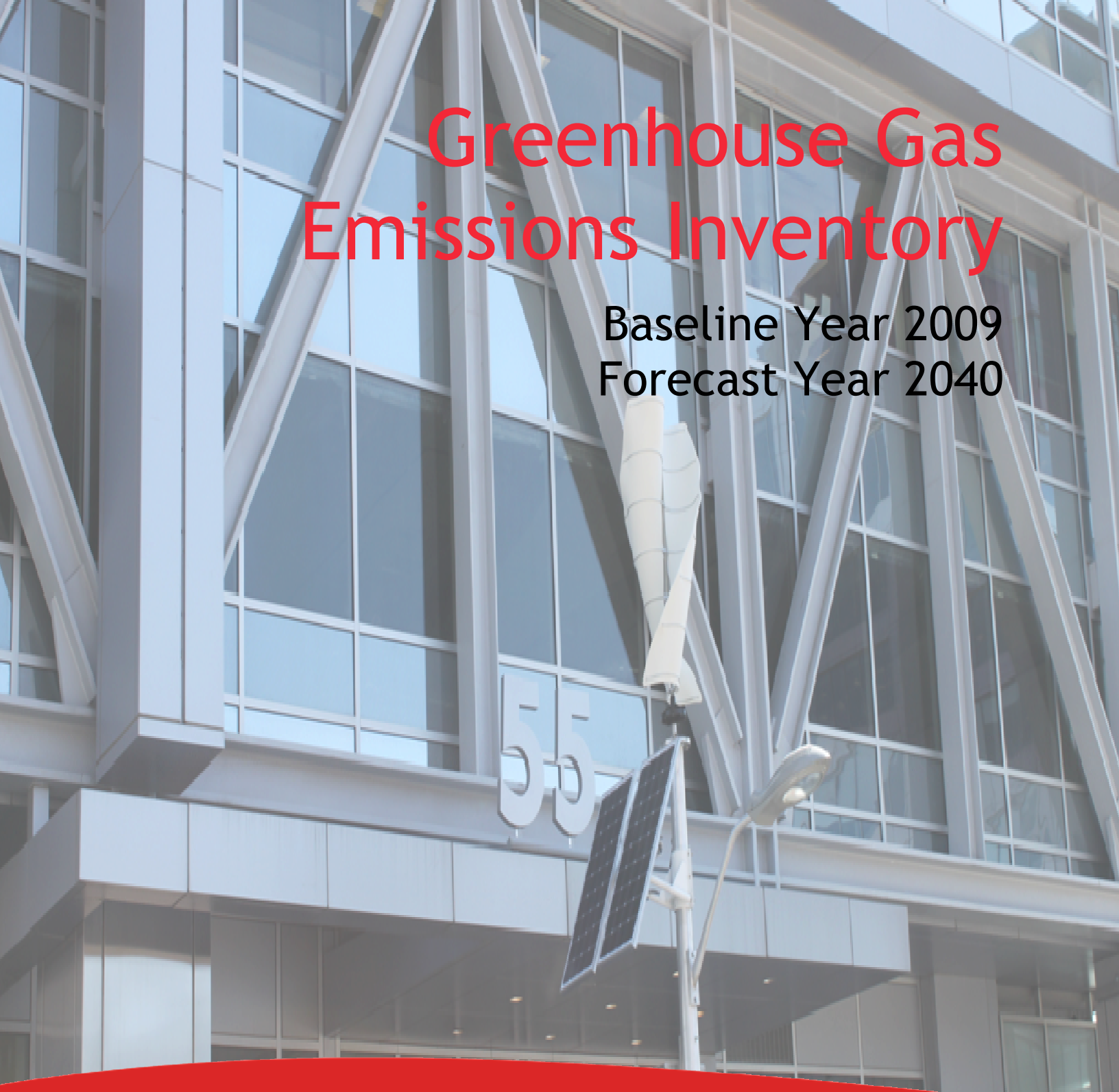

Greenhouse Gas Emissions Inventory

Baseline Year 2009
Forecast Year 2040

District Department of Transportation

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Greenhouse Gas Emissions Inventory

Baseline Year 2009/Forecast 2040

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Appendices may be downloaded from the DDOT Website: www.ddot.dc.gov/environment

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Acronyms and Abbreviations

CH_4	Methane
CFC	Chlorofluorocarbons
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COG	Council of Governments
DDOT	District Department of Transportation
DOE	U.S. Department of Energy
DOT	Department of Transportation
eGRID	Emissions and Generation Resource Integrated Database
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
FTA	U.S. Federal Transit Administration
g/mile	Grams per mile
GHG	Greenhouse Gas
GWP	Global Warming Potential
HC	Hydrocarbons
HCFC	Hydrochlorofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
Kg/gallon	Kilograms per gallon
Kg/TJ	Kilograms per terajoule
lbs/GWh	Pounds per gigawatt-hour
lbs/MWh	Pounds per megawatt-hour
LEED	Leadership in Energy and Environmental Design
MOVES	Motor Vehicle Emission Simulator
MPO	Metropolitan Planning Organization

MWCOG	Metropolitan Washington Council of Governments
N_2O	Nitrous Oxide
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
TPB	Transportation Planning Board
USEPA	United States Environmental Protection Agency
VMT	Vehicle miles traveled
WMATA	Washington Metropolitan Area Transit Authority


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SPEED LIMIT
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TAXI

1.0 Introduction

The District Department of Transportation (DDOT) recognizes the threat posed by climate change and the effects it will have on District of Columbia residents, visitors, institutions, and businesses. The Intergovernmental Panel on Climate Change (IPCC) is the leading scientific body studying the effects of climate change. There is widespread agreement amongst IPCC and other leading scientists and government agencies around the world, including the U.S. Environmental Protection Agency (EPA), Transportation Research Board (TRB), and Federal Highway Administration (FHWA), regarding the contributions of human activities on climate change. It has been concluded that the effects of climate change are driven by: (1) the increase in greenhouse gas (GHG) concentrations above their natural levels due to emissions from fossil fuels combustion and other human activities; and (2) the decrease in carbon absorption resulting from deforestation and other land-clearing (IPCC, 2007).

In the United States, the transportation sector is the second-largest emitter (next to the electricity generation sector) of GHG, at 29 percent of all GHG-emitting sectors (TRB, 2012). The majority of transportation GHG emissions (i.e., approximately 84 percent) are generated by road transportation, including both passenger and freight travel (EPA, 2012). Although average fuel economy for vehicles has increased since 2005, people have been driving more, thereby increasing the vehicle miles traveled (VMT) and fuel consumption (EPA, 2012). VMT is one of the key indicators of emission levels as it is linked to vehicle combustion of fossil fuels (i.e., tailpipe emissions).

DDOT's mission is to provide reliable transportation facilities and services for residents, commuters, and businesses so they can move safely and efficiently, while enhancing quality of life and economic competitiveness. DDOT is committed to practicing environmental excellence as it fulfills its mission with minimal adverse impacts on the environment. DDOT is committed to providing transportation options that encourage reduced vehicle miles traveled and GHG emissions.

Greenhouse Gas Inventory:

A greenhouse gas inventory is an accounting of the amount of greenhouse gases an organization emits to or removes from the atmosphere over a specific period of time, generally one year.

Source: EPA, 2012a

For the first time in its history, in an effort to better understand the agency's contribution to climate change, DDOT is calculating the GHG emissions from its activities, projects, and operations. This DDOT Greenhouse Gas Emissions Inventory is the first step in accounting for, monitoring, and eventually reducing DDOT's GHG emissions. By understanding the sources of its GHG emissions, the agency can then develop and implement actions to reduce these GHG emissions as well as track the effect of changes made over time.

