sector was the largest emitter, totaling 429,301 metric tons of CO_2e. The Wastewater Facilities sector was responsible for 23 percent of government operations emissions, with a total of 163,454 metric tons of CO_2e. Emissions from the Vehicle Fleet & Off-road Equipment sector were 47,829 metric tons of CO_2e, or 7 percent of the total for government operations. The Streetlights & Traffic Signals sector was 6 percent of the total, with 45,586 metric tons of CO_2e. Emissions from the Employee Commute sector (personal vehicles used by District staff to commute to and from work) were estimated at 33,101 metric tons CO_2e, or 5

6 This number represents a roll-up of emissions, and is not intended to represent a complete picture of emissions from the District's operations. This roll-up number should not be used for comparison with other local government roll-up numbers without a detailed analysis of the basis for this total. See section 2.3.2 for more detail.

7 The sectors with the largest scale of emissions do not necessarily represent the best opportunity for emissions reductions. Cost, administration, and other concerns may affect the District's ability to reduce emissions from any one sector.

percent of the emissions accounted for in the inventory. Finally, emissions from the Government-Generated Solid Waste sector accounted for an estimated 625 metric tons of CO_2e, or 0.1 percent of the government operations total.

Figure 3.1 2006 District Government Operations Emissions by Sector

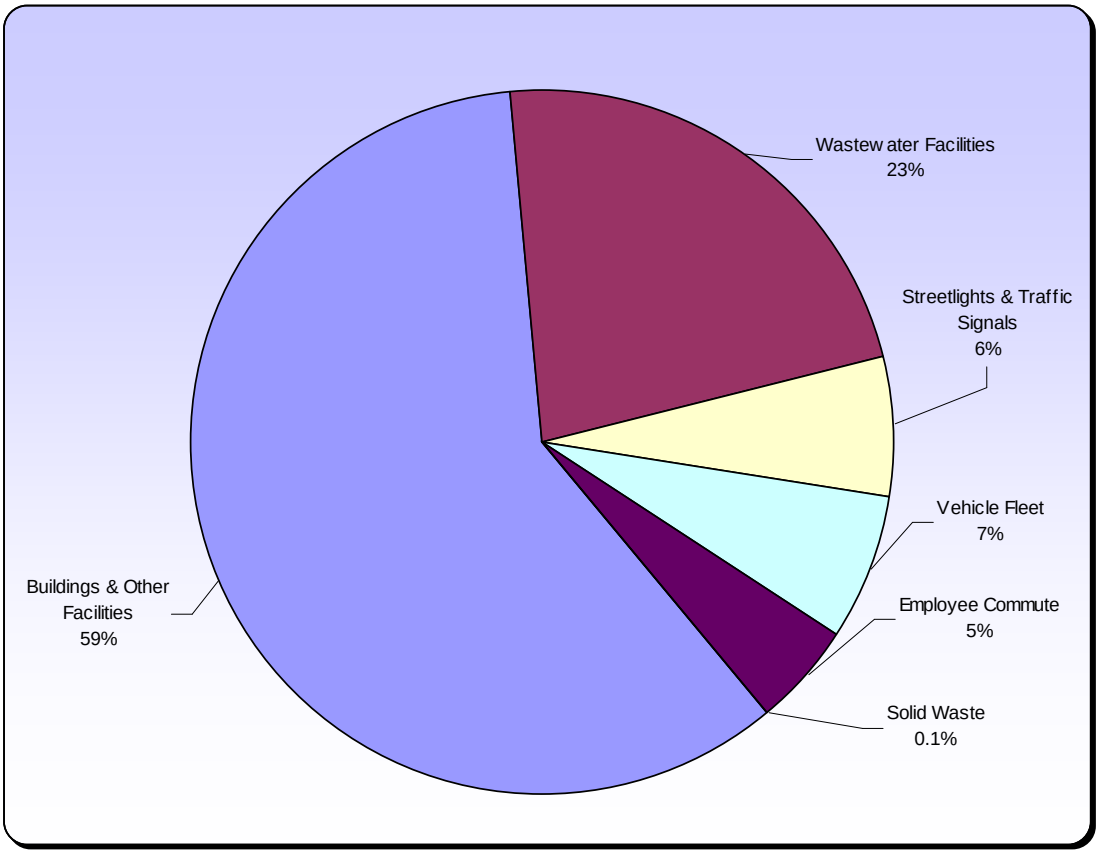


Table 3.1 2006 District Government Operations Emissions by Sector

Sector	CO_2e Emitted (metric tons)
Buildings and Other Facilities	429,301
Wastewater Facilities	163,454
Vehicle Fleet & Off-Road Equipment	47,829
Streetlights & Traffic Signals	45,586
Employee Commute	33,101
Government-Generated Solid Waste	625

3.2 Summary by Source

When considering how to reduce emissions, it is helpful to look not only at which sectors are generating emissions, but also at the specific raw resources and materials (e.g.: gasoline, diesel, electricity, natural gas, solid waste, etc.) whose use and generation directly result in the release of greenhouse gases. This analysis can help target resource

management in a way that will successfully reduce greenhouse gas emissions. Figure 3.2 and Table 3.2 provide a summary of the District's government operations 2006 greenhouse gas emissions by fuel type or material.

Figure 3.2 2006 District Government Operations Emissions by Source

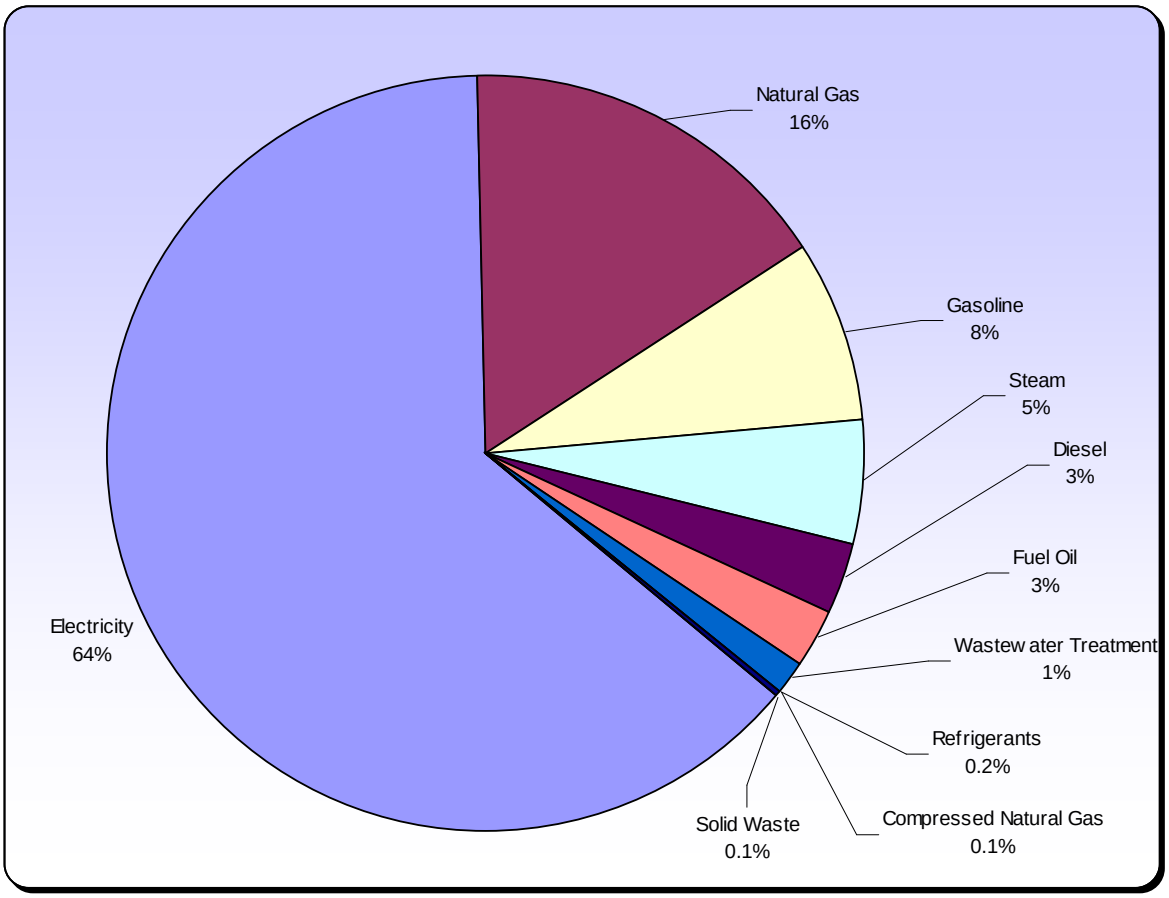


Table 3.2 2006 District Government Operations Emissions by Source

Fuel/Source	CO_2e emitted (metric tons)
Electricity	457,853
Natural Gas	116,892
Gasoline	55,815
Steam	36,653
Diesel	22,906
Fuel Oil	18,243
Wastewater Treatment	8,665
Refrigerants	1,540
Compressed Natural Gas	670
Government-Generated Solid Waste	625

3.3 Summary of Energy-Related Costs

In addition to tracking energy consumption and generating estimates on emissions per sector, ICLEI has calculated the basic energy costs of various government operations. Cumulatively, District agencies that reported costs spent $98,267,863 on energy for their operations in 2006. The true figure is likely well over $100,000,000, as cost information was not universally reported. Of the totals collected, 85 percent of the energy expenses ($82,953,877) resulted from the Buildings & Other Facilities sector. Electricity consumption in this sector accounted for $40,422,830 (49 percent of the sector total), followed by natural gas ($36,811,079 or 44 percent of the sector total), fuel oil ($2,920,897 or 4 percent of the sector total), and steam ($2,799,071 or 3 percent of the sector total). Reported fuel purchase costs (i.e.: gasoline, diesel, ethanol, and compressed natural gas) for the vehicle fleet and off-road equipment totaled $8,916,514, or 9 percent of total costs included in this inventory. Electricity consumed by streetlights and traffic signals cost the District $6,371,499, or 6 percent of total costs included in this inventory. In addition to reducing greenhouse gases, any future reductions in municipal energy consumption will have the potential to reduce these costs, enabling District government to reallocate funds toward other municipal services or towards a dedicated fund to support future climate protection activities.

Table 3.3 2006 District Energy Costs by Sector

Sector	Costs ($)
Buildings & Other Facilities	$82,953,877
Vehicle Fleet & Off-Road Equipment	$8,916,514
Streetlights & Traffic Signals	$6,371,499
Wastewater Facilities (natural gas only)	$25,973
Total Assessed Costs	**$98,267,863**

3.4 Detailed Sector Analyses

3.4.1 Buildings and Other Facilities

Through their use of energy for heating, cooling, lighting, and other purposes, buildings and other facilities operated by local governments constitute a significant amount of a government's greenhouse gas emissions. The District Government operates approximately 550 facilities. Schools are the largest contributor to the sector, both in terms of emissions and absolute number of facilities. Other sources include libraries, fire companies, police stations, recreation centers, housing authority properties, stadiums, and other District-Government owned and leased space operated by the Department of Real Estate Services. Facility operations contribute to greenhouse gas emissions in two major ways. First, facilities consume electricity and fuels such as natural gas and heating oil. This consumption contributes the majority of greenhouse gas emissions from facilities. Second, fire suppression, air conditioning, and refrigeration equipment in buildings can emit hydrofluorocarbons (HFCs) and other greenhouse gases when these systems leak refrigerants or fire suppressants.

In 2006, the operation of District Government buildings and other facilities produced approximately 429,301 metric tons of CO_2e from the above sources. Table 3.4 shows estimated costs associated with the activities that generated these emissions, and Figure 3.3 depicts 2006 emissions per agency, although not all agencies operate facilities. Of total facility emissions, 60 percent came from the consumption of electricity, 27 percent came from the combustion of natural gas, 4 percent came from the combustion of fuel oil, and 9 percent came from the consumption of steam. The District Government spent approximately $82,953,877 in 2006 on the fuels and electricity that were the cause of these emissions. Emissions from refrigerants leaked from HVAC, refrigeration, or fire suppression systems were not estimated in this inventory due to lack of data.