1.1. Related Plans and Efforts

The District of Columbia has a history of promoting environmentally responsible behavior that will lead to a more sustainable urban environment. There are approximately 600,000 people living in the District of Columbia (similar to a state like Vermont) (BOC, 2011). The District attracts approximately 16 million visitors annually, including 1.2 million international visitors, who arrive into the city through various modes of transportation (DC, 2012). The contributions of this larger community to the city's overall GHG emissions are significant and have been analyzed by the District Department of Environment (DDOE) in the ***District of Columbia Greenhouse Gas Emissions Inventory*** (DDOE, 2010) and the District's ***Climate of Opportunity***, the city-wide climate action plan.

Additionally, the Mayor's goal is for the District to become the most sustainable city in the country. With its agencies and citizens working collaboratively, the District has drafted an ambitious, yet achievable vision, ***A Vision for a Sustainable DC*** that creates the framework to become a healthier, cleaner and greener city (DDOE, 2012). The transportation element of the District's sustainability plan highlights the city's commitment to reducing transportation-related emissions through shifting to alternative modes of transportation and building multi-modal infrastructure, setting a goal to make at least 75 percent of all trips in the District by walking, biking, transit, or other clean transportation alternative by 2032.

DDOT continues to work closely with other District agencies, regional organizations, and the city's eight Business Improvement Districts (BIDs) to develop climate change planning initiatives that are beneficial to the District of Columbia and the region. DDOT has partnered with DDOE, Office of Planning (OP), Department of Public Works (DPW), Department of Parks and Recreation (DPR), and Department of General Services (DGS), as well as the National Capital Region Transportation Planning Board (TPB) and the Washington Metropolitan Area Transit Authority (WMATA). The TPB, which is staffed by the Department of Transportation Planning of the Metropolitan Washington Council of Governments (MWCOG), is the entity responsible for coordinating transportation planning at the regional level in the Washington metropolitan area. WMATA is the regional transit authority.

DDOT has also prepared a ***DDOT Climate Change Adaptation Plan,*** which establishes a framework for adaptation actions and provides high-level, overarching solutions that DDOT could implement to ensure that its infrastructures are resilient to the effects of climate change. Together with the ***DDOT Action Agenda*** and the ***DDOT Sustainability Plan***, this ***DDOT Greenhouse Gas Emissions Inventory*** and the ***DDOT Climate Change Adaptation Plan*** will advance the efforts of the DDOT environmental management system.

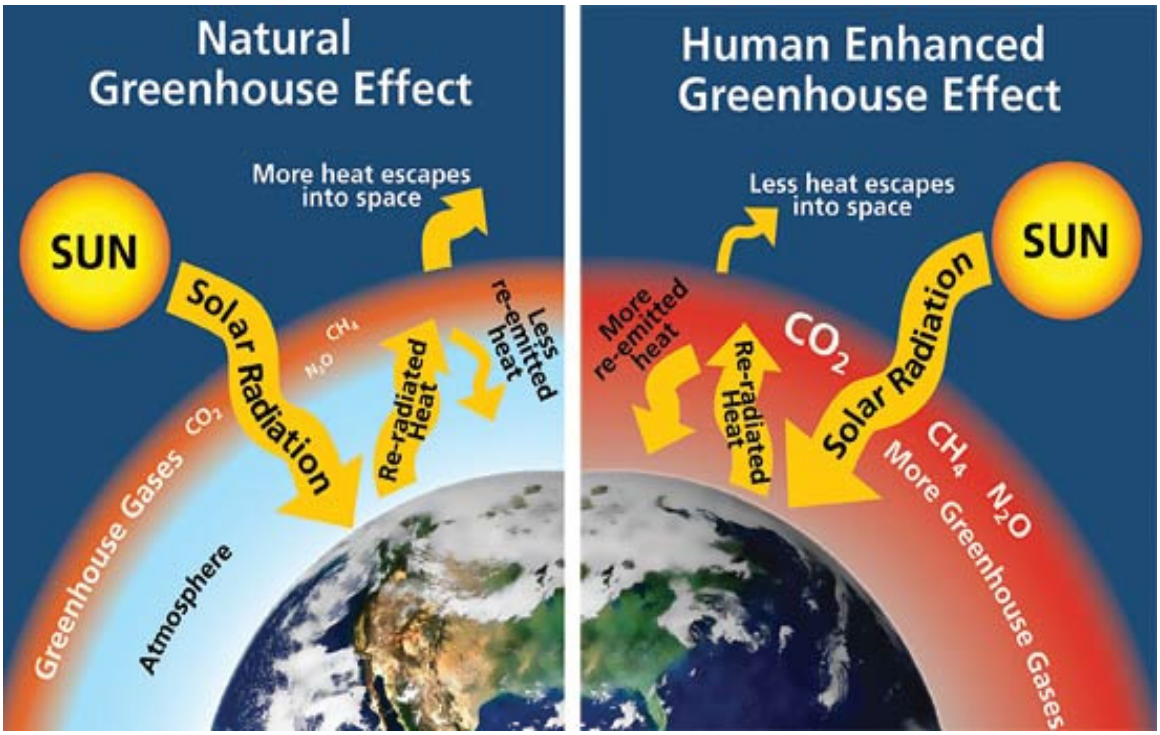
2.0 Background on Greenhouse Gases

Climate change is one of the greater environmental challenges facing the world today. As the concentration of anthropogenic greenhouse gases (GHG) continues to increase in the atmosphere, global temperature also continues to climb. According to National Aeronautics and Space Administration (NASA) data, the global temperature has increased by an average of 1.5 degrees Fahrenheit since 1880 – a level noticeably higher than historic levels (NASA, 2012). Other aspects of the earth's climate and its effects are also changing, including rainfall patterns, snow and ice cover, and sea level.

2.1. Greenhouse Effect

Greenhouse gases absorb infrared radiation and trap heat in the Earth's atmosphere from sunlight. Sunlight heats the Earth's surface that radiates energy back into space. Greenhouse gasses in the atmosphere absorb some of this energy and reradiated it back to the surface, creating an effect that seems similar to the warming inside a greenhouse. This effect keeps the Earth's surface warmer than it would be otherwise, which is necessary to sustain life. This is referred to as the Greenhouse Effect (IPCC, 2007). As concentrations of GHGs increase, however, the Earth's temperature also increases.

Figure 1: The Greenhouse Effect



Source: National Park Service (NPS), 2011

2.2. Greenhouse Gases

Some GHGs, such as water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3) are naturally emitted through natural processes, such as evaporation, respiration by and decay of plants and animals, and reaction of sunlight on molecular oxygen and nitrogen. Naturally occurring GHG levels are also increased by human activities such as fossil fuel burning, agriculture, and landfills. However, some GHGs, such as the fluorinated gases, occur exclusively as a result of human industrial activities, such as the use of aerosol spray propellant and cleaning solvents. From around 1750, the start of the industrial age, to 2005, human activities have caused the global concentrations of all GHG to significantly increase; thereby changing the composition of the atmosphere and influencing the Earth's climate (IPCC, 2007).

The principal GHGs that enter the atmosphere due to human activities are:

Carbon Dioxide (CO_2)

CO_2 enters the atmosphere through the combustion of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). CO_2 is also removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH_4)

CH_4 is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices, as well as by the decay of organic waste in municipal solid waste landfills.

Nitrous Oxide (N_2O)

N_2O is emitted during agricultural and industrial activities, as well as during the combustion of fossil fuels and solid waste.

Fluorinated Gases

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) are powerful synthetic greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (e.g., chlorofluorocarbons [CFCs], hydrochlorofluorocarbons [HCFCs], and halons). Although these gases are typically emitted in smaller quantities, they have a higher global warming potential per unit emission.

Source: EPA, 2012a

3.0 DDOT Greenhouse Gases Emissions Inventory Protocol

The DDOT Greenhouse Gas Emissions Inventory follows the guidelines outlined in the ***Greenhouse Gas Emissions Inventory Methodologies for State Transportation Departments.*** This document was developed by the American Association of State Highway and Transportation Officials (AASHTO) to provide a GHG accounting procedure to help state DOTs inventory their operations in a consistent manner (hereto refer to as The AASHTO GHG Emissions Inventory Guidelines). The AASHTO GHG Emissions Inventory Guidelines document was developed by reviewing the best available guidance materials and methods for estimating GHG emissions, primarily referencing the ***Local Government Operations Protocol*** and the ***Federal Greenhouse Gas Accounting and Reporting Guidance***. Additionally, DDOT has chosen to go beyond the AASHTO Guidelines by including data on general roadway emissions in this report for the sake of completeness and context.

Operations:

"Operations" refers to the GHG emissions that occur through the daily activities associated with running a state DOT as a governmental body.

Source: AASHTO 2011

This section addresses one of the recommendations in the AASHTO GHG Emissions Inventory Guidelines that state DOTs apply the following five principles of GHG accounting to their GHG inventory as described:

1) **Relevance:** Include relevant emission sources that both reflect the emissions impact of a state DOT as well as serve the needs of decision-makers, both within the state DOT and external stakeholders.

2) **Completeness:** Include all GHG emission sources that are within the DOT's defined organizational and operational boundaries. Document and justify any excluded emission sources.

3) **Consistency:** Use consistent methodologies to estimate DOT emissions to enable meaningful comparison of inventories over time. Document any changes in methodologies used, inventory boundary, data, and other factors that impact emissions.

4) **Transparency:** Disclose all relevant assumptions, data sources, and calculation methodologies used to estimate GHG emissions.

5) **Accuracy:** Achieve sufficient accuracy in emission estimates to prove useful to decision-makers and stakeholders. Ensure that GHG emission estimates are neither systematically underestimated nor overestimated. Reduce estimate uncertainties to the extent possible.

Source: AASHTO, 2011

Throughout its effort to develop the DDOT Greenhouse Gas Emissions Inventory, DDOT applied these five principles to its GHG inventory to ensure a comprehensive accounting of its emissions and to show a fair representation of GHG emissions from DDOT's operations.

3.1. DDOT Responsibilities and Organizational Structure

DDOT is responsible for the transportation infrastructure in the Nations' Capital, which includes 1,100 miles of streets; more than 50 miles of bike lanes; 241 bridges; 1,600 miles of sidewalk; 453 miles of alleys; and 144,000 city street trees. DDOT's daily operations involve the following:

- Planning, designing, constructing, and maintaining the District's streets, alleys, sidewalks, bridges, traffic signals, street lights, as well as the highway and interstate system within the District's boundaries (i.e., I-295, I-695, I-395, I-66);
- Managing and making improvements to the transportation system to facilitate traffic flow (including vehicular, pedestrian, and bicycle) through the District of Columbia;
- Assisting with the removal of snow, ice, and other debris from the system, and coordinating activities during snow and other emergencies with other District government agencies; and
- Coordinating the District's mass transit services with WMATA.

The Office of the Director is responsible for the oversight and management of the entire DDOT. DDOT's operations are carried out through the work of six administrations: the **Infrastructure Project Management Administration (IPMA)** designs and builds roads and bridges, rails, and other transportation projects; the **Progressive Transportation Services Administration (PTSA)** provides public transportation service coordination and policy recommendation with WMATA through the Metro buses and rail and the DC Circulator bus system; the **Traffic Operations Administration (TOA)** ensures a safe and user-friendly transportation environment; the **Planning Policy and Sustainability Administration (PPSA)** develops strategic goals for the agency; the **Urban Forestry Administration (UFA)** maintains the District's street trees, providing our community with traffic calming, improved air quality, increased ground water retention that minimizes runoff and flooding, temperature moderation, and improved aesthetics; and the **Public Space Regulations Administration (PSRA)** enforces public space laws and regulations and inspects all work in public space completed under a public space permit.

3.2. DDOT Operational Boundaries and GHG Emission Sources

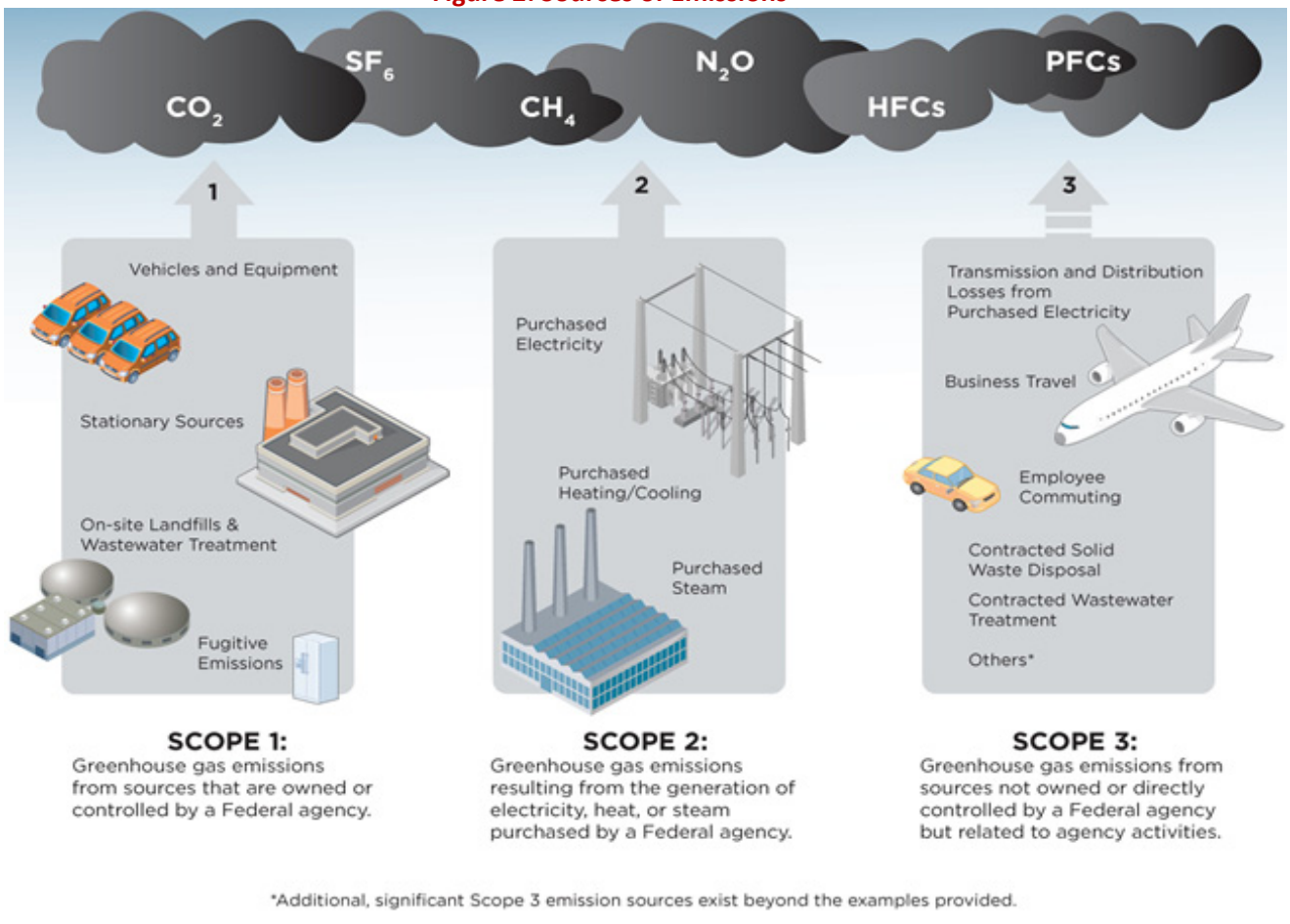
The AASHTO guidance categorizes GHG emissions into groups based on the state DOT emissions resulting directly or indirectly from an organization's activities. The guidance defines the categories as follows:

Direct emissions are those that are emitted by sources owned or controlled by an organization (i.e., fuel consumed in the organization's vehicles).