Figure 3.3: District Government Emissions by Agency

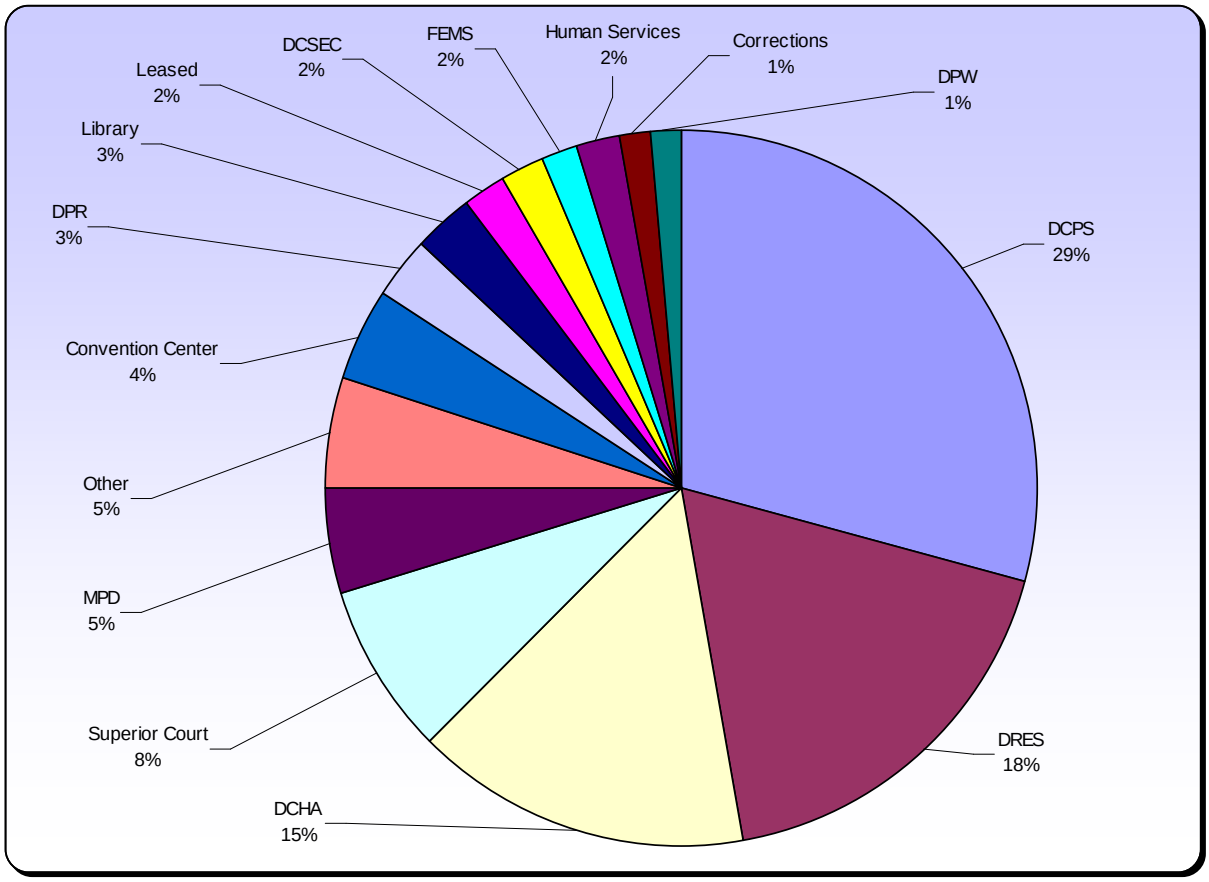
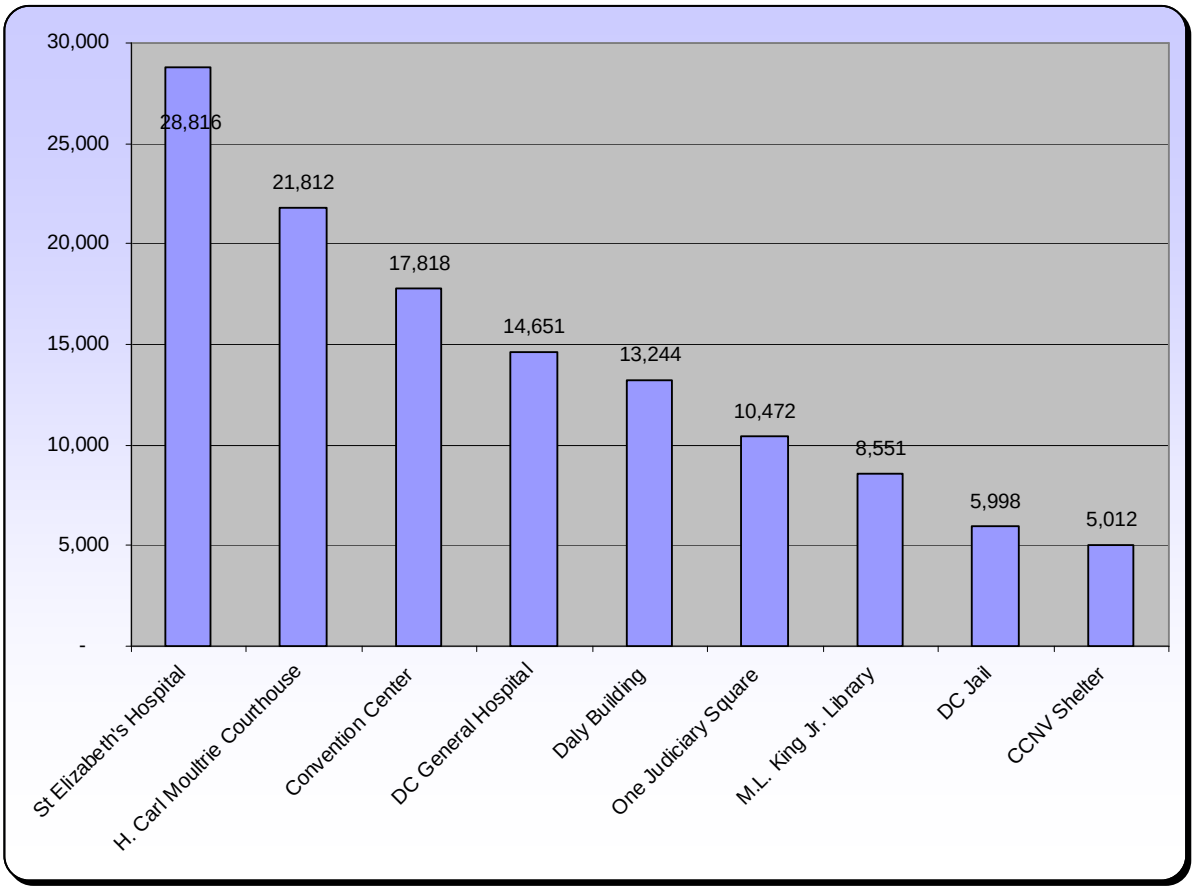


Figure 3.4: Facilities Producing Over 5,000 (metric Tons CO_2e)



3.4.2 Streetlights and Traffic Signals

Like most local governments, the District Government operates a range of public lighting, including streetlights, traffic signals, crossing signals, and other public lighting. The agency that oversees the installation and maintenance of these devices is the District Department of Transportation (DDOT). DDOT is responsible for approximately 78,500 streetlights and 57,000 traffic signal fixtures, and provided the energy used by signals and lighting based on their records. Electricity consumed in the operation of this infrastructure is a significant source of greenhouse gas emissions, roughly equaling the emissions of the District's vehicle fleet.

In 2006, public lighting in the District consumed a total of 87,734,545 kilowatt hours of electricity, producing approximately 45,586 metric tons CO_2e. Table 3.5 depicts 2006 emissions per lighting type and estimated electricity consumption and costs associated with the activities that generated these emissions. The District Government spent $6,371,499 in 2006 on the fuels and electricity that were the cause of these emissions.

Table 3.4: Energy Use and Emissions from Public Lighting

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent Emissions of All Lighting	Electricity Use (kWh)	Cost
Streetlights	38,726	84.9%	74,518,865	$5,938,880
Traffic Signals	6,825	15.0%	13,133,762	$965,125
Crossing Signals	46	0.1%	81,918	$5,993
TOTAL	**45,586**	**100.0%**	**87,734,545**	**$6,371,499**

3.4.3 Water Facilities

The distribution of drinking water and the collection and treatment of stormwater and wastewater is handled by the District of Columbia Water and Sewer Authority (DCWASA). Electricity consumption and the on-site combustion of fuels such as natural gas are the most significant sources of greenhouse gas emissions from the operation of DCWASA equipment, which accounts for 23 percent of emissions included in this inventory. DCWASA provided total electricity and natural gas use for calendar year 2006, and completed an extensive internal emissions audit for 2007 and 2008. The percentage breakdown of energy use between Customer Service (CS), Department of Sewer Services (DSS), Department of Water Services (DWS), and Department of Wastewater Treatment (DWT) were used as a proxy to break-down the 2006 aggregate data.

The energy use reported here consists of three main components – the water distribution system, the wastewater/stormwater collection system, and the Blue Plains Advanced Wastewater Treatment Facility. DCWASA operates all three, and presently the energy use of these system components is reported as an aggregate figure.

To distribute water and support the distribution system, DCWASA operates more than 1,200 miles of pipes, five pumping stations, five reservoirs, four elevated water storage tanks, 36,000 valves and 8,700 public hydrants.

To collect wastewater, DCWASA operates 1,800 miles of sanitary and combined sewers, 22 flow-metering stations, nine off-site wastewater pumping stations, and 16 stormwater pumping stations within the District.

Wastewater is ultimately channeled to the Blue Plains Advanced Wastewater Treatment Facility, which is the largest advanced wastewater treatment plant in the world, with a capacity of 370 million gallons per day and a peak capacity of 1.076 billion gallons per day. In 2006, the Blue Plains Advanced Wastewater Treatment Facility treated wastewater for a population of 2,153,368, which is roughly four times greater than the population of the District. While DCWASA is not part of the District Government, the emissions from DCWASA are included in this inventory because the District has a majority of the seats on the DCWASA board. LGOP specifies that the District

take credit for all emissions produced by DCWASA operations, as they have the power to directly influence operating procedures via board representation.

In 2006, the operation of all DCWASA infrastructure produced approximately 154,789 metric tons of CO_2e from the above sources. Table 3.6 depicts year 2006 emissions by source from DCWASA facilities and shows estimated activities and costs associated with the operation of this equipment. Electricity costs were not provided, but estimated at $26,000,000 based on energy consumed and rates paid by other agencies. Natural gas costs were $25,973.

Table 3.5: Energy Use and Emissions from DCWASA Facilities

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent of Emissions	Energy Use (kWh & therms)	Cost
DWT	132,619	87%	255,190,205	$22,682,482
DWS	10,671	7%	20,534,096	$1,825,165
DSS	8,725	6%	16,789,781	$1,492,353
Electricity Total	**152,016**	**100%**	**292,514,082**	**$26,000,000 (estimated)**
DWT	1,933	71%	363,391	$18,392
DWS	317	12%	59,505	$3,012
CS	262	10%	49,186	$2,489
DSS	191	7%	35,944	$1,819
Natural Gas Total	**2,730**	**100%**	**513,185**	**$25,973**

3.4.4 Wastewater Treatment Process Emissions

Wastewater coming from homes and businesses is rich in organic matter and has a high concentration of nitrogen and carbon (along with other organic elements). As wastewater is collected, treated, and discharged, chemical processes in aerobic and anaerobic conditions can lead to the creation and emission of two greenhouse gases: methane and nitrous oxide. Local governments that operate wastewater treatment facilities, including wastewater pumps, treatment plants, septic systems, collection lagoons, and other facilities, must therefore account for the emission of these gases in their overall greenhouse gas emissions inventory.[8]

Wastewater treatment for the District of Columbia, along with many Maryland and Virginia suburbs, is handled by DCWASA. In 2006, the Blue Plains Advanced Wastewater Treatment Facility treated wastewater for a population of 2,153,368, which is roughly four times greater than the population of the District. Because the District has

8 These emissions should not be confused with the emissions described in Section 3.4.3—those emissions refer to the *transportation* of water and wastewater while this section refers exclusively to the decomposition and treatment of wastewater.

operational control of DCWASA, LGOP specifies that the District should take credit for all emissions produced by DCWASA operations.

The emissions reported in this section do not include any energy use, just the nitrous oxide emissions that result from the treatment process. Energy used by the DCWASA system is reported above. In 2006, process emissions from wastewater treatment facilities produced approximately 8,665 metric tons of CO_2e from the above sources. This figure is unusually small in comparison to energy use due to the unique treatment processes employed at Blue Plains. Table 3.7 breaks down emissions per emissions type. Of total wastewater facility process emissions, 49 percent came from the nitrification/denitrification process, while 51 percent resulted from effluent discharge.

Table 3.6: Wastewater Treatment Emissions by Source

Gas	Source	Greenhouse Gas Emissions (metric tons CO_2e)
N_20	**Treated Effluent Released to Environment**	4,427
N_20	**Nitrification/Denitrification**	4,238
	TOTAL	**8,665**

3.4.5 Vehicle Fleet and Off-Road Equipment

Local governments use vehicles and other off-road equipment as an integral part of their daily operations—from maintenance trucks used for parks and recreation to police cruisers and fire trucks. These vehicles and equipment burn gasoline, diesel, and other fuels, which results in greenhouse gas emissions. In addition, vehicles with air conditioning or refrigeration equipment use refrigerants that can leak from the vehicle, resulting in greenhouse gas emissions. Emissions from vehicles and off-road equipment (such as mowers, forklifts, construction equipment, etc.) compose a significant portion of emissions within most local governments.

Table 3.7: Vehicle Fleet and Off-Road Equipment Emissions[9]

Agency	GHG Emissions (metric tons CO_2e)	Percent of All Mobile Emissions	Gasoline Consumption (gal)	Diesel Consumption (gal)	Cost
MPD	15,802	34%	1,755,969	9,911	$3,954,575
DCPS	11,098	24%	111,466	991,619	$2,196,407
DPW	6,288	14%	91,462	510,129	$1,278,832
FEMS	4,550	10%	42,686	409,534	n/a
DDOT	1,717	4%	94,719	79,146	$412,343

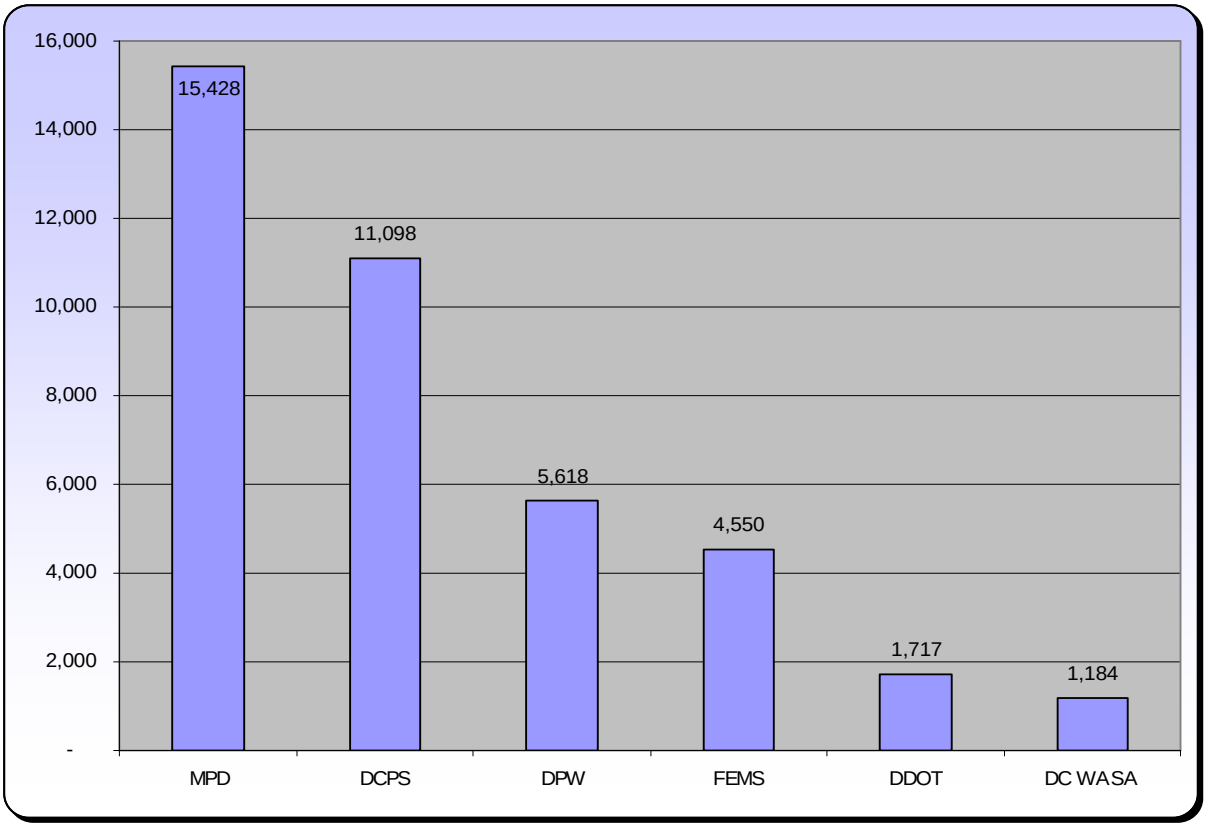
9 The numbers reported here include emissions from fuel consumption only-emissions from leaked refrigerants are reported separately. Costs are shown for departments that reported costs, and may be incomplete.