Indirect emissions are those that are emitted by sources owned or controlled by another entity but result from the activities of the organization (i.e., purchased electricity). These emissions are the direct emissions of the separate entity that owns or controls the emission source (i.e., the emissions from the electric company).

Direct and indirect emissions are further categorized by scope, as illustrated in Figure 2 for federal agencies.

Figure 2: Sources of Emissions



Source: U.S. Department of Energy (DOE), 2011

With direct and indirect emissions as factors, DDOT must set the boundaries for the inventory based on financial or operational control. The financial control approach allows an organization to set GHG inventory boundaries based on its ability to direct financial policies of the operations, and to gain economic benefits from them. The operational control approach allows an organization to set GHG inventory boundaries based on sources for which it has operational control and has the authority to introduce and implement operating policies and procedures.

For the purpose of the DDOT GHG inventory, DDOT adopted the AASHTO GHG Emissions Inventory Guideline recommendation that state DOTs take an operational control approach to set boundaries for their GHG inventory. The operational control approach was selected, since DDOT operates a large portion of GHG emissions sources that it does not own. Therefore, rather than try to indirectly control financial policies to influence GHG sources, DDOT will focus on operational policies and procedures for direct control of emissions. To account for its GHG emissions, DDOT reviewed its organizational structure to identify functions within its six administrations that yield direct GHG emissions. Additionally, DDOT collected data for indirect sources from other District government agencies (e.g., DGS and DPW) from which DDOT receives services and resources for its daily function. Table 1 presents those DDOT activities and assets that have been included in the GHG inventory and they are further discussed, separated by scope, below. The specific GHG from each of DDOT's sources are discussed in Section 4.

Table 1: DDOT Activities and Operations Evaluated

Scope 1	Scope 2	Scope 3
Fleets	Facilities	Roadways
DC Circulator Bus	Streetlights & Signals	

3.2.1. Scope 1 Sources

Scope 1 emissions include direct emissions from operations, facilities, and sources under a DOT's operational control (AASHTO, 2011). Scope 1 emissions result from activities such as on-site combustion of fossil fuels to generate electricity or heat, use of fleet vehicles, and fugitive GHG emissions from refrigeration and air-conditioning equipment. For DDOT, the following sources represent Scope 1 emissions (details of each source are provided in Section 4.0):

Fleets

The GHG emissions of all DDOT-owned vehicles are evaluated in the inventory. DDOT purchases its vehicles through DPW. Vehicles purchased for DDOT are available only to DDOT-employees. Also included in the analysis are off-road fleets (i.e. construction equipment) that DDOT employees and contractors use for snow removal and local road repair projects.

DC Circulator Bus

The DC Circulator buses are managed and operated through a public/private partnership between DDOT, WMATA, and DC Surface Transit. DDOT acknowledges that the DC Circulator buses emissions are also part of the roadway network emissions (see Section 4.5); however, these emissions are calculated separately in this inventory so as to give a clear understanding of their contributions as a DDOT source and help in identifying strategies to minimize them.

3.2.2. Scope 2 Sources

Scope 2 emissions include indirect emissions from purchased electricity, gas, steam, and chilled water that are consumed within the organizational boundaries of the DOT (AASHTO, 2011). For DDOT, the following sources represent Scope 2 emissions, which are mainly indirect emissions from purchased electricity and gas (details of each source are provided in Section 4):

Facilities

The GHG emissions associated with the electrical and natural gas use by all DDOT -occupied and -operated, District government buildings and DDOT-owned infrastructures, such as bridges and tunnels. DDOT-leased buildings, through a private vendor are included in the analysis. A majority of the buildings and facilities that DDOT occupies and operates are owned by DGS.

Streetlights & Traffic Signals

The GHG emissions associated with the electrical use of all DDOT streetlights and signals are included in the analysis. DDOT TOA manages the District's 68,000 street and alley lights, specialty lights, and supporting infrastructure.

3.2.3. Scope 3 Sources

Like Scope 2, Scope 3 emissions are indirect emissions that are a consequence of the activities of the organization; however, the actual Scope 3 emissions are generated by sources not controlled by the organization (AASHTO, 2011). Scope 3 emissions are typically more difficult to estimate and may be more challenging to reduce due to the lack of direct control over the emission source, but they are often significantly larger than Scope 1 or Scope 2 emission sources and thus provide greater emission reduction potential. Although Scope 3 emissions may typically not be included in an organization's GHG inventory, DDOT is including the following Scope 3 source in this inventory:

Roadway Network

The GHG emissions associated with all vehicles (incl. the DC Circulator and DDOT employees' private vehicles) traveling on DDOT roadways are included in the analysis for context and clarity. DDOT is responsible for constructing, operating, and maintaining its roadways and can control how those activities are implemented. DDOT cannot completely control how the roadways are used by motorists. DDOT is including this source in the inventory to help with future planning and design of the District's roadway network and multi-modal transportation system.

3.2.4. Sources not Included in this Inventory

As discussed below, several sources were not included in this analysis mainly because they fall under Scope 3 emissions; therefore, DDOT lacked the appropriate data or could not accurately quantify the incomplete data that was available.

Capital BikeShare

Capital Bikeshare is the successor to DDOT's first bike-sharing system called Smartbike DC which was launched in August 2008. The system was the first bike-sharing, public transit program of its kind in the U.S. Although the Capital Bikeshare program is a partnership with Arlington County and the City of Alexandria in Virginia, DDOT is solely responsible for the program within the District's borders. The day-to-day operations and maintenance of the system is performed by Alta Bicycle Share, through a contract. There are currently over 191 stations with over 1,600 bicycles across the District and Virginia. Fifty-four more stations are planned in the District for early 2013.

The GHG emissions associated with Capital BikeShare are not included in this analysis because they are considered negligible. The stations are solar powered and use wireless technology and do not generate any GHG emissions. However, the day-to-day operation and maintenance, which is done by driving service vehicles from station-to-station, do generate GHG. The GHG emissions from service vehicles are accounted for in the roadway network; however, those emissions are more than offset by the amount of miles traveled by Capital Bikeshare members. Through November 2012, there have been 2,146,915 miles traveled using Capital Bikeshare (DDOT, 2012b). This is an increase of about one million miles from 2011.

Commuter Buses and Commuter Rails

Commuter buses and rail lines from Maryland and Virginia, as well as tour buses and other motor coaches that visit the city are not included in this analysis. Although these vehicles do contribute to the overall GHG emissions in the District, DDOT does not control the operation or policies to reduce their GHG emissions; however, the emissions from these vehicles are captured in the Roadway Network source analysis (see Section 4.5). Furthermore, the joint DDOT/DDOE anti-idling campaign and regulations, which limits the idle time of these types of vehicles, is helpful in reducing the amount of GHG these vehicles emit.