DCWASA	1,524	3%	46,783	74,695	n/a
All Others	5,311	12%	378,087	177,256	$654,515
TOTAL	**46,289**	**100%**	**2,521,172**	**2,252,289**	**$8,496,671**

In 2006, the District Government operated a vehicle fleet comprised of approximately 5,500 vehicles and pieces of off-road equipment. The District's vehicle fleet performed a number of essential services, including police protection, busing of school children, and collection of solid waste. In 2006, agencies operating a large number of vehicles included DCPS (810), DCWASA (464), MPD (1,686), DPW (674), and DDOT (349). Of all mobile emissions calculated, emissions from the vehicle fleet made up 6 percent of total emissions, while emissions from off-road equipment made up 0.6 percent of total emissions, and leaked refrigerants made up 0.2 percent of total emissions. Leaked refrigerants were estimated according to alternate methods for vehicle fugitive emissions set forth in LGOP, but are likely to represent a significant over-estimation of actual fugitive emissions from vehicle air conditioning. However, they represent the best assessment possible based on available data, and comprise a very small percentage of overall inventory results.

In 2006, the District Government emitted a total of approximately 46,289 metric tons of CO_2e as a result of the combustion of fuels to power the District's vehicle fleet and off-road equipment. Of this total, 41,817 metric tons of CO_2e (90 percent) is from the vehicle fleet while 4,472 (10 percent) is from off-road equipment. Table 3.8 shows estimated costs associated with the activities that generated these emissions, and Figure 3.7 depicts 2006 vehicle emissions per major agency. The six agencies listed in Figure 3.7 represent 95 percent of vehicle fleet emissions. Across agencies, the vehicles used by MPD were the largest emitters of greenhouse gases at 15,428 metric tons of CO_2e, representing 37 percent of total vehicle fleet emissions. Across all government operations, emissions from the vehicle fleet and off-road equipment represented 7 percent of rolled-up emissions from District operations in 2006. Of total sector emissions, 49.5 percent came from the consumption of diesel, 49.1 percent came from the combustion of gasoline, and the remaining percent (1.4) came from the combustion of compressed natural gas. The District spent approximately $8,903,592 in 2006 on the fuels that were the cause of these emissions. District vehicles and off-road equipment used 4,939,708 gallons of fuel and traveled 36,929,062 miles.

Figure 3.5: Emissions from Mobile Sources (metric tons CO2e)



3.4.6 Government-Generated Solid Waste

Local government operations generate solid waste, much of which is eventually sent to a landfill. Typical sources of waste in local government operations include paper and food waste from offices and facilities, construction waste from public works, and plant debris from parks departments. Organic materials in government-generated solid waste (including paper, food scraps, plant debris, textiles, wood waste, etc.) generate methane as they decay in the anaerobic environment of a landfill. An estimated 75 percent of this methane is routinely captured via landfill gas collection systems;[10] however, a portion escapes into the atmosphere, contributing to the greenhouse effect. As such, estimating emissions from waste generated by government operations is an important component of a comprehensive emissions inventory.

Inventorying emissions from government-generated solid waste is considered optional by LGOP for two reasons. First, the emissions do not result at the point of waste generation (as with fuel combustion), but often in a landfill

10 This is a default methane collection rate per LGOP. This rate can vary from 0 to 99 percent based upon the presence and extent of a landfill gas collection system at the landfill/s where the waste is disposed. Most commonly, captured methane gas is flared into the atmosphere, which converts the methane gas to CO_2 and effectively negates the human-caused global warming impact of the methane. Increasingly, landfill methane is being used to power gas-fired turbines as a carbon-neutral means of generating electricity.

located outside of jurisdictional boundaries. In addition, the emissions are not generated in the same year that the waste is disposed, but over a lengthy decomposition period. Since inventorying these emissions is considered optional, LGOP does not provide guidance on recommended methods for quantifying these types of emissions. ICLEI therefore devised data collection and calculation methods based upon previous experience and national standards. See Appendix D for more information for more detail on quantifying emissions from government-generated solid waste.

It is estimated that the waste disposed by government facilities in 2006 will cumulatively produce 30 metric tons of methane gas, or 625 metric tons $C0_2e$. Please note that this figure is only reflective of facilities managed by the Department of Real Estate Services. Data was not available from other sources.

3.4.7 Employee Commute

Fuel combustion from employees commuting to work is another important emissions source from the District's government operations. Similar to the District's vehicle fleet, personal employee vehicles use gasoline and other fuels which, when burned, generate greenhouse gas emissions. Emissions from employee commutes are considered optional for inclusion in that inventory by LGOP because the vehicles are owned and operated privately by the employees. However, LGOP encourages reporting these emissions because local governments can influence how their employees commute to work through incentives and commuting programs. For this reason, employee commute emissions were included in this report as an area where the District could achieve significant reductions in greenhouse gases.

To calculate emissions, the District administered a survey to all of its employees regarding their commuting patterns and preferences. ICLEI then extrapolated the results of the survey based on year 2006 employment of 32,067 to represent emissions from all employees. See Appendix C for a detailed description of the survey and methods used to calculate emissions.

In 2006, employees commuting in vehicles to and from their jobs with the District emitted an estimated 33,101 metric tons of CO_2e. Table 3.9 shows estimated emissions and vehicle miles traveled for all the District employees. This is emissions from employee vehicle travel only; it does not include emissions from transit use, which are captured in other areas of the inventory.

Table 3.8: Emissions from Employee Commutes

	Greenhouse Gas Emissions (metric tons CO_2e)	Estimated Vehicle Miles Traveled to Work	Estimated Gallons Consumed
All Employees	33,101	76,754,134	3,639,221

Community Inventory Results

This chapter provides a detailed description of the District of Columbia's community-level emissions during 2006, rolling-up and comparing emissions across sectors and sources as appropriate. This chapter also provides details on the greenhouse gas emissions from each sector, including a breakdown of emissions types. The community inventory provides an estimate of all of the GHG emissions produced within the District of Columbia both by residents in their homes and by local businesses and agencies as they carry out their operations. Six key sectors are included in the community inventory: Residential, Non-Residential, Federal, Transportation (VMT), Transit (Metro), and Solid Waste. District government emissions are a subset of the community emissions, and are embedded in the sector totals. District government emissions are 6 percent of the community total, but are not culled out of the results reported below.

During the 2006 calendar year, the District's citywide direct emissions, emissions from electricity consumption and select indirect sources totaled 10,505,946 metric tons of CO_2e. Of the total emissions accounted for in this inventory, emissions from the Non-Residential sector were the largest (51 percent as shown in Figure 4.1 and Table 4.1).

4.1 Summary by Sector

Reporting emissions by sector provides a useful way to understand the sources of the District of Columbia's overall community emissions. By better understanding the relative scale of emissions from each of the sectors, the District can more effectively focus emissions reductions strategies to achieve the greatest emissions reductions.[11]

11 The sectors with the largest scale of emissions do not necessarily represent the best opportunity for emissions reductions. Cost, administration, and other concerns may affect the District's ability to reduce emissions from any one sector.

Figure 4.1 2006 District Community Emissions by Sector

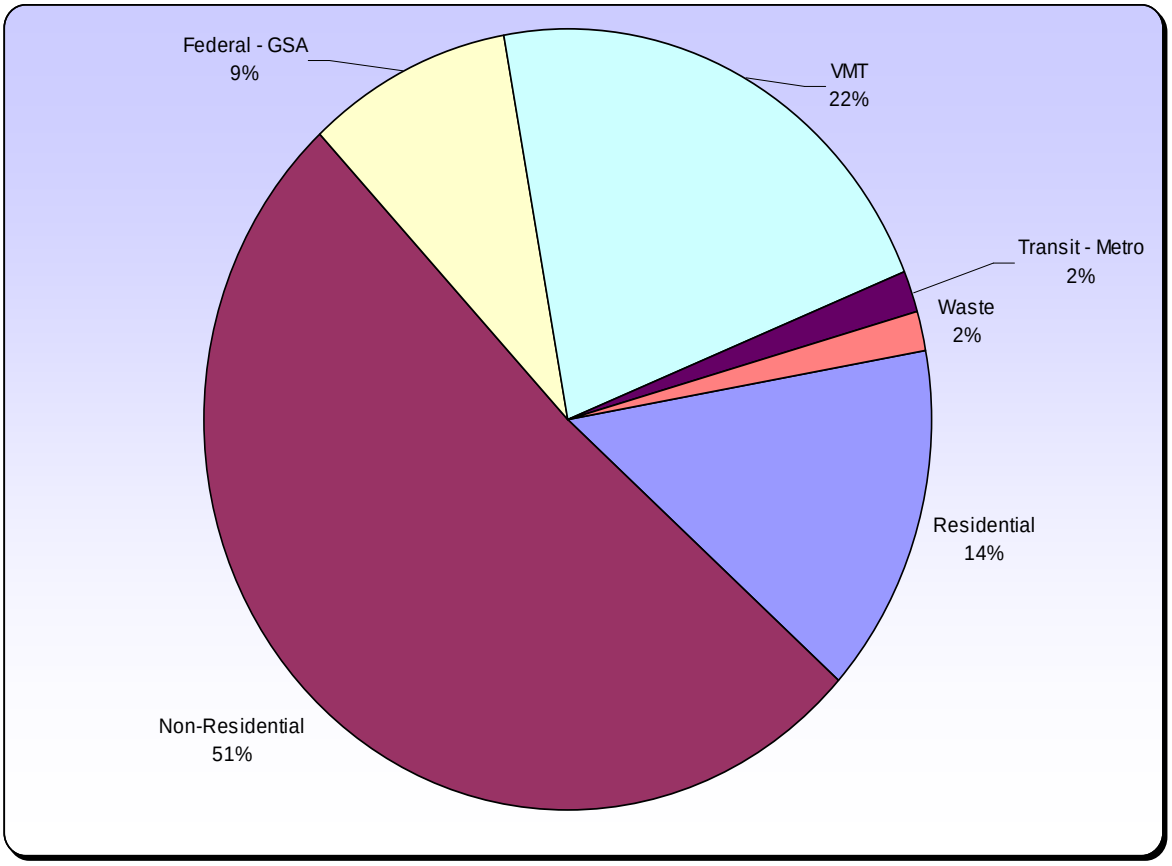


Table 4.1 2006 District Community Emissions by Sector

Sector	Sector Total (metric tons CO_2e)
Non-Residential	5,401,510
Vehicle Miles Traveled	2,261,338
Residential	1,517,011
Federal - GSA	963,178
Solid Waste	185,991
Transit – Metro	176,918

As shown in Figure 4.1, the Non-Residential sector was the largest emitter (5,401,510 metric tons CO_2e) in 2006. The Non-Residential sector includes a wide variety of facilities, including commercial and industrial buildings, as well as multi-family dwellings of four units or more. The Residential sector was responsible for 15 percent of community emissions, with a total of 1,517,011 metric tons of CO_2e. Federal facilities managed by GSA accounted for 9 percent of emissions, with a total of 963,178 metric tons of CO_2e. Between Residential, Non-Residential, and Federal facilities, emissions from buildings consisted of approximately 75 percent of community emissions. Emissions from the Vehicle Miles Traveled sector totaled 2,261,338 metric tons of CO_2e, or 22 percent of community emissions. Emissions from Metro were culled from the Non-Residential sector and were 2 percent of

the community total, with 176,918 metric tons of CO_2e. Finally emissions from the Solid Waste sector accounted for an estimated 185,991 metric tons of CO_2e, also 2 percent of the community total.

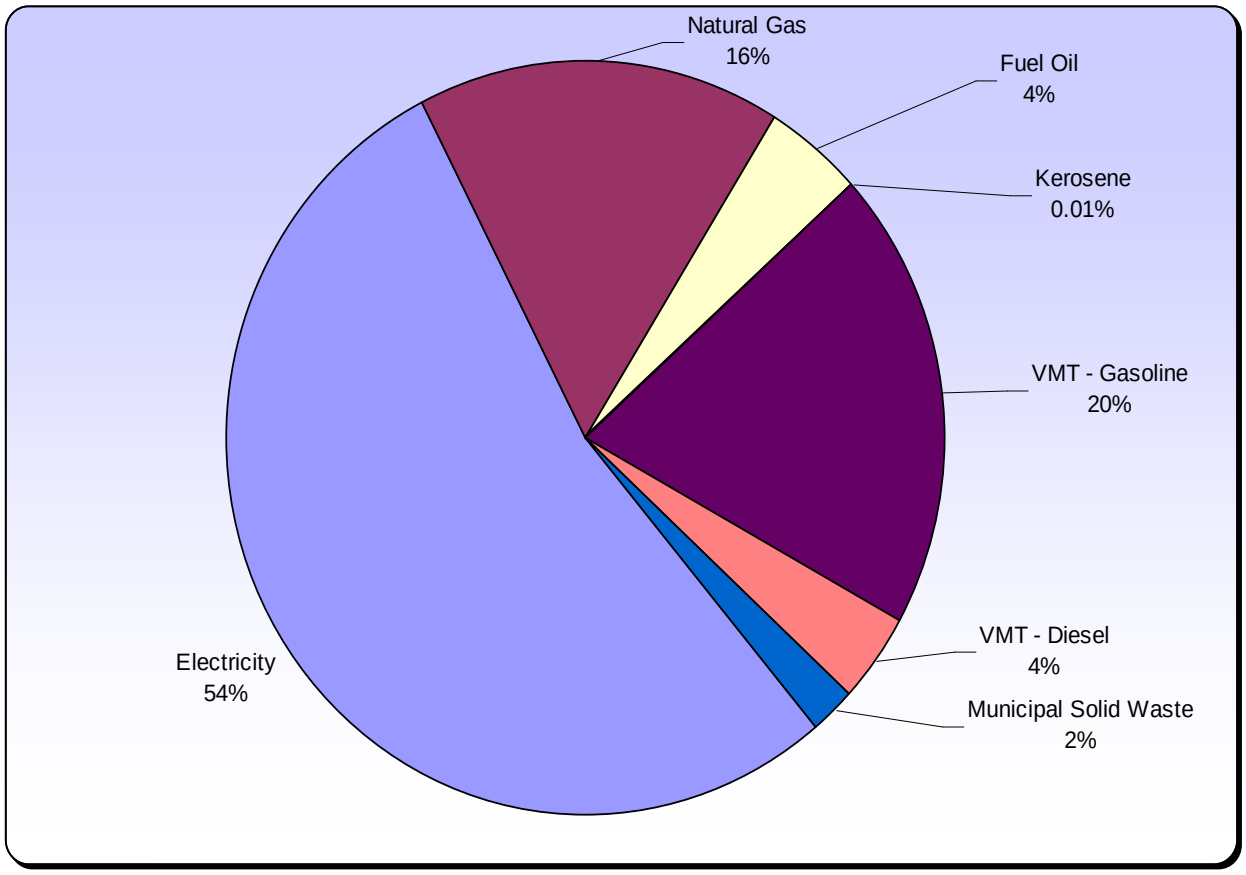
4.2 Summary by Source

When considering how to reduce emissions, it is helpful to look not only at which sectors are generating emissions, but also at the specific raw resources and materials (gasoline, diesel, electricity, natural gas, solid waste, etc.) whose use and generation directly result in the release of greenhouse gases. This analysis can help target resource management in a way that will successfully reduce greenhouse gas emissions. Table 4.2 and Figure 4.2 provide a summary of the District's 2006 community greenhouse gas emissions by fuel type or material.

Table 4.2 2006 District Government Operations Emissions by Source

Fuel/Source	CO_2e emitted (metric tons)
Electricity	5,924,683
Natural Gas	1,549,920
Gasoline	1,902,224
Fuel Oil	423,686
Diesel	359,113
Municipal Solid Waste	185,991
Kerosene	1,123

Figure 4.2 2006 District Community Emissions by Source



4.3 Detailed Sector Analyses

4.3.1 Residential

Through energy use for heating, cooling, lighting, and other purposes, residential buildings constitute a significant amount of total community greenhouse gas emissions. In 2006, the District had approximately 588,000 residents living in 255,000 households.

In 2006, residences in the District produced approximately 1,517,011 metric tons of CO_2e from electricity and natural gas consumption. Table 4.4 shows the energy use associated with the activities that generated these emissions. Of total residential emissions, 954,318 metric tons of CO_2e (62 percent) came from the consumption of electricity and 487,023 metric tons of CO_2e (38 percent) came from the combustion of natural gas.

Table 4.3: Energy Use and Emissions from Residential Buildings

Type	Electricity Use (kWh)	Greenhouse Gas Emissions (metric tons CO_2e)	Natural Gas Use (therms)	Greenhouse Gas Emissions (metric tons CO_2e)
Residential	1,836,662,611	954,318	91,552,500	487,023

4.3.2 Non-Residential

Through use of energy for heating, cooling, lighting, and other purposes, non-residential buildings constitute the largest contributor to total community greenhouse gas emissions. In 2006, the District had second highest numeric increase in daytime population in the country, where 410,000 workers boosted the capital's population by 72 percent during business hours. Obviously, the District is a regional and national employment hub with unique characteristics due to the prevalence of the federal government. The Non-Residential sector includes the sizable presence of the myriad of institutions and non-governmental organizations that are located in the District.

In 2006, the Non-Residential sector energy use in the District produced approximately 5,401,510 metric tons of CO_2e. Table 4.5 shows the energy use associated with the activities that generated these emissions. Of the total sector emissions, 3,989,474 metric tons of CO_2e (77.2 percent) came from the consumption of electricity, 1,062,897 metric tons of CO_2e (17.1 percent) came from the combustion of natural gas, 347,912 metric tons of CO_2e (5.6 percent) came from the combustion of fuel oil, and 1,122 metric tons of CO_2e (0.02 percent) came from the combustion of kerosene.

Table 4.4: Energy Use and Emissions from Non-Residential Buildings

Energy Source	Energy Use	Units	Greenhouse Gas Emissions (metric tons CO_2e)	Percentage of Total
Electricity	9,225,381,265	kWh	3,989,474	77.2%
Natural Gas	199,807,771	therms	1,062,897	17.1%
Fuel Oil	34,277	thousand gallons	347,912	5.6%
Kerosene	115	thousand gallons	1,122	0.02%

4.3.3 Federal - GSA

This section addresses emissions associated with the operation of Federal facilities within District borders. The emissions figures presented here are exclusive to facilities operated by the General Services Administration (GSA). It does not include all Federal facilities within the District, the significant exception being Department of Defense

facilities. The consumption from GSA facilities was subtracted out of the Non-Residential sector figures presented above.

In 2006, Federal facilities managed by GSA produced approximately 963,178 metric tons of CO_2e. Of the sector emissions included in the inventory, 803,973 metric tons of CO_2e came from the consumption of electricity, and 159,209 metric tons of CO_2e came from the combustion of natural gas. Overall, emissions from facilities operated by the General Services Administration accounted for 9 percent of community emissions.

Table 4.5: Energy Use and Emissions from GSA facilities

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent of Emissions by Fuel Source
Electricity	803,973	83%
Natural Gas	159,209	17%
TOTAL	**963,178**	**100.0%**

4.3.4 Transit - Metro

This section addresses emissions associated with the operation of the Washington Metropolitan Area Transit Authority (WMATA) Metro system within District borders. The inventory includes energy use from WMATA facilities and from MetroRail. This section of the inventory does not include MetroBus fuel usage; that usage is embedded in the vehicle miles traveled data shown below. The electricity usage of the WMATA system was originally embedded in the Non-Residential sector electricity data, but was parsed out thanks to cooperation from WMATA.

In 2006, Metro service in the District consumed 340,493,897 kilowatt hours of electricity and produced approximately 176,918 metric tons of CO_2e. As shown in Figure 4.1, this quantity represents 2 percent of all emissions included in the community inventory.

4.3.5 Vehicles Miles Traveled

This section addresses emissions associated with the operation of vehicles on District roadways in 2006. It does not include emissions from off-road vehicles and construction equipment operated in the District. The estimates shown below are based on vehicle miles traveled (VMT) data provided by the Washington Metropolitan Council of Governments.

In 2006, vehicle use in the District produced approximately 2,261,338 metric tons of CO_2e. Vehicle use had the second-highest emissions per sector in the community inventory, with 22 percent of the community total. Table 4.6

shows the energy use associated with the activities that generated these emissions. Of the total sector emissions, 1,902,224 metric tons of CO_2e (84 percent) came from the consumption of gasoline, and 359,113 metric tons of CO_2e (16 percent) came from the combustion of diesel. Gasoline use represented 94 percent of miles traveled, but diesel vehicles generally are larger (and therefore get poorer mileage) and diesel produces slightly higher emissions than gasoline, so there is not a perfect correlation between emissions and vehicle miles traveled.

Table 4.6: Energy Use and Emissions from Vehicle Use

Source	Greenhouse Gas Emissions (metric tons CO_2e)	Percent of Emissions by Fuel Source	Miles Traveled
Gasoline	1,902,224	84%	3,156,722,592
Diesel	359,113	16%	201,053,349
TOTAL	**2,261,338**	**100%**	**3,357,775,941**

4.3.5 Solid Waste

The community portion of the inventory measures solid waste in much the same way as the government operations inventory. Both generate solid waste, much of which is eventually sent to a landfill. Typical sources of solid waste include paper and food waste from offices and facilities, construction and demolition waste, and plant debris and yard trimmings. Organic materials in community-generated solid waste (including paper, food scraps, plant debris, textiles, wood waste, etc.) generate methane as they decay in the anaerobic environment of a landfill. An estimated 75 percent of this methane is routinely captured via landfill gas collection systems;[12] however, a portion escapes into the atmosphere, contributing to the greenhouse effect. As such, estimating emissions from waste generated by community operations is an important component of a comprehensive emissions inventory.

The District Government operates two transfer stations that collect waste from both residential and commercial sources. All residential waste for buildings of three or fewer units is collected by the Department of Public Works, so residential waste figures represent the totality of that subsector. However, commercial waste and waste for larger residential buildings are collected by a multitude of private haulers that are not required to deposit waste at a transfer station within the District. As a result, an estimate was used for the total commercial waste generated in the District. DPW estimates total waste generation within the District in 2006 at 800,000 tons. This waste is estimated to generate 185,991 metric tons of CO_2e, or two percent of total District community emissions.

12 This is a default methane collection rate per LGOP. This rate can vary from 0 to 99 percent based upon the presence and extent of a landfill gas collection system at the landfill/s where the waste is disposed. Most commonly, captured methane gas is flared into the atmosphere, which converts the methane gas to CO_2 and effectively negates the human-caused global warming impact of the methane. Increasingly, landfill methane is being used to power gas-fired turbines as a carbon-neutral means of generating electricity.

Emissions Forecast

The objective of this greenhouse gas emissions inventory is to identify the sources and quantities of greenhouse gas emissions resulting from government operations and community activities in the District of Columbia during the 2006 calendar year. This inventory represents the first step in a comprehensive approach to reducing the District's emissions.

While developing the emissions inventory is critically important, forecasting emissions is also an essential step in ICLEI's Milestone One: Conduct a baseline emissions inventory of government operations and the community as a whole, as well as forecast emissions. Without a projection of emissions growth, it is impossible to make informed decisions in setting a reduction target and developing a climate action plan. The emissions forecast assumes a "business as usual" scenario in which emissions per unit of energy stay constant, but population growth and jobs growth are factored in. Thus, any changes to vehicle fuel efficiency or electricity emissions factors, such as through the provision of renewable energy, are not included in the business as usual forecast. Rather, these measures are accounted for as part of the climate action plan to meet the emissions reduction target.

The District of Columbia's 2006 government operations emissions were estimated at a total of 719,896 metric tons of CO_2e. Table 5.1 shows projected growth in these emissions through 2050. Total government emissions were projected to 2050 under low, medium, and high growth scenarios. Under the medium growth scenario, emissions are forecasted to rise to 915,107 metric tons of CO_2e, an increase of approximately 27 percent under a no-action scenario. The table shows forecasts per sector for 2012, 2020 and 2050. For buildings, the forecast uses an Energy Information Administration (EIA) estimate for increased commercial building energy consumption of 1.1 percent annually. The building forecast contains an additional correction to account for the anticipated increase in energy use in modernized school facilities. Vehicles and employee commute emissions are projected to grow at 0.4 percent annually according to the EIA. DCWASA does not expect its service population to increase, but the forecast does account for the energy consumption of known expansions of DCWASA operations. Emissions from traffic signals and street lighting were not expected to increase, while emissions from solid waste were forecast to increase with increases in employment.

Table 5.1 - Forecasted GHG Emissions for District Government Operations (metric tons CO_2e)

	2006	2012	2020	2050
District Population	588,292	619,135	675,583	840,824
District Government Employees	33,000	34,730	37,897	47,166
Buildings Emissions	429,301	459,820	503,398	698,951
Water/Wastewater Treatment Emissions	163,454	163,454	179,745	179,745
Signals & Lighting Emissions	45,586	45,586	45,586	45,586
Vehicle Fleet Emissions	47,829	49,579	50,578	57,013
Employee Commute Emissions	33,101	34,312	35,004	39,457
Solid Waste Emissions	625	658	718	893
District Government Emissions - Low Growth Scenario	719,896	731,087	759,836	819,473
District Government Emissions - Medium Growth Scenario	719,896	742,178	787,005	915,138
District Government Emissions - High Growth Scenario	719,896	753,408	815,073	1,021,690

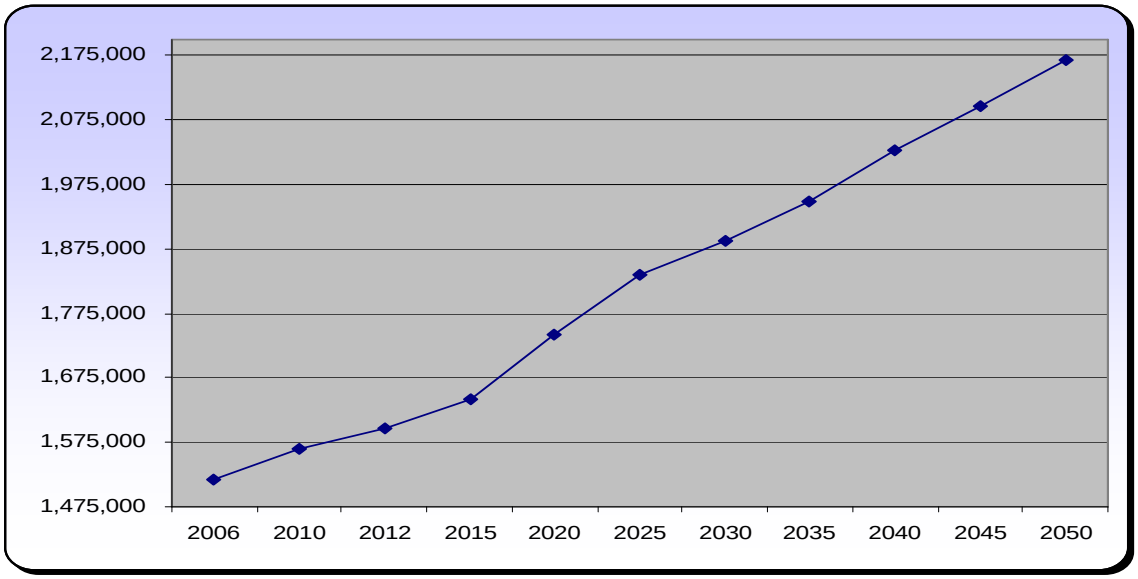
The three growth scenarios are based on projections of increases in employee efficiency – 0.5 percent annually under low growth, 0.25 percent under medium growth, and no increase in efficiency under the high growth scenario.

The District of Columbia's 2006 community emissions stood at an estimated 10,505,946 metric tons of CO_2e. Table 5.2 shows projected growth in these emissions through 2040. Total community emissions are projected to grow to 14,284,067 by 2050, an increase of approximately 23 percent under a no-action scenario.