DC Fleet Share Program

The District government was the first in the nation to introduce an innovative motor pool operation. The DC Fleet Share is based on the car-sharing model used by Zipcar™ and others, which allows District government employees to reserve a vehicle, on an hourly basis, via the Internet on a first-come, first-served basis. DDOT is one of 30 District government agencies with employee membership in the program. The GHG emissions associated with vehicles in the DC FleetShare are not included in this analysis because those vehicles are available to all District government employees. It is difficult to determine how much of the vehicle usage could be attributed to DDOT employees for DDOT purposes. The DC Fleet Share, which is managed by DPW; however, has alternative fuel vehicles in the fleet mix and DPW has implemented programs to reduce GHG emissions from its operations.

DC Streetcars

The DC Streetcars are not included in this inventory because most of the project is in the planning or design phase and construction has not yet begun. The goals of the DC Streetcar system are to reduce short inner-city auto trips, parking demand, traffic congestion and air pollution. Meeting these goals would help in reducing an estimated 150 tons per year of CO_2 from vehicle emissions (DDOT, 2010).

DDOT Construction Projects

GHG emissions from construction projects are mainly from combustion of fuel from vehicles and equipment at the construction site. Emissions from traffic divergence due to construction project are captured in the GHG analysis of the roadway network (see Section 4.5). Additional construction related GHG emissions would include the use of electricity at construction sites. The GHG emissions associated with construction of DDOT projects are not included in this analysis at this time. A majority of DDOT construction projects are contracted out to private vendors and consultants. DDOT encourages its construction contractors to use equipment that employs electric or solar power in lieu of diesel and gasoline, to promote energy efficiency, and to reduce GHG emissions.

Employee Business Travel

The GHG emissions associated with employee business travel are not included in this analysis due to lack of data. Most of the business-related travel by DDOT employees occurs within the city or the Washington metropolitan area. Most business ground travel by DDOT employees involves DDOT vehicles and those emissions are captured in the Fleet analysis (see Section 4.1). Data was not available for employees business travel by air or rail at time of analysis.

Employee Commuting

As discussed further in the report, the GHG emissions associated with employee commuting are included as a part of the roadway network (see Section 4.5) and the emissions from employee commuting are not separated out. However, DDOT conducted a survey to get a better understanding of

employee commuting habits (see Appendix B). Although DDOT cannot control the commuting behavior of its employees regarding their privately owned vehicles, it can implement policies that could positively influence those behaviors to achieve reductions in GHG emissions in the District.

MetroBus and MetroRail

Although they contribute to the overall GHG emissions in the District (as captured in the roadways network emissions in Section 4.5), the GHG emissions for MetroBus and MetroRail are not separated out for this analysis. The MetroBus and MetroRail is a regional transit system, which serves the District, Maryland, and Virginia. The system is owned and operated by WMATA. Although DDOT provides financial and technical support to WMATA, it does not control the day-to-day operation of its transit system. DDOT continually works with WMATA to develop improved service plans for high ridership routes in the District and have provided an enhancement of the transit service with the DC Circulator, within the District.

3.3. Calculating GHG Emissions

For this inventory, DDOT followed the general procedure for calculating GHG emissions as recommended in the AASHTO GHG Emissions Inventory Guidelines, as follows:

Step 1. Determine the needed activity data for each emission source. Activity data is a measurement of the activities that generate GHG emissions (e.g., fuel consumption; amount of electricity purchased).

Step 2. Collect the activity data.

Step 3. Select appropriate emission factors based on the activity data. Emission factors are ratios of the GHGs emitted per unit of activity data (e.g., metric tons of CO_2 emitted per kilowatt hour of generated electricity or gallons of fuel burned).

Step 4. Calculate GHG emissions by gas (i.e., CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) by multiplying activity data by the appropriate emission factors.

Global Warming Potential:

Other GHG gases are measured against CO_2, according to their global warming potential (GWP). The GWP is a factor that describes the atmospheric heat-trapping impact of one mass unit (e.g., 1 metric ton) of a particular GHG compared to the impact of one mass unit (i.e., 1 metric ton) of CO_2. GWPs are calculated and published widely by bodies such as the IPCC and there is a specific set of GWPs that governs all GHG reporting. As science advances, the GWP for a particular GHG may change; however the current convention is to use 100-year GWPs, published in the ***IPCC's Second Assessment Report (1996)***, in order to maintain consistency across other inventories and across time.

Source: AASHTO, 2011

Step 5. Convert emissions to metric tons CO_2-equivalent (CO_2e), to take into account the global warming potential (GWP) of the different GHGs.

The five DDOT GHG emission sources, which are presented in Table 1, were evaluated using the information collected and researched. Section 4.0 provides further detail for each source. The activity data in this inventory are collected from District government agency personnel, responsible for monitoring, measuring, and tracking the data for each of the sources. Depending on the emissions source, DDOT obtained emission factors, adjustment factors, and other variables used in the calculations from various nationally and internationally recognized sources, including the following:

- The EPA's Emissions & Generation Resource Integrated Database (eGRID2012) for electrical information;
- The EPA's Motor Vehicle Emission Simulator (MOVES) for information on the roadway network; and
- IPCC Emissions Factor Database for natural gas information.

MWCOG/TPB provided DDOT travel-related output data from its regional travel demand forecasting model based on the 2011 Constrained Long Range Plan (CLRP), the most recent adopted long range transportation plan at the time of analysis. In addition to vehicle miles traveled (VMT) for years 2007, 2017 and 2025, MWCOG/TPB also provided MOVES-ready input databases such as: vehicle population based on the 2011 Vehicle Identification Number (VIN) database, fuel supply, fuel formulation, I/M programs and meteorology data for years 2007, 2017 and 2025. DDOT used this MWCOG/TPB data and the MOVES program to estimate CO_2 emissions for years 2007, 2017 and 2025. However, since these planning horizons did not coincide with DDOT's analysis years of 2009 (baseline) and 2040 (forecast), DDOT derived both VMT and emissions estimates for years 2009 and 2040 using methodology and calculations for each applicable source type as presented in Appendix A.

3.4. Managing Inventory Quality

DDOT strives to ensure complete and accurate GHG accounting and to effectively manage the GHG inventory quality. Throughout the data collection process, DDOT identified challenges and data gaps, as well as potential solutions to address these issues. Since DDOT has only limited operational and financial control over many of the transportation activities contributing to GHG emissions in the District (e.g., activities on the roadways), the main challenges DDOT faced were establishing the data collection boundaries and determining what sources to include in the inventory, and avoiding double counting to extent practicable. Note that the DC Circulator is coded in the regional transit network of the MWCOG/TPB regional travel demand forecasting model and as such it is reflected in the travel-related output data (i.e., VMT) that MWCOG/TPB provided to DDOT for use in its MOVES runs. Therefore, there is a potential that DC Circulator emissions may be double-counted in both the roadway network and DDOT emissions.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4.0 Results: Baseline vs. Future Conditions

The ***District of Columbia Greenhouse Gas Emissions Inventory***, developed by DDOE used a baseline year of 2006. In order to avoid duplication of the work already completed by DDOE and to establish a more recent baseline year, DDOT chose calendar year 2009 as the baseline year. DDOT determined this baseline year through coordination with DDOE as well as on the availability of a complete set of data for one calendar year. For the forecast year, DDOT choose calendar year 2040. The year 2040 was chosen because it is the forecast year for long-range transportation planning purposes in the District and the last year of the 2011 CLRP and the 2012 CLRP, which are the approved long-range plan of the MWCOG/TPB.

According to MWCOG data, the Washington Metropolitan region is expected to gain an additional 1.5 million new residents and 1.2 million new jobs between 2010 and 2040. From this regional total the District will gain 155,000 residents and 191,000 jobs (MWCOG, 2010). Typically, forecast emissions are calculated under a "business as usual" scenario, which assume these factors are constant. However, since 2009, there have been actions taken locally, regionally, and nationally to change the energy profile and energy usage patterns in DDOT and the District. Therefore, the projected 2040 emissions in this GHG emissions inventory were calculated by DDOT by taking into account any regulatory actions (i.e., legislative requirements) and policy initiatives that have been in effect since 2009 or with lasting effect beyond 2009 (e.g., CAFE standards, policy on renewable energy purchase). DDOT has chosen this approach to estimate future emissions in 2040 because it allows the agency to look beyond measures that are already in place or look beyond the "low hanging fruit", when developing mitigation measures for GHG reduction. DDOT used this same proactive approach to develop resiliency and adaptation measures to address the impacts of climate change in the ***DDOT Climate Adaptation Plan***.

4.1. Fleet

DPW provided activity data for the DDOT fleet (on-road and non-road), including annual fuel costs and fuel types for each vehicle. DPW's Fleet Management Administration (FMA) is responsible for providing the District of Columbia government agencies a fleet that is appropriate for the service delivery needs, well maintained, environmentally responsible, and cost effective. The DPW FMA is responsible for fleet management activities, including acquisition and disposal, fueling, and vehicle maintenance services. In 2009, DDOT owned and operated approximately 400 vehicles in its fleet, ranging from passenger cars, light-duty vehicles such as pickup trucks, and heavy-duty vehicles such as snow removal and construction vehicles. Additionally, DDOT had in its fleet, approximately 270 non-road equipment that generated GHG emissions, such as compressors, generators, and forklifts. The 2009 DDOT's vehicle fleet also included 92 alternative fuel vehicles (AFV) and hybrid vehicles.

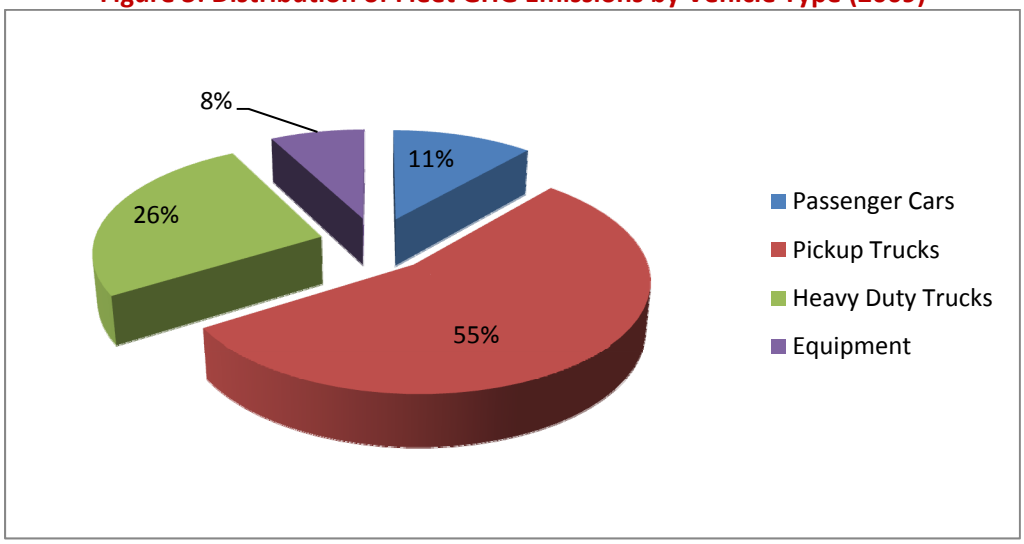
Emissions estimated from the fleet included CO_2, CH_4, and N_2O. The CH_4 and N_2O emissions were very small in comparison to the CO_2 emissions for the fleet. Although, the fleet may have also emitted small quantities of fluorinated gases from vehicle coolant and solvents, emissions for those gases were not estimated in this inventory due to lack of available data. Emissions factors from the Energy Information Administration (EIA), the Department of Energy (DOE), and EPA's MOVES were applied to the activity data to estimate DDOT GHG emissions. Appendix A provides detailed calculations.

The total GHG emissions of DDOT's 2009 fleet, separated by vehicle type, are presented in Table 2 and illustrated in Figure 3. Generally, pick-up trucks generate the most GHG emissions of DDOT's fleet, followed by heavy-duty trucks. Passenger vehicles generate the least amount of GHG emissions of the on-road vehicles in the fleet. Overall, DDOT's non-road equipment generates the lowest amount of GHG emissions.

Table 2: Fleet GHG Emissions by Vehicle Type (2009)

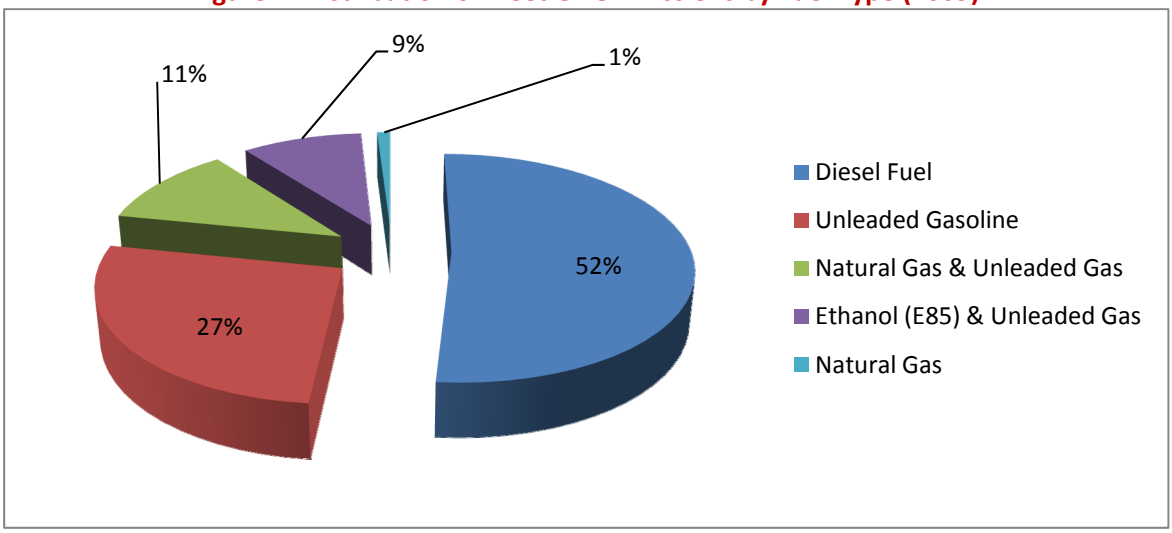
Type	CO_2e (metric tons)
Passenger Cars	194
Light-duty Pickup Trucks	927
Heavy-duty Trucks	443
Equipment	130
Total	**1,695**

Figure 3: Distribution of Fleet GHG Emissions by Vehicle Type (2009)



As presented in Figure 4, diesel fuel is the predominant source of GHG emissions from DDOT's fleet, at 52 percent, followed by unleaded gasoline, at 27 percent.