Table 5.2 - Forecasted Community GHG Emissions (metric tons CO2e)

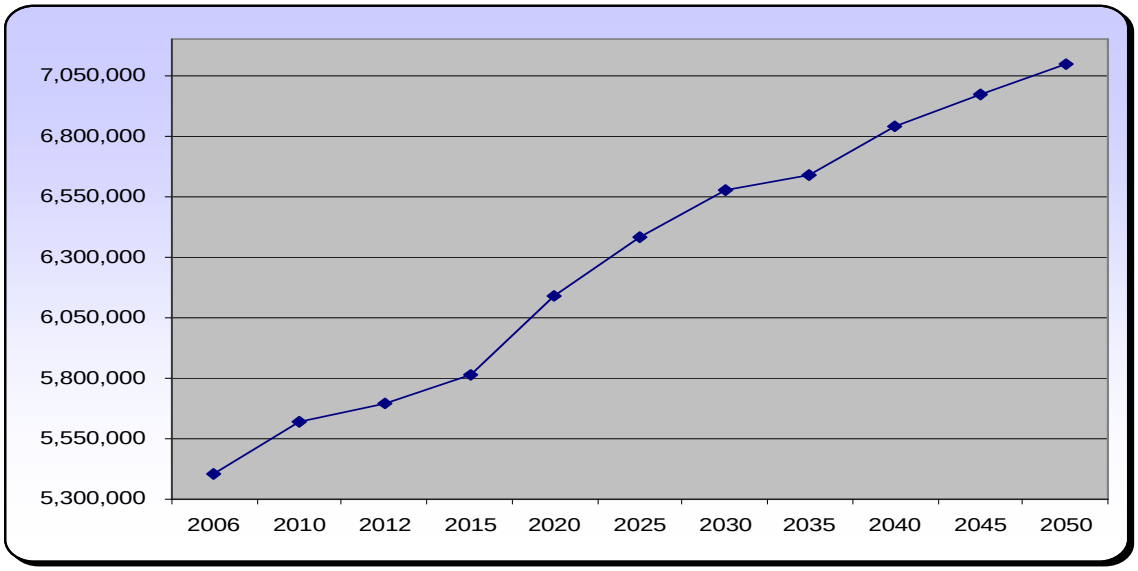
	2006	2012	2020	2050
Non-Residential	5,401,510	5,694,599	6,136,174	7,099,214
VMT	2,261,338	2,379,896	2,596,876	3,232,046
Residential	1,517,011	1,596,545	1,742,106	2,168,208
Federal - GSA	963,178	1,015,441	1,094,181	1,265,907
Solid Waste	185,991	195,742	213,588	265,830
Transit - Metro	176,918	186,194	203,170	252,863
Totals	**10,505,946**	**11,068,416**	**11,986,095**	**14,284,067**

Figure 5.1 Projected Community Residential Emissions (metric tons CO_2e)



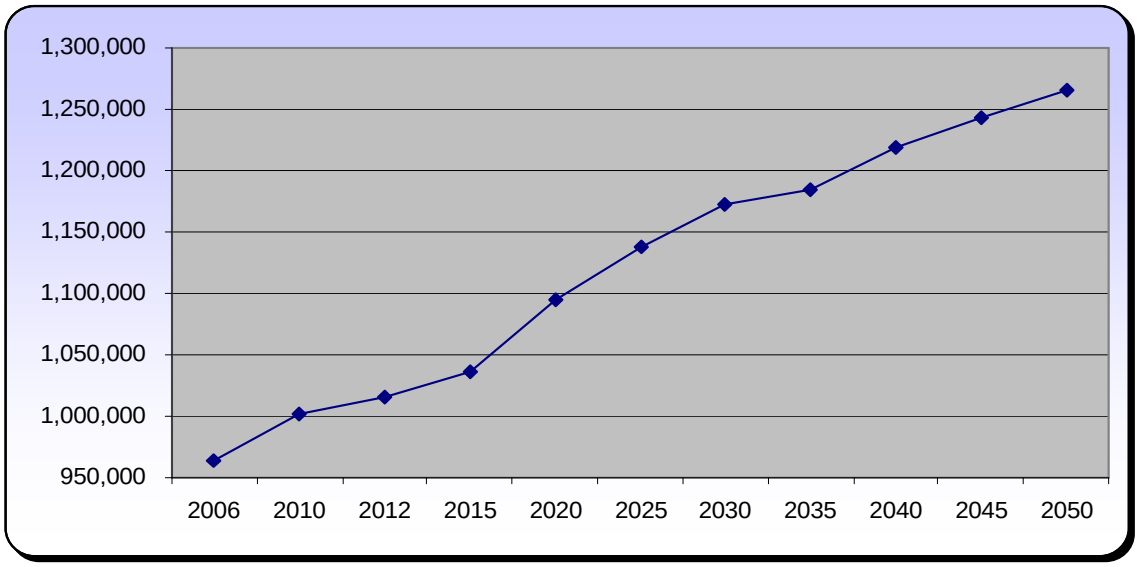
The projected increases in the Residential sector emissions depicted in Figure 5.1 are based on population forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 population of 588,292 is forecasted by COG to grow to a population of 786,244 in 2040. Further projections indicate a population of 840,824 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per resident for the residential sector were 2.58 metric tons CO_2e. The forecast carries the emissions per resident figure forward as population grows, and does not attempt to forecast increases in energy use from increased use of consumer electronic products, for example. The forecast also assumes the present emissions factors for electricity and fossil fuels remain at their current rates. Emissions in 2050 are forecasted to reach 2,186,208 metric tons CO_2e, an increase of 38 percent above 2006 levels.

Figure 5.2 2006 Projected Community Non-Residential Emissions (metric tons CO_2e)



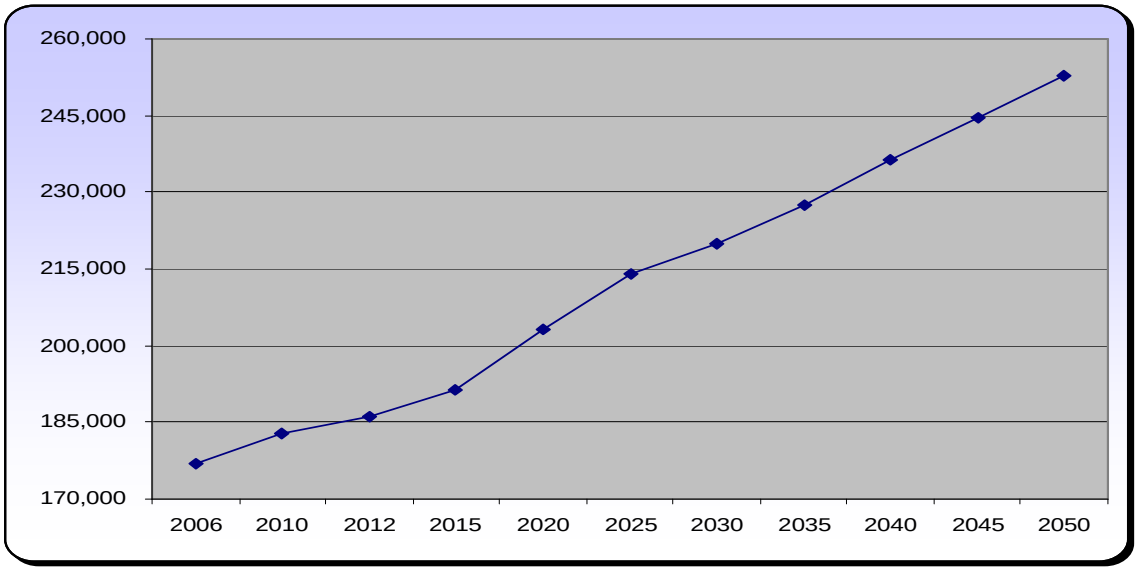
The projected increases in the Non-Residential sector emissions depicted in Figure 5.2 are based on employment forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 employment of 757,840 is forecasted by COG to grow to 959,225 in 2040. Further projections indicate a workforce of 996,031 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per employee for the Non-Residential sector were 8.19 metric tons CO_2e. The forecast carries the emissions per employee figure forward as employment grows, and does not attempt to forecast increases in energy use from increased use of electronic office equipment, for example. The forecast also assumes the present emissions factors for electricity and fossil fuels remain at their current rates. Emissions in 2050 are forecasted to reach 7,099,244 metric tons CO_2e, an increase of 26 percent above 2006 levels.

Figure 5.3 2006 Projected Community Emissions from Federal – GSA (metric tons CO_2e)



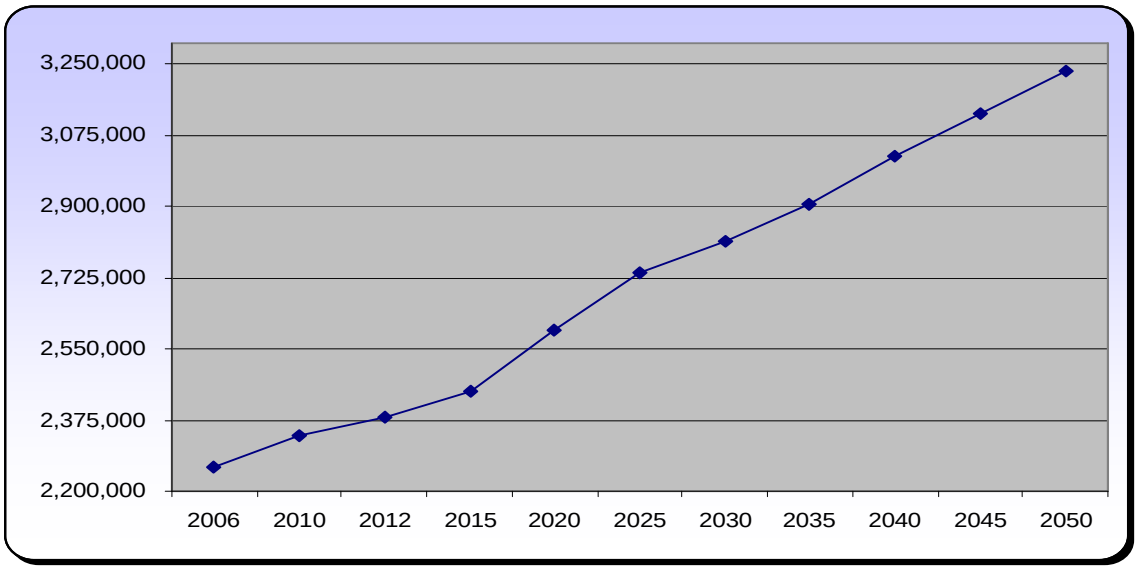
The projected increases in the Federal - GSA sector emissions depicted in Figure 5.3 are based on employment forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 employment of 757,840 is forecasted by COG to grow to 959,225 in 2040. Further projections indicate a workforce of 996,031 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per employee for the Non-Residential sector were 8.19 metric tons CO_2e. The forecast carries the emissions per employee figure forward as employment grows, and does not attempt to forecast increases in energy use from increased use of electronic office equipment, for example. The forecast also assumes the present emissions factors for electricity and fossil fuels remain at their current rates. Emissions in 2050 are forecasted to reach 1,265,907 metric tons CO_2e, an increase of 26 percent above 2006 levels.

Figure 5.4 2006 Projected Community Emissions from Transit – Metro (metric tons CO_2e)



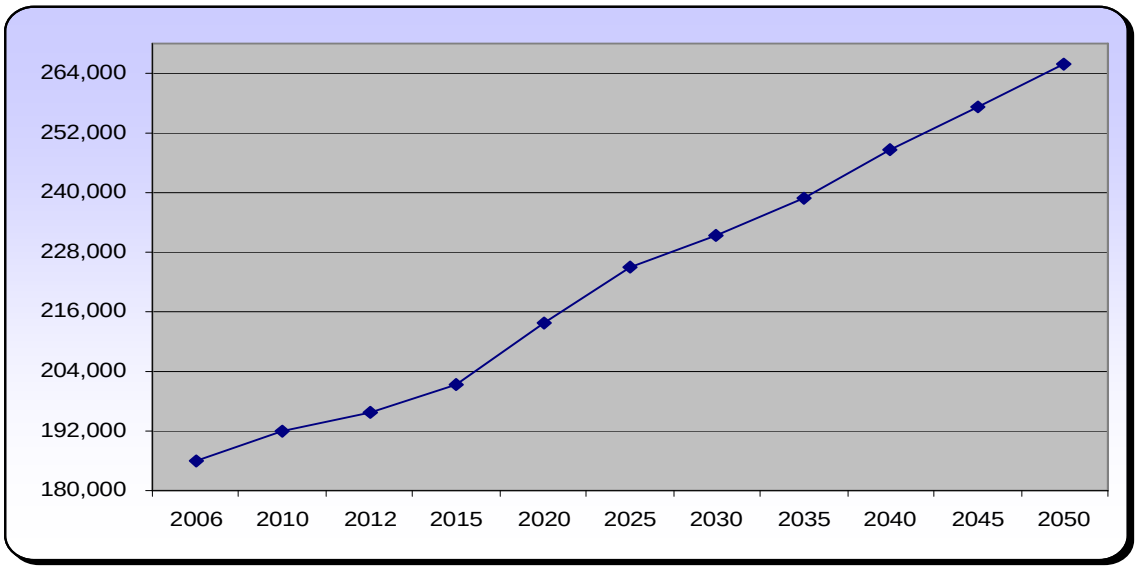
The projected increases in the Transit - Metro sector emissions depicted in Figure 5.4 are based on population forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 population of 588,292 is forecasted by COG to grow to a population of 786,244 in 2040. Further projections indicate a population of 840,824 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per resident for the Transit - Metro sector were 0.30 metric tons CO_2e. The forecast carries these emissions per resident figure forward as population grows, and does not attempt to forecast increases in energy use from expanded transit service, for example. The forecast also assumes the present emissions factors for electricity and fossil fuels remain at their current rates. Emissions in 2050 are forecasted to reach 252,863 metric tons CO_2e, an increase of 38 percent above 2006 levels.

Figure 5.5 2006 Projected Community Emissions from Vehicle Use (metric tons CO_2e)



The projected increases in the Transportation- Vehicle Miles Traveled sector emissions depicted in Figure 5.5 are based on population forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 population of 588,292 is forecasted by COG to grow to a population of 786,244 in 2040. Further projections indicate a population of 840,824 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per resident for the Transportation- Vehicle Miles Traveled sector were 3.84 metric tons CO_2e. The forecast carries these emissions per resident figure forward as population grows, and does not attempt to forecast increases in energy use from increases in vehicle miles traveled. The forecast also assumes the present emissions factors for fossil fuels remain at their current rates. Emissions in 2050 are forecasted to reach 3,232,046 metric tons CO_2e, an increase of 38 percent above 2006 levels.

Figure 5.6 2006 Projected Community Solid Waste Emissions (metric tons CO_2e)



The projected increases in the Solid Waste sector emissions depicted in Figure 5.6 are based on population forecast data provided by the Washington Metropolitan Council of Governments (COG). The 2006 population of 588,292 is forecasted by COG to grow to a population of 786,244 in 2040. Further projections indicate a population of 840,824 in 2050 if the 2030-2040 growth rates are extrapolated. In 2006, emissions per resident for the Solid Waste sector were 0.32 metric tons CO_2e. The forecast carries these emissions per resident figure forward as population grows, and does not attempt to forecast changes in landfill methane capture rates or the impact of recycling programs, for example. Emissions in 2050 are forecasted to reach 265,830 metric tons CO_2e, an increase of 38 percent above 2006 levels.

Conclusion

In choosing to engage ICLEI, undertake the Five Milestone process, and conduct an inventory of greenhouse gas emissions, the District of Columbia has demonstrated commitment to evaluating and reducing its emissions of greenhouse gases. This report lays the groundwork for an ongoing climate protection effort by estimating baseline emissions levels against which future progress can be demonstrated.

During the 2006 calendar year, the District's government operations direct emissions, emissions from electricity consumption, and select indirect sources totaled 719,896 metric tons of CO_2e. Of the total emissions accounted for in this inventory, emissions from the Buildings & Other Facilities sector were the largest (59 percent as shown in Figure ES.1 and Table ES.1), totaling 429,301 metric tons of CO_2e. The Wastewater Facilities sector was responsible for 24 percent of government operations emissions, with a total of 163,454 metric tons of CO_2e. Emissions from the Vehicle Fleet & Off-Road Equipment sector was 47,829 metric tons of CO_2e, or 7 percent of the total for government operations. The Streetlights & Traffic Signals sector was also 7 percent of the total, with 45,586 metric tons of CO_2e. Emissions from the Employee Commute sector (personal vehicles used by District staff to commute to and from work) were estimated at 33,101 metric tons CO_2e, or 5 percent of the emissions accounted for in the inventory. Finally, emissions from the Government-Generated Solid Waste sector accounted for an estimated 625 metric tons of CO_2e, or 0.1 percent of the government operations total. Given the large contribution of the Buildings & Other Facilities and Wastewater Facilities sectors to the overall government operations emissions profile, the District should pay particularly close attention to these sectors during the Climate Action Planning process.

Undertaking efforts to reduce these emissions will also reduce energy expenditures, on which District agencies that reported costs spent $98,267,863 on energy for their operations in 2006. Of this total, 85 percent of these energy expenses ($82,953,877) resulted from the Buildings & Other Facilities sector.

During the 2006 calendar year, the District's community direct emissions, emissions from electricity consumption, and select indirect sources totaled 10,505,946 metric tons of CO_2e. Of the total emissions accounted for in this inventory, emissions from the Non-Residential sector were the largest at 59 percent of inventoried sources. During

the 2006 calendar year, the District's direct emissions, emissions from electricity consumption, and select indirect sources totaled 10,505,946 metric tons of CO_2e at the community level. Of the total emissions accounted for in this inventory, emissions from the Non-Residential sector were the largest (59 percent as shown in Figure ES.2 and Table ES.2). The Residential sector was responsible for 15 percent of community emissions, with a total of 1,517,011metric tons of CO_2e. Between Residential and Non-Residential facilities, emissions from buildings consisted of approximately 75 percent of community emissions. Emissions from the Transportation- Vehicle Miles Traveled sector were 2,261,338 metric tons of CO_2e, or 22 percent of community emissions. Emissions from Metro were culled from the Non-Residential sector and were 2 percent of the community total, with 176,918 metric tons of CO_2e. Finally, emissions from the Solid Waste sector accounted for an estimated 185,991 metric tons of CO_2e, also 2 percent of the community total. Reducing energy consumption from buildings will pay the largest dividends for community-wide emissions reductions.

The next step in the District's climate protection effort is Milestone Two: Set an Emissions Reduction Target. The target brings an enhanced level of focus to the process of identifying emissions reduction measures. Developing a Climate Action Plan is Milestone Three, and work on this task has been begun even as the inventory is being finalized. The District of Columbia may choose to set different targets for government operations emissions reductions than for community emissions reductions. ICLEI recommends selecting several target years, so that there is a short-term, mid-term, and long-term goal. It is also suggested that the District re-inventory every 3-5 years to measure progress toward achieving the target.

Appendices

Appendix A:
The Local Government Operations Protocol

This inventory follows the standard outlined in the Local Government Operations Protocol, which was adopted in 2008 by the California Air Resources Board (ARB) and serves as the national standard for quantifying and reporting greenhouse emissions from local government operations. This and the other inventories conducted in 2009 are the first to follow LGOP, representing a strong step toward standardizing how inventories are conducted and reported.

A.1 Local Government Operations Protocol

A.1.1 Background

In 2008, ICLEI, ARB, and the California Climate Action Registry (CCAR) released LGOP to serve as a U.S. supplement to the International Emissions Analysis Protocol. The purpose of LGOP is to provide the principles, approach, methodology, and procedures needed to develop a local government operations greenhouse gas emissions inventory. It leads participants through the process of accurately quantifying and reporting emissions, including providing calculation methodologies and reporting guidance. LGOP guidance is divided into three main parts: identifying emissions to be included in the inventory, quantifying emissions using best available estimation methods, and reporting emissions.

The overarching goal of LGOP is to allow local governments to develop emissions inventories using standards that are consistent, comparable, transparent, and recognized nationally, ultimately enabling the measurement of emissions over time. LGOP adopted five overarching accounting and reporting principles toward this end: relevance, completeness, consistency, transparency and accuracy. Methodologies that did not adhere to these principles were either left out of LGOP or included as Scope 3 emissions. LGOP was created solely to standardize how emissions inventories are conducted and reported; as such it represents a currently accepted standard for inventorying emissions but does not contain any legislative or program-specific requirements. Program-specific requirements, such as ICLEI's Milestones or CCAR's reporting protocol, are addressed in LGOP but should not be confused with LGOP itself.

Also, while LGOP standardizes inventories from government operations, it does not seek to be a wholly accurate inventory of all emissions sources, as certain sources are currently excluded or otherwise impossible to accurately estimate. This and all emissions inventories therefore represent a best estimate of emissions using best available data and calculation methodologies; it does not provide a complete picture of all emissions resulting from the

District's operations, and emissions estimates are subject to change as better data and calculation methodologies become available in the future.

A.1.2 Organizational Boundaries

Setting an organizational boundary for greenhouse gas emissions accounting and reporting is an important first step in the inventory process. The organizational boundary for the inventory determines which aspects of operations are included in the emissions inventory, and which are not. Under LGOP, two control approaches are used for reporting emissions: operational control or financial control. A local government has operational control over an operation if it has full authority to introduce and implement its operating policies at the operation. A local government has financial control if the operation is fully consolidated in financial accounts. If a local government has joint control over an operation, the contractual agreement will have to be examined to see who has authority over operating policies and implementation, and thus the responsibility to report emissions under operational control.[13] Local governments must choose which approach is the most applicable and apply this approach consistently throughout the inventory.

While both control approaches are acceptable, there may be some instances in which the choice may determine whether a source falls inside or outside of a local government's boundary. LGOP strongly encourages local governments to utilize operational control as the organization boundary for a government operations emissions inventory. Operational control is believed to most accurately represent the emissions sources that local governments can most directly influence, and this boundary is consistent with other environmental and air quality reporting program requirements. For this reason, this inventory was conducted according to the operational control framework.

A.1.3 Types of Emissions

The greenhouse gases inventoried in this report are described in Section 2.1 As described in LGOP, emissions from each of the greenhouse gases can come in a number of forms:

Stationary or mobile combustion: These are emissions resulting from on-site combustion of fuels (natural gas, diesel, gasoline, etc.) to generate heat, electricity, or to power vehicles and off-road equipment.

Purchased electricity: These are emissions produced by the generation of power from utilities outside of the District.

Fugitive emissions: Emissions that result from the unintentional release of greenhouse gases into the atmosphere (e.g., leaked refrigerants, methane from waste decomposition, etc.).

13 Please see Local Government Operations Protocol for more detail on defining your organizational boundary: http://www.icleiusa.org/programs/climate/ghg-protocol

Process emissions: Emissions from physical or chemical processing of a material (e.g., wastewater treatment).

A1.4 Quantifying Emissions

Emissions can be quantified two ways:

Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility. This methodology is not generally available for most types of emissions and will only apply to a few local governments that have these monitoring systems.

The majority of the emissions recorded in the inventory can be and will be estimated using **calculation-based methodologies** to calculate their emissions using activity data and emission factors. To calculate emissions, the equation below is used:

Activity Data x Emission Factor = Emissions

Activity data refer to the relevant measurement of energy use or other greenhouse gas–generating processes such as fuel consumption by fuel type, metered annual energy consumption, and annual vehicle mileage by vehicle type. Emissions factors are calculated ratios relating emissions to a proxy measure of activity at an emissions source (e.g., CO_2 generated/kWh consumed). For a list of common emissions calculations see Table 2.2.

The guidelines in LGOP are meant to provide a common method for local governments to quantify and report greenhouse gas emissions by using comparable activity data and emissions factors. However, LGOP recognizes that local governments differ in how they collect data concerning their operations and that many are not able to meet the data needs of a given estimation method. Therefore, LGOP outlines both "recommended" and "alternative" methods to estimate emissions from a given source. In this system, recommended methods are the preferred method for estimating emissions, as they will result in the most accurate estimate for a given emission source. Alternative methods often require less intensive data collection, but are likely to be less accurate. This approach allows local governments to estimate emissions based on the data currently available to them. It also allows local governments that are unable to meet the recommended methods to begin developing internal systems to collect the data needed to meet these methods.

This inventory has used the recommended activity data and emissions factors wherever possible, using alternative methods where necessary. For details on the methodologies used for each sector, see Appendix B.

A.1.5 Reporting Emissions

A.1.5.1 Significance Thresholds

Within any local government's own operations there will be emission sources that fall within Scope 1 and Scope 2 that are minimal in magnitude and difficult to accurately measure. Within the context of local government operations, emissions from leaked refrigerants, backup generators and other septic tanks may be common sources of these types of emissions. For these small, difficult to quantify emission sources, LGOP specifies that up to 5 percent of total emissions can be reported using estimation methods not outlined in LGOP.[14]

In this report, the following emissions fell under the significance threshold and were reported using best available methods:

- Scope 1 fugitive emissions from leaked refrigerants from HV/AC and refrigeration equipment
- Scope 1 CH_4 and N_2O emissions from vehicle fleet

A.1.5.2 Units Used in Reporting Emissions

LGOP requires reporting of individual gas emissions, and this reporting is included in Appendix B. In this narrative report, emissions from all gases released by an emissions source (e.g., stationary combustion of natural gas in facilities) are combined and reported in metric tons of carbon dioxide equivalent (CO_2e). This standard is based on the global warming potential (GWP) of each gas, which is a measure of the amount of warming a greenhouse gas may cause, measured against the amount of warming caused by carbon dioxide. For the GWPs of reported greenhouse gases, see Table 2.1.

A.1.5.3 Information Items

Information items are emissions sources that, for a variety of reasons, are not included as Scope 1, 2, or 3 emissions in the inventory. In order to provide a more complete picture of emissions from the District's operations, however, these emissions should be quantified and reported.

In this report, the following emissions are included as information items (emission quantities are reported in Appendix B):

- Scope 1 CO_2 emissions from ethanol consumption to power vehicle fleet

A common emission that is categorized as an information item are carbon dioxide emissions caused by the combustion of biogenic fuels. Local governments will often burn fuels that are of biogenic origin (wood, landfill gas, organic solid waste, biofuels, etc.) to generate power. Common sources of biogenic emissions are the combustion of landfill gas from landfills or biogas from wastewater treatment plants, as well as the incineration of organic municipal solid waste at incinerators.

14 In the context of registering emissions with an independent registry (such as the California Climate Action Registry), emissions that fall under the significance threshold are called *de minimis*. This term, however, is not used in LGOP and was not used in this inventory.

Carbon dioxide emissions from the combustion of biogenic fuels are not included in Scope 1 based on established international principles. [15] These principles indicate that biogenic fuels (e.g., wood, biodiesel), if left to decompose in the natural environment, would release CO_2 into the atmosphere, where it would then enter back into the natural carbon cycle. Therefore, when wood or another biogenic fuel is combusted, the resulting CO_2 emissions are akin to natural emissions and should therefore not be considered as human activity-generated emissions. The CH_4 and N_2O emissions, however, would not have occurred naturally and are therefore included as Scope 1 emissions.

A.2 Baseline Years

Part of the local government operations emissions inventory process requires selecting a "performance datum" with which to compare current emissions, or a base year. Local governments should examine the range of data they have over time and select a year that has the most accurate and complete data for all key emission sources. It is also preferable to establish a base year several years in the past to be able to account for the emissions benefits of recent actions. A local government's emissions inventory should comprise all greenhouse gas emissions occurring during a selected *calendar* year.

After setting a base year and conducting an emissions inventory for that year, local governments should make it a practice to complete a comprehensive emissions inventory on a regular basis to compare to the baseline year. ICLEI recommends conducting an emissions inventory at least every five years.

15 Methane and nitrous oxide emissions from biogenic fuels are considered Scope 1 stationary combustion emissions and are included in the stationary combustion sections for the appropriate facilities.

Appendix B:
LGOP Standard Report

Local Government Operations Standard Inventory Report

Back to Intro

1. Local Government Profile

Jurisdiction Name:	District of Columbia
Website Address:	http://www.dc.gov/
Size (sq. miles):	68.3
Population:	588,000
Annual Budget:	1,000,000,000
Employees (Full Time Equivalent):	33,000
Climate Zone:	7
Annual Heating Degree Days:	4571
Annual Cooling Degree Days:	1243
Lead Inventory Contact Name:	Daniel Barry
Title:	Senior Policy Analyst for Climate
Department:	DDOE
Email:	daniel.barry@dc.gov
Phone Number:	202-442-7626

Services Provided:

☑ Water treatment	☐ Mass transit (buses)	☑ Hospitals	☐ Natural gas utility
☑ Water distribution	☐ Mass transit (light rail)	☐ Airport	☐ Other (Specify below)
☑ Wastewater treatment	☐ Mass transit (ferries)	☐ Seaport/shipping terminal	
☑ Wastewater collection	☑ Schools (primary/secondary)	☐ Marina	
☐ Electric utility	☑ Schools (colleges/universities)	☑ Stadiums/sports venues	
☑ Fire Protection	☑ Solid waste collection	☑ Convention center	
☑ Police	☐ Solid waste disposal	☑ Street lighting and traffic signals	

Local Government Description:

The 1973 Home Rule Act devolved certain Congressional powers over the District to a local government administered by an elected mayor and the thirteen-member Council of the District of Columbia. Each of the city's eight wards elects a single member of the council and five members, including the chairman, are elected at large. There are 37 Advisory Neighborhood Commissions (ANCs) elected by small neighborhood districts. The mayor and council adopt a local budget, which must be approved by Congress. Local income, sales, and property taxes provide about 67% of the revenue to fund city government agencies and services. Like the 50 states, D.C. receives federal grants for assistance programs such as Medicare, accounting for approximately 26% of the city's total revenue. The Federal government operates the District's court system and all federal law enforcement agencies.