Figure 4: Distribution of Fleet GHG Emissions by Fuel Type (2009)



For 2040, it is assumed that DDOT's fleet will be approximately the same size as it is in 2009. However, it is certain that the DDOT on-road vehicle fleet will contain a newer mix of vehicles in 2040. By 2040, the newer mix of vehicles would be manufactured in compliance with more stringent standards to reduce GHG emissions from newer model year vehicles, which would have been in place after 2009 (such as the Corporate Average Fuel Economy [CAFE] standards[1]). Additionally, DDOT's 2040 on-road fleet would likely contain more AFVs because by the end of the 2012 fiscal year, in an effort to achieve a 75 percent AFV fleet, DPW will implement a conversion program to replace, on a regular basis, the District government's on-road vehicles that use gasoline with AFVs (DPW, 2011). Because of these policies that would have been in place since 2009, the DDOT fleet in 2040 would produce less GHG emissions. DDOT estimates that GHG emissions from the on-road fleet will be reduced by a factor of 0.86 percent (i.e., negative 0.86%) per year, even if DDOT does not implement any policy change to reduce GHG from its fleet (see Appendix A).

[1] In April 2010, the first ever CAFE standard to reduce GHG emissions and improved fuel economy for model year (MY) 2012 through 2016 passenger cars, light-duty trucks, and medium-duty passenger vehicles was finalized by EPA and the DOT National Highway Traffic and Safety Administration (NHTSA). In September 2011, a similar rule was established for medium- and heavy-duty for MYs 2014-2018. In December 2011, EPA and NHTSA proposed to extend the rule to MY2017 -2025 passenger and light-duty vehicles. [NHTSA, 2012]

This report assumes that the amount of non-road equipment in DDOT's fleet would not change. Although the fleet may contain newer equipment in 2040, it is not expected that the GHG emissions would change. There have not been any new or proposed regulations since 2009 to reduce emissions from non-road equipment. Therefore, non-road equipment GHG emissions in 2040 are assumed to be the same as they were in 2009. Table 3 provides a comparison of baseline emissions to future forecast emissions from GHG from DDOT's fleet.

Table 3: Fleet GHG Emissions (2009 vs. 2040)

Type	2009 CO_2e (metric tons)	2040 CO_2e (metric tons)
Passenger Cars	194	149
Light-duty Pickup Trucks	927	710
Heavy Duty Trucks	443	339
Equipment	130	130
Total	***1,695***	***1,328***

4.2. DC Circulator

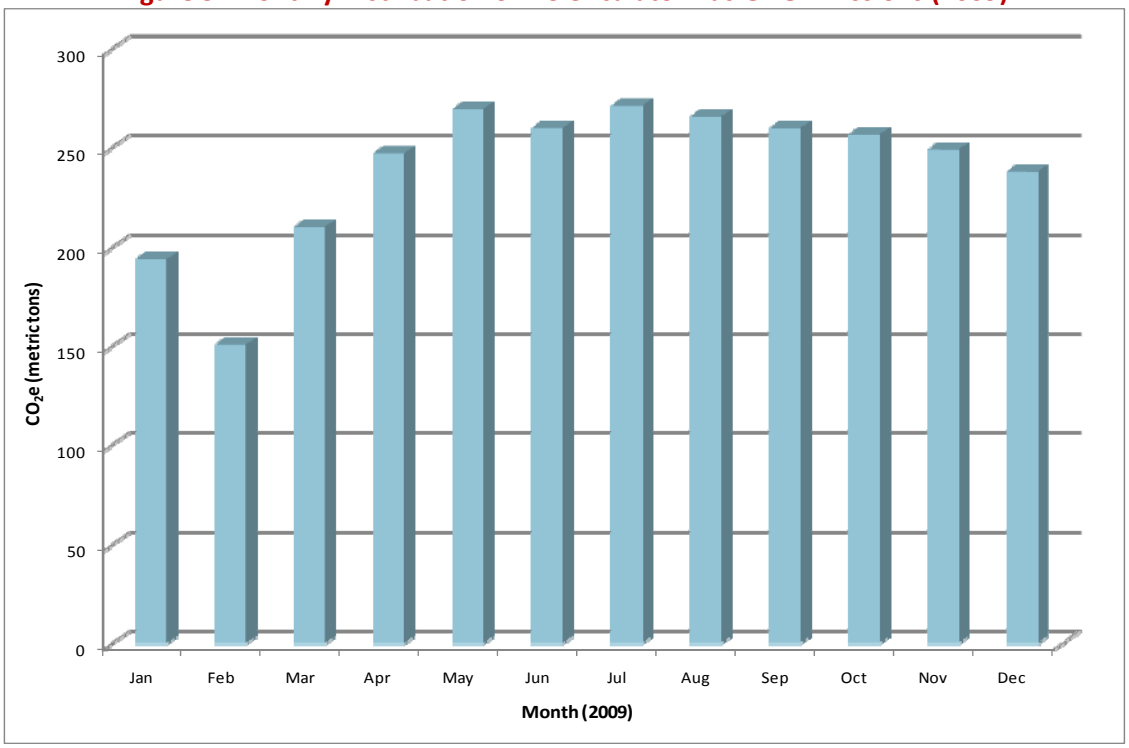
The DC Circulator began service in 2005 with an initial two routes, offering an enhanced transit link between Georgetown and Union Station as well as the Convention Center and Southwest Waterfront. By 2009, the DC Circulator had expanded to five routes in its network (DDOT, 2012). The DC Circulator 2009 fleet consisted of 49 vehicles, including 35 40-foot buses and 14 30-foot buses, all of which run on ultra-low sulfur diesel fuel. Annual mileage data for the DC Circulator are available on the online DC Circulator Dashboard (circulatordashboard.dc.gov). In 2009, the DC Circulator traveled a total of 1,005,224 miles through its five routes. Using the annual mileage data, emission factors from the U.S. Federal Transit Administration (FTA) and the EPA were applied to determine the amounts of CO_2, CH_4 and N_2O emitted from the DC Circulator bus operations. Detailed calculations of the DC Circulator GHG emissions are provided in Appendix A.

Table 4 presents the total GHG emissions for all 49 buses for the year 2009 and this information is further illustrated in Figure 5.

Table 4: DC Circulator Bus GHG Emissions (2009)

Month	CO_2e (metric tons)
January	194
February	151
March	210
April	247
May	269
June	260
July	271
August	265
September	260
October	256
November	249
December	238
Total	***2,870***

Figure 5: Monthly Distribution of DC Circulator Bus GHG Emissions (2009)



In 2009, DDOT operated five DC Circulator bus routes. Table 5 presents the five 2009 DC Circulator bus routes, with the roundtrip route length for each.

Table 5: DC Circulator Bus Routes in 2009

Route	Roundtrip Route Length (miles)
Georgetown – Union Station	8.8
Convention Center – Southwest Waterfront	4.7
Smithsonian – National Gallery of Art	4.2
Woodley Park – Adams Morgan – McPherson Square Metro	6.6
Union Station – Navy Yard	6.4
Total	***30.7***

In 2010, DDOT discontinued the Southwest Waterfront route and added the Dupont Circle to Rosslyn route. According to DDOT's ***D.C. Circulator Transit Development Plan***, there are plans to add an additional nine routes and two extensions (see Table 6) starting in 2012 and continuing through 2020 (DDOT, 2011).