2. GHG Inventory Details

Reporting Year:	2006
Protocol Used:	Local Government Operations Protocol, Version 1.0 (September 2008)
Control Approach:	Operational Control

GHG Emissions Summary (All Units in Metric Tons Unless Stated Otherwise)

Note: CO_2e totals listed here are summed totals of the estimated emissions of each inventoried gas based upon their global warming potentials (Appendix E of LGOP)

BUILDINGS & OTHER FACILITIES

SCOPE 1

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	169,058	164,481	2,582	1,995			
Fugitive Emissions					0.000		
Total Direct Emissions from Buildings & Facilities	169,058	164,481	2,582	1,995	0.000	0.000	0.000

SCOPE 2

	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	260,243	258,781	144	1,318
Purchased Steam				
District Heating & Cooling				
Total Indirect Emissions from Buildings & Facilities	260,243	258,781	144	1,318

INDICATORS

Operating Hours	
Square Footage	
Number of Employees	

STREETLIGHTS AND TRAFFIC SIGNALS

SCOPE 2

	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	45,586	45,586	25	231
Total Indirect Emissions from Streetlights and Traffic Signals	45,586	45,586	25	231

SCOPE 3

	CO_2e
See list at bottom for some examples	

INDICATORS

WATER DELIVERY FACILITIES

SCOPE 1

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	317	316	1	0			
Total Direct Emissions from Water Delivery Facilities	317	316	1	0	0.000	0.000	0.000

SCOPE 2

	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	10,669	10,609	6	54
Purchased Steam				
District Heating & Cooling				
Total Indirect Emissions from Water Delivery Facilities	10,669	10,609	6	54

SCOPE 3

	CO_2e
See list at bottom for some examples	

INDICATORS

Gallons of Drinking Water Treated	
Gallons of Water Transported	

WASTEWATER FACILITIES

SCOPE 1

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Stationary Combustion	2,484	2,478	5	1			
Fugitive Emissions	8,665						
Process Emissions							
Total Direct Emissions from Wastewater Facilities	11,149	2,478	5	1	0.000	0.000	0.000

SCOPE 2

	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity	141,319	140,525	78	716
Purchased Steam				
District Heating & Cooling				
Total Indirect Emissions from Wastewater Facilities	141,319	140,525	78	716

SCOPE 3

	CO_2e
See list at bottom for some examples	

INDICATORS

Gallons of Wastewater Treated	370 MGD
Gallons of Wastewater Transported	

VEHICLE FLEET

SCOPE 1

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs
Mobile Combustion	46,289	45,828	64	398	1,540	
Fugitive Emissions						
Total Direct Emissions from Vehicle Fleet	46,289	45,828	64	398	1,540	0.000

SCOPE 2

	CO_2e	CO_2	CH_4	N_2O
Purchased Electricity for Electric Vehicles				
Total Indirect Emissions from Vehicle Fleet	0.000	0.000	0.000	0.000

SCOPE 3

	CO_2e

INDICATORS

Number of Vehicles	4,659
Vehicle Miles Traveled	36,929,062
Number of Pieces of Equipment	881
Equipment Gallons Consumed	466,706

WASTE GENERATION

SCOPE 3

	CO_2e
Waste All Facilities	625

INDICATORS

Short tons of solid waste accepted for disposal	2,685
Short tons of recyclable materials accepted for processing	

EMPLOYEE COMMUTE

SCOPE 3

	CO_2e
Mobile Combustion	33,101

INDICATORS

Vehicle Miles Traveled	76,754,134
Number of Vehicles	

INFORMATION ITEMS

	CO_2e
Washington Aqueduct	24,845
Total Information Items	24,845

Total Emissions

	CO_2e	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
SCOPE 1	226,813	213,102	2,651	2,395	1,540	-	-
SCOPE 2	457,818	455,502	254	2,318	-	-	-
SCOPE 3	33,726						
INFORMATION ITEMS	24,845						

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS

Employee Commute
Employee Business Travel
Emissions From Contracted Services
Upstream Production of Materials and Fuels
Upstream and Downstream Transportation of Materials and Fuels
Waste Related Scope 3 Emissions
Purchase of Electricity Sold to an End User
Transmission and Distribution Losses from Consumed Electricity
Other Scope 3

POSSIBLE INFORMATION ITEMS

Biogenic $C0_2$ from Combustion
Carbon Offsets Purchased
Carbon Offsets Sold
Renewable Energy Credits (Green Power) Purchased
Renewable Energy Credits Sold (GreenPower)
Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Other Information Items

Local Government Operations Standard Inventory Report

ICLEI Local Governments for Sustainability

3. Activity Data Disclosure

Every emission source must be accompanied by a reference for the activity data. This worksheet is meant to assist in recording activity data and the methods used to gather those data for government operations. Activity data represent the magnitude of human activity resulting in emissions; data on energy use, fuel consumtion, vehicle miles traveled, and waste generation are all examples of activity data that are used to compute GHGs. Detailed disclosure should be made of the activity data used and at what quantities. This disclosure should also cite the source(s) of the data and the methodology used, including whether that methodology is a recommended method or an alternate method.

Deviations from the primary methodology should be explained in detail. All assumptions and estimations should be cited as such. Local governments may also use this space in the reporting format to discuss the rationale for the inclusion or exclusion of optional inventory components. It is good practice to include appropriate citations (such as website URL, report title, etc) and all contact information that is necessary to verify the source and accuracy of the activity data.

BUILDINGS & OTHER FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Natural Gas	CO_2e					
	CO_2	Primary	Known fuel use	21,460,213	therms	Washington Gas
	CH_4	Primary	Known fuel use	21,460,213	therms	Washington Gas
	N_2O	Primary	Known fuel use	21,460,213	therms	Washington Gas
	HFCs					
	PFCs					
	SF_6					
Fuel Oil	CO_2e					
	CO_2	Primary	Known fuel use	1,384,554	gallons	DRES
	CH_4	Primary	Known fuel use	1,384,554	gallons	DRES
	N_2O	Primary	Known fuel use	1,384,554	gallons	DRES
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	500,858,748	kWh	PEPCO
	CH_4	Primary	Known Electricity Use	500,858,748	kWh	PEPCO
	N_2O	Primary	Known Electricity Use	500,858,748	kWh	PEPCO
	HFCs					
	PFCs					
	SF_6					

Purchased Steam

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Steam	CO_2e					
	CO_2	Primary	Known Steam Use	80,020	million pounds	DRES
	CH_4	Primary	Known Steam Use	80,020	million pounds	DRES
	N_2O	Primary	Known Steam Use	80,020	million pounds	DRES
	HFCs					
	PFCs					
	SF_6					

STREETLIGHTS AND TRAFFIC SIGNALS (Chapter 6.2)

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	87,734,545	kWh	PEPCO
	CH_4	Primary	Known Electricity Use	87,734,545	kWh	PEPCO
	N_2O	Primary	Known Electricity Use	87,734,545	kWh	PEPCO
	HFCs					
	PFCs					
	SF_6					

WATER DELIVERY FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Natural Gas	CO_2e					
	CO_2	Primary	Known Fuel Use	59,505	therms	DCWASA
	CH_4	Primary	Known Fuel Use	59,505	therms	DCWASA
	N_2O	Primary	Known Fuel Use	59,505	therms	DCWASA
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	20,534,096	kWh	DCWASA
	CH_4	Primary	Known Electricity Use	20,534,096	kWh	DCWASA
	N_2O	Primary	Known Electricity Use	20,534,096	kWh	DCWASA
	HFCs					
	PFCs					
	SF_6					

WASTEWATER FACILITIES (Chapters 6 and 10)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Natural Gas	CO_2e					
	CO_2	Primary	Known Fuel Use	466,981	therms	DCWASA
	CH_4	Primary	Known Fuel Use	466,981	therms	DCWASA
	N_2O	Primary	Known Fuel Use	466,981	therms	DCWASA
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	271,979,986	kWh	DCWASA
	CH_4	Primary	Known Electricity Use	271,979,986	kWh	DCWASA
	N_2O	Primary	Known Electricity Use	271,979,986	kWh	DCWASA
	HFCs					
	PFCs					
	SF_6					

SCOPE 1

Fugitive Emissions

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Unit	Data Sources and References
Nitrification/Denitrification	N_2O	Primary	Population Served	15	metric tons N_2O	DCWASA
Effluent Discharge	N_2O	Primary	Population Served	16	metric tons N_2O	DCWASA

VEHICLE FLEET (Chapter 7)

SCOPE 1

Mobile Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Gasoline	CO_2e					
	CO_2	Primary	Fuel use	2,521,172	gallons	DPW
	CH_4	Alternate	Model Year	2,521,172	gallons	DPW
	N_2O	Alternate	Model Year	2,521,172	gallons	DPW
	HFCs					
	PFCs					
	SF_6					

E85	CO_2e					
	CO_2	Primary	Fuel use	97,171	gallons	DPW
	CH_4	Alternate	Model Year	97,171	gallons	DPW
	N_2O	Alternate	Model Year	97,171	gallons	DPW
	HFCs					
	PFCs					
	SF_6					

Diesel	CO_2e					
	CO_2	Primary	Fuel use	2,252,289	gallons	DPW
	CH_4	Alternate	Model Year	2,252,289	gallons	DPW
	N_2O	Alternate	Model Year	2,252,289	gallons	DPW
	HFCs					
	PFCs					
	SF_6					

Compressed Natural Gas	CO_2e					
	CO_2	Primary	Fuel use	94,726	gallons	DPW
	CH_4	Alternate	Model Year	94,726	gallons	DPW
	N_2O	Alternate	Model Year	94,726	gallons	DPW
	HFCs					
	PFCs					
	SF_6					

Fugitive Emissions

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Unit	Data Sources and References
Refrigerants	R-134	Alternate	Estimating based upon equipment inventory and use	1,184	kg	

WASTE GENERATION (Scope 3)

SCOPE 3

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Unit	Data Sources and References
Generated Waste	CH_4	Primary/Alternate	Known waste weight; Estimated waste weight based upon volume and number of containers	2,685	tons	DRES

EMPLOYEE COMMUTE (Scope 3)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Gasoline	CO_2e					
	CO_2	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	3,639,221	gallons	Online survey of all employees; see Appendix C of Narrative report for more information
	CH_4	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	3,639,221	gallons	Online survey of all employees; see Appendix C of Narrative report for more information
	N_2O	Alternate	Proxy Year Estimated Fuel Use-based upon daily vehicle miles traveled for all repspondents extrapolated to represent all local government employees	3,639,221	gallons	Online survey of all employees; see Appendix C of Narrative report for more information
	HFCs					
	PFCs					
	SF_6					

INFORMATION ITEMS

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Natural Gas	CO_2e					
	CO_2	Primary	Known fuel use	160,925	therms	Washington Aqueduct
	CH_4	Primary	Known fuel use	160,925	therms	Washington Aqueduct
	N_2O	Primary	Known fuel use	160,925	therms	Washington Aqueduct
	HFCs					
	PFCs					
	SF_6					

Fuel Oil	CO_2e					
	CO_2	Primary	Known fuel use	18,318	gallons	Washington Aqueduct
	CH_4	Primary	Known fuel use	18,318	gallons	Washington Aqueduct
	N_2O	Primary	Known fuel use	18,318	gallons	Washington Aqueduct
	HFCs					
	PFCs					
	SF_6					

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Resource Quantity	Fuel Unit	Data Sources and References
Electricity	CO_2e					
	CO_2	Primary	Known Electricity Use	45,703,249	kWh	Washington Aqueduct
	CH_4	Primary	Known Electricity Use	45,703,249	kWh	Washington Aqueduct
	N_2O	Primary	Known Electricity Use	45,703,249	kWh	Washington Aqueduct
	HFCs					
	PFCs					
	SF_6					

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS

Employee Commute
Employee Business Travel
Emissions From Contracted Services
Upstream Production of Materials and Fuels
Upstream and Downstream Transportation of Materials and Fuels
Waste Related Scope 3 Emissions
Purchase of Electricity Sold to an End User
Transmission and Distribution Losses from Consumed Electricity
Other Scope 3

POSSIBLE INFORMATION ITEMS

Biogenic $C0_2$ from Combustion
Carbon Offsets Purchased
Carbon Offsets Sold
Renewable Energy Credits (Green Power) Purchased
Renewable Energy Credits Sold (GreenPower)
Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Other Information Items

Local Government Operations Standard Inventory Report

ICLEI Local Governments for Sustainability

4. Calculation Methodology Disclosure

In addition to activity data, every emission source must be accompanied by the emission factor used, a reference for each emission factor, and the calculation

BUILDINGS & OTHER FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Natural Gas	CO_2e			
	CO_2	Default	53.06 kg/MMBtu	LGOP v1 Table G.1
	CH_4	Default	5 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	0.1 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			
Fuel Oil	CO_2e			
	CO_2	Default	10.15 kg/gallon	LGOP v1 Table G.1
	CH_4	Default	11 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	.6 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	1,139 lbs/mWh	eGRID 2007
	CH_4	Default	30.270 lbs/gWh	eGRID 2007
	N_2O	Default	18.710 lbs/gWh	eGRID 2007
	HFCs			
	PFCs			
	SF_6			
Steam (Natural Gas)	CO_2e			
	CO_2	Default	53.06 kg/MMBtu	LGOP v1 Table G.1
	CH_4	Default	5 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	0.1 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			

STREETLIGHTS AND TRAFFIC SIGNALS (Chapter 6.2)

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	1,139 lbs/mWh	eGRID 2007
	CH_4	Default	30.270 lbs/gWh	eGRID 2007
	N_2O	Default	18.710 lbs/gWh	eGRID 2007
	HFCs			
	PFCs			
	SF_6			

WATER DELIVERY FACILITIES (Chapter 6)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Natural Gas	CO_2e			
	CO_2	Default	53.06 kg/MMBtu	LGOP v1 Table G.1
	CH_4	Default	5 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	0.1 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	1,139 lbs/mWh	eGRID 2007
	CH_4	Default	30.270 lbs/gWh	eGRID 2007
	N_2O	Default	18.710 lbs/gWh	eGRID 2007
	HFCs			
	PFCs			
	SF_6			

WASTEWATER FACILITIES (Chapters 6 and 10)

SCOPE 1

Fugitive Emissions

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Nitrification/Denitrification	N_2O	Default	Population Served	LGOP v1 Equation 10.7
Effluent Discharge	N_2O	Default	N-Load	LGOP v1 Equation 10.9

VEHICLE FLEET (Chapter 7)

SCOPE 1

Mobile Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Gasoline	CO_2e			
	CO_2	Default	8.81 kg/gallon	LGOP v1 Table G.9
	CH_4	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	N_2O	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	HFCs			
	PFCs			
	SF_6			
E85	CO_2e			
	CO_2	Default	5.56 kg/gallon	LGOP v1 Table G.9
	CH_4	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	N_2O	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	HFCs			
	PFCs			
	SF_6			
Diesel	CO_2e			
	CO_2	Default	10.15 kg/gallon	LGOP v1 Table G.9
	CH_4	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	N_2O	Default	Varies by model year	LGOP v1 Table G.10; Table G.12 for other equipment
	HFCs			
	PFCs			
	SF_6			

Compressed Natural Gas	CO_2e			
	CO_2	Default	.054 kg/scf	LGOP v1 Table G.9
	CH_4	Default	Varies by vehicle type	LGOP v1 Table G.11
	N_2O	Default	Varies by vehicle type	LGOP v1 Table G.11
	HFCs			
	PFCs			
	SF_6			