Table 6: Planned Circulator Bus Routes from 2010 to 2020

Route	Roundtrip Route Length (miles)
Union Station – Skyland – Camp Simms	14.0
Dupont Circle – U Street / Howard University Extension	3.6
North Mall – Georgetown	9.4
South Mall – Arlington Cemetery	10.4
Union Station – Navy Yard – NoMA Extension	2.0
Dupont Circle – Georgetown – Rosslyn*	4.3
Dupont Circle – Southwest Waterfront – Navy Yard	9.0
Adams Morgan – H Street NE	9.0
St. Elizabeth's – H Street NE	12.0
Tenleytown – Brookland	16.0
Tenleytown – Silver Spring	12.2
Minnesota Avenue – Skyland	6.4
Total	***108.3***

**Route that was online in 2010. All other routes are planned to be operational between 2012 and 2020. (DDOT, 2011)*

As shown in the tables, the total roundtrip route length for the 2009 system is approximately 31 miles; the future routes would total 108 miles of roundtrip routes. However, with the replacement of one of the 2009 routes and the implementation of the planned routes, the total roundtrip route length would be 134 miles. This is a 437 percent increase in route miles over the 2009 network. To determine the 2040 GHG emission estimate, the total bus mileage for 2009 was adjusted to account for the additional planned bus routes as well as to account for cleaner diesel buses in 2040 due to implementation of regulations that are in place since 2009.

Based on calculations using the MOVES runs for the years 2017 and 2025, an adjustment factor for GHG emission rates of negative 0.18 percent per year was calculated specifically for buses in the D.C. area to account for the reduction in GHG emissions beyond 2025. Appendix A has detailed calculations. Table 7 presents the 2009 and 2040 GHG emissions for the DC Circulator buses.

Table 7: DC Circulator Bus GHG Emissions (2009 vs. 2040)

Scenario	Mileage	CO_2e (metric tons)
2009 Baseline	1,005,224	2,870
2040 Forecast (not adjusted)	4,392,826	12,540
2040 Forecast (adjusted)	4,392,826	12,202

4.3. Facilities

DGS provides centralized facility management services for buildings and other infrastructure owned and occupied by the District government. Specifically, DGS provides energy conservation, utilities management, and maintenance for 36 facilities which were occupied and operated by DDOT in 2009. These facilities range from the Reeves Center to parking lots and maintenance garages to the "Welcome to D.C." signs. Typical GHG emissions from facilities are CO_2, CH_4, and N_2O as a result of electrical and natural gas consumption. Buildings and facilities that are leased by DDOT from private companies are not included in this inventory.

In order to calculate the GHG emissions from electricity use, emission factors from the EPA's eGRID2012, specific to this region, were used. For natural gas consumption, emission factors for commercial/institutional land use from the IPCC were used. Detailed calculations and emission factors are provided in Appendix A.

Table 8 present the annual GHG emissions from electric and natural gas consumption for all DDOT facilities. As shown in Figure 6, the tunnel and underpass lights and the Reeves Center (the former location of DDOT headquarters) account for a majority (i.e., 80 percent) of the GHG emissions.

Table 8: DDOT Facility GHG Emissions (2009)

Facility	CO_2e (metric tons)
KA-144 -Tunnel Lights	2,778
R-1 -Reeves Center	1,333
KA-764 –Underpass Lights-1	573
KA-705 -Storage Space	513
KA-786 -Underpass Lights-2	336
KA-213 -Bridge & Street Maintenance	213
KA-740 -Transportation Garage	130
KA-581 -Overpass Lights	77
KA-179 -Annex 8	47
KA-214 -Bridge Sign and Lights	33
KA-653 -Salt Dome	32
KA-525 -Underpass Lights-3	30
KA-5084 -N Capitol & Rhode Island Ave NW	29
KA-682 -South Side of Bridge	23
KA-588 -Park Walkway Lights	23
KA-155-DDOT 2311 M L King Ave SE	21
KA-596 -Parkway Lights	19
KA-5073 -DDOT 100 Benning Rd and Kenilworth Ave NE	16
KA-589 -Parking Lot	16
KA-5076 -DDOT 100 Anacostia Freeway	12
KA-713 -Street Lighting	12
KA-5067 -DDOT 100 I295 Chesapeake St SW	10
KA-651 -S Capitol St Bridge	9
KA-5070 -4th & VA Av SE Underpass	7
KA-527 -South Capitol Street Bridge	7
KA-654 -Salt Storage	4
KA-201 -Welcome to DC Sign	4
KA-20 -Outdoor Lights - West VA Ave NE	4
KA-5095 -Tool House #1	4
KA-163 -14th Street Bridge Light	3
KA-732 -Testing Laboratory	2
KA-215 -DDOT 2500-T2 Benning Rd NE	1
KA-503 -Maintenance Facility #3	1
KA-526 -DDOT 1922 Vermont Ave NW	1
KA-5069 -DDOT 3800-T Fort Dr NW	1
KA-5071 -DDOT 100 Rhode Island @ Otis St NE	0.41
Total	***6,323***

Overall, electricity consumption accounts for 5,976 metric tons or 95 percent of CO_2e from DDOT facilities. Natural gas consumption accounts for 347 metric tons or five percent of CO_2e from DDOT facilities (Figure 7).

Figure 6: Top GHG Emitting DDOT Facilities in 2009

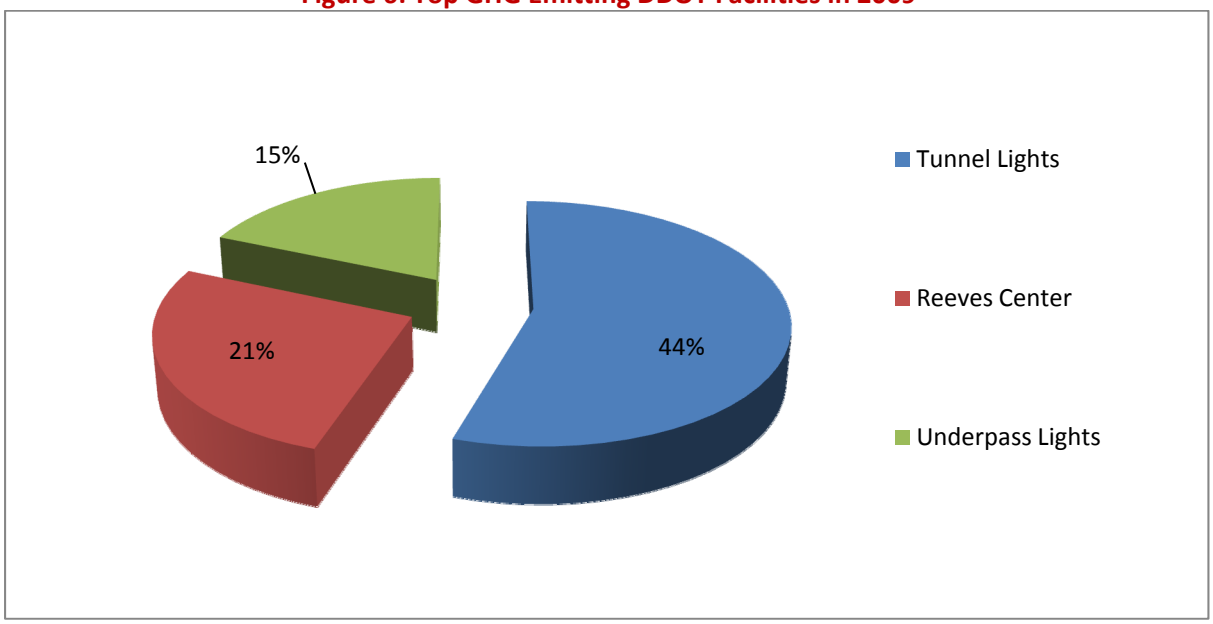