Fugitive Emissions

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Refrigerants	R-134	None	GWP-1000	LGOP v1 Table E.1&E.2

WASTE GENERATION (Scope 3)

SCOPE 1

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Generated Waste	CH_4	Alternate	Varies by waste type	EPA Waste Reduction Model http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html; Public Administration waste charaterization provided by CIWMB

EMPLOYEE COMMUTE (Scope 3)

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Methodology Type	Methodology Name and Description	Data Sources and References
Gasoline	CO_2e			
	CO_2	Default	8.81 kg/gallon	LGOP v1 Table G.9
	CH_4	Default	Varies by model year	LGOP v1 Table G.10
	N_2O	Default	Varies by model year	LGOP v1 Table G.10
	HFCs			
	PFCs			
	SF_6			

INFORMATION ITEMS

SCOPE 1

Stationary Combustion

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Natural Gas	CO_2e			
	CO_2	Default	53.06 kg/MMBtu	LGOP v1 Table G.1
	CH_4	Default	5 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	0.1 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			
Fuel Oil	CO_2e			
	CO_2	Default	10.15 kg/gallon	LGOP v1 Table G.1
	CH_4	Default	11 g/MMBtu	LGOP v1 Table G.3
	N_2O	Default	.6 g/MMBtu	LGOP v1 Table G.3
	HFCs			
	PFCs			
	SF_6			

SCOPE 2

Purchased Electricity

Emissions Source Name	GHG	Default/Alternate	Emission Factor	Emission Factor Sources and References
Electricity	CO_2e			
	CO_2	Default	1,139 lbs/mWh	eGRID 2007
	CH_4	Default	30.270 lbs/gWh	eGRID 2007
	N_2O	Default	18.710 lbs/gWh	eGRID 2007
	HFCs			
	PFCs			
	SF_6			

POSSIBLE SOURCES OF OPTIONAL SCOPE 3 EMISSIONS	POSSIBLE INFORMATION ITEMS
Employee Commute	Biogenic $C0_2$ from Combustion
Employee Business Travel	Carbon Offsets Purchased
Emissions From Contracted Services	Carbon Offsets Sold
Upstream Production of Materials and Fuels	Renewable Energy Credits (Green Power) Purchased
Upstream and Downstream Transportation of Materials and Fuels	Renewable Energy Credits Sold (GreenPower)
Waste Related Scope 3 Emissions	Ozone-depleting Refrigerants/Fire Suppressants not in LGOP
Purchase of Electricity Sold to an End User	Other Information Items
Transmission and Distribution Losses from Consumed Electricity	
Other Scope 3	

Appendix C:
Employee Commute

Emissions from employee commuting were calculated based on responses to a survey on commuting behavior distributed through the Department of Transportation and the February 2009 District Government eNewsletter. Greenhouse gas emissions were calculated for survey respondents and then extrapolated to account for all District employees. The following sections explain in detail the methodology used to:

1. Survey District employees about their commuting patterns
2. Calculate greenhouse gas emissions for all employees who responded to the employee commute survey
3. Use emissions calculated from survey results to estimate emissions for all District employees

C.1 Employee Commute Survey

A survey asking employees about their commuting behaviors were distributed in the Department of Transportation and a link to the survey was also sent in the February 2009 District Government eNewsletter. The survey was created using Surveymonkey.com, and asked employees to answer questions about their commuting behaviors in a typical week commuting to work. This survey was distributed to employees regardless of whether the person worked for the District in 2006. Among other questions, employees were asked about the different modes of transportation they use to commute, the frequency with which they use each mode of transport, and the distance traveled to arrive at work. Survey questions were asked under five general categories:

1. Commute Origin – From where do District employees commute?
2. Transportation Mode – In a typical week, how often did employees use each type of transportation to get to work? Employees said they take public transportation, carpool, and/or drive alone to work one or more days per week were asked a series of follow-up questions to help calculate greenhouse gas emissions.
    a. Walking
    b. Biking
    c. Public Transportation
    d. Carpooling
    e. Driving Alone
    f. Telecommuting

3. Annual Work Day Count – How many days of the year do District employees commute to work? Employees were asked how many months of the year they work for the District and the amount of vacation and extended leave they took in the past year. It was assumed that all District employees have 12 paid holidays each year and that seasonal employees had one paid holiday for each month they work for the District.
4. Employee History – Did the employee work for the District in 2006?

C.2 Calculating Emissions from Survey Results

Emissions were calculated for all employees who drove alone or carpooled one or more days per week. The first step was to calculate the total mileage driven and gallons of fuel consumed in one year. The fuel consumption data was converted into CO_2 emissions and mileage data was converted into N_2O and CH_4 emissions using emissions factors (EFs) from the Local Government Operations Protocol (LGOP). Emissions from public transportation were not included in the employee commute section of the inventory since these emissions were calculated in the transit section of the inventory.

Appendix D: Government-Generated Solid Waste Methodology

Emissions from the waste sector are an estimate of methane generation that will result from the anaerobic decomposition of all organic waste sent to landfill in the base year. It is important to note that although these emissions are attributed to the inventory year in which the waste is generated, the emissions themselves will occur over the 100+ year timeframe that the waste will decompose. This frontloading of emissions is the approach taken by EPA's Waste Reduction Model (WARM). Attributing all future emissions to the year in which the waste was generated incorporates all emissions from actions taken during the inventory year into that year's greenhouse gas release. This facilitates comparisons of the impacts of actions taken between inventory years and between the Districts. It also simplifies the analysis of the impact of actions taken to reduce waste generation or divert it from landfills.

D.1 Emissions Calculation Methods

As some types of waste (e.g., paper, plant debris, food scraps, etc.) generate methane within the anaerobic environment of a landfill and others do not (e.g., metal, glass, etc.), it is important to characterize the various components of the waste stream. Waste characterization for government-generated solid waste was estimated using the EPA "Municipal Solid Waste Generation, Recycling and Disposal in the United States" report for 2006.

Most landfills in the D.C. area capture methane emissions either for energy generation or for flaring. EPA estimates that 60 percent to 80 percent[16] of total methane emissions are recovered at the landfills to which the District sends its waste. Following the recommendation of LGOP, ICLEI adopted a 75 percent methane recovery factor.

Recycling and composting programs are reflected in the emissions calculations as reduced total tonnage of waste going to the landfills. The model, however, does not capture the associated emissions reductions in "upstream" energy use from recycling as part of the inventory.[17] This is in-line with the "end-user" or "tailpipe" approach taken throughout the development of this inventory. It is important to note that, recycling and composting programs can have a significant impact on greenhouse gas emissions when a full lifecycle approach is taken. Manufacturing products with recycled materials avoids emissions from the energy that would have been used during extraction, transporting and processing of virgin material.

16 AP 42, section 2.4 Municipal Solid Waste, 2.4-6, http://www.epa.gov/ttn/chief/ap42/index.html
17 "Upstream" emissions include emissions that may not occur in your jurisdiction resulting from manufacturing or harvesting virgin materials and transportation of them.

D.1.1 Methane Commitment Method

CO_2e emissions from waste disposal were calculated using the methane commitment method outlined in the EPA WARM model. This model has the following general formula:

$CO_2e = W_t * (1-R)A$

Where:

W_t is the quantify of waste type "t"

R is the methane recovery factor,

A is the CO_2e emissions of methane per metric ton of waste at the disposal site (the methane factor)

While the WARM model often calculates upstream emissions, as well as carbon sequestration in the landfill, these dimensions of the model were omitted for this particular study for two reasons:

This inventory functions on an end-use analysis, rather than a life-cycle analysis, which would calculate upstream emissions), and this inventory solely identifies emissions sources, and no potential sequestration "sinks."

Appendix E:
Conducting a Monitoring Inventory

The purpose of this appendix is to assist District staff in conducting a monitoring inventory to measure progress against the baseline established in this inventory report. Conducting such an inventory represents milestone five of the Five- Milestone Process, and allows a local government to assess how well it is progressing toward achieving its emissions reduction targets.

This inventory was conducted by ICLEI in conjunction with numerous staff from key District agencies. To facilitate a monitoring inventory, ICLEI has documented all of the raw data, data sources, and calculation methods used in this inventory. Future inventories should seek to replicate or improve upon the data and methods used in this inventory. Wherever possible, however, ICLEI strongly recommends institutionalizing internal data collection in order to be able to meet the recommended methods outlined in LGOP.

E.1 ICLEI Tools for Local Governments

ICLEI has created a number of tools for the District to use to assist them in future monitoring inventories. These tools comply with the methods outlined in LGOP. These tools are designed to work in conjunction with LGOP, which is, and will remain, the primary reference document for conducting an emissions inventory. These tools include:

- A "master data sheet" that contains most or all of the raw data (including emails), data sources, emissions calculations, data templates, notes on inclusions and exclusions, and reporting tools (charts and graphs and the excel version of LGOP reporting tool)
- A copy of all electronic raw data, such as finance records or Excel spreadsheets
- LGOP reporting tool (included in the master data sheet and in Appendix B) that has all activity data, emissions factors, and methods used to calculate emissions for this inventory
- Sector-specific instructions that discuss the types of emissions, emissions calculations methods, and data required to calculate emissions from each sector, as well as instructions for using the data collection tools and calculators in the master data sheet
- The appendices in this report include detailed methodologies for calculating emissions from Scope 3 employee commute and government-generated solid waste, as well as two versions of the employee commute survey

It is also important to note that all ICLEI members receive on-demand technical assistance from their ICLEI liaison, which local staff should feel free to contact at any point during this process.

E.2 Improving Emissions Estimates

One of the benefits of a local government operations inventory is that local government staff can identify areas in their current data collection systems where data collection can be improved. For example, a local government may not directly track fuel consumption by each vehicle and instead will rely upon estimates based upon VMT or purchased fuel to calculate emissions. This affects both the accuracy of the emissions estimate and may have other implications for government operations as a whole.

During the inventory process, ICLEI and local government staff identified the following gaps in data that, if resolved, would allow the District to meet the recommended methods outlined in LGOP in future inventories.

- Direct tracking of refrigerants recharged into HVAC and refrigeration equipment
- Direct tracking of fire suppressants recharged into fire suppression equipment
- Refrigerants recharged into vehicles in the vehicle fleet
- Solid waste generated from government facilities

ICLEI encourages staff to review the areas of missing data and establish data collection systems for this data as part of normal operations. In this way, when staff are ready to re-inventory for a future year, they will have the proper data to make a more accurate emissions estimate.

E.3 Conducting the Inventory

ICLEI recommends the following approach for local governments that wish to conduct a monitoring inventory:

Step 1: Identify a Climate Steward

This steward will be responsible for the District's climate actions as a whole and could serve as an ICLEI liaison in all future climate work. In the context of a monitoring inventory, the steward will be responsible for initiating discussions on a new inventory.

Step 2: Determine which Sectors to Inventory

There are many ways to determine which sectors apply to a local government's operations, but the easiest to review will be LGOP Standard Report, which is located both in Appendix B and in the master data sheet. This document clearly delineates which sectors will need to be inventoried within a local government's operations and which LGOP sectors do not apply to the District.

Step 3: Gather Support: Identify Data Gathering Team and Leads

Coordination and acceptance among all participating departments is an important factor in coordinating a successful inventory. To that end, the inventory coordinator should work with the District administrator to identify all staff

who will need to be part of the inventory. To facilitate this process, ICLEI has documented all people associated with the inventory in the master data sheet—these names are located in the final completed data form for each sector. Once this team has been identified, the inventory coordinator should hold a kickoff meeting with the administrator, all necessary staff, and relevant department and agency heads which clearly communicates the priority of the inventory in relationship to competing demands. At this meeting, the roles of each person, including the inventory coordinator, should be established.

Step 4: Review Types of Emissions and Available Methodologies for Applicable Sectors

Local staff should then review LGOP and the instructions documents provided through this inventory to better understand the types of emissions for each sector (for example, within Mobile Emissions, CO_2 emissions and CH_4/N_2O emissions represent two different data requirements and emissions calculations methodologies). Each emissions type may have more than one possible estimation methodology, and it is important that the inventory coordinator understands all possible methodologies and be able to communicate this to all parties assisting in the data gathering.

Step 5: Review Methodologies Used for the 2005 Inventory to Determine Data to Collect

In order to duplicate or improve upon the methods used in this inventory, local staff should again review the methods used for this inventory—these methods are again located in Appendix B—and within the master data sheet. These methods reflect the data limitations for each local government (as many local governments could not obtain data necessary to meet the recommended methods in LGOP). Wherever possible, these methods should be duplicated or, if it is possible, replaced with the recommended methods outlined in LGOP. Using these methodologies, staff will determine what data needs to be collected and communicate this effectively to the data gathering team.

Step 6: Use the Data Forms as a Resource During Data Gathering

A number of questions will come up during the data gathering process that may be difficult to answer. ICLEI has attempted to capture all of the questions that arose during the 2006 inventory and how they were addressed through the master data sheet. Within the master data sheet, staff should review the raw data, working data, and completed data forms to review how raw data was converted to final data, and also to review any notes taken by ICLEI staff during the 2006 inventory process.

For example, reviewing the buildings data within the master data sheet will allow local staff to review how individual accounts were separated into each category and which counts may have been excluded from the inventory.

Step 7: Calculate Emissions

ICLEI has provided the staff lead on the 2006 inventory with all spreadsheets and tools needed to calculate the emissions included in this report. Staff should use these options to calculate emissions by inputting updated activity data. ICLEI staff and ICLEI trainings are available to assist local government staff in calculating emissions.

Step 8: Report Emissions

The master data sheet also contains the LGOP Standard Reporting Template, which is the template adopted by ARB as the official reporting template for government operations emissions inventory. This tool, as well as the charts and graphs tool provided by ICLEI can be used to report emissions from government operations. Also, local government staff should utilize this narrative report as guide for a narrative report if they so choose.

Step 9: Standardize and Compare to Base Year

Conducting a monitoring inventory is meant to serve as a measuring point against the baseline year represented in this report. In order to make a more accurate comparison, it is necessary to standardize emissions from stationary sources based upon heating and cooling degree days (staff can use a ratio of heating /cooling degree days to standardize across years).

In addition, it is important, when comparing emissions across years, to clearly understand where emissions levels may have changed due to a change in methodology or due to excluding an emissions source. For example, if the default method was used to estimate refrigerant leakage in 2004 (this method highly overestimates these emissions), and the recommended method was available in a monitoring year, this would appear as a dramatic reduction in these emissions even though actual leaked refrigerants may be similar to the base year. Changes such as these should not be seen as progress toward or away from an emissions reduction target, but emissions estimates should be adjusted to create as much of an apples-to-apples comparison as possible. If such an adjustment is not possible, staff should clearly note the change in methodology between years when comparing emissions.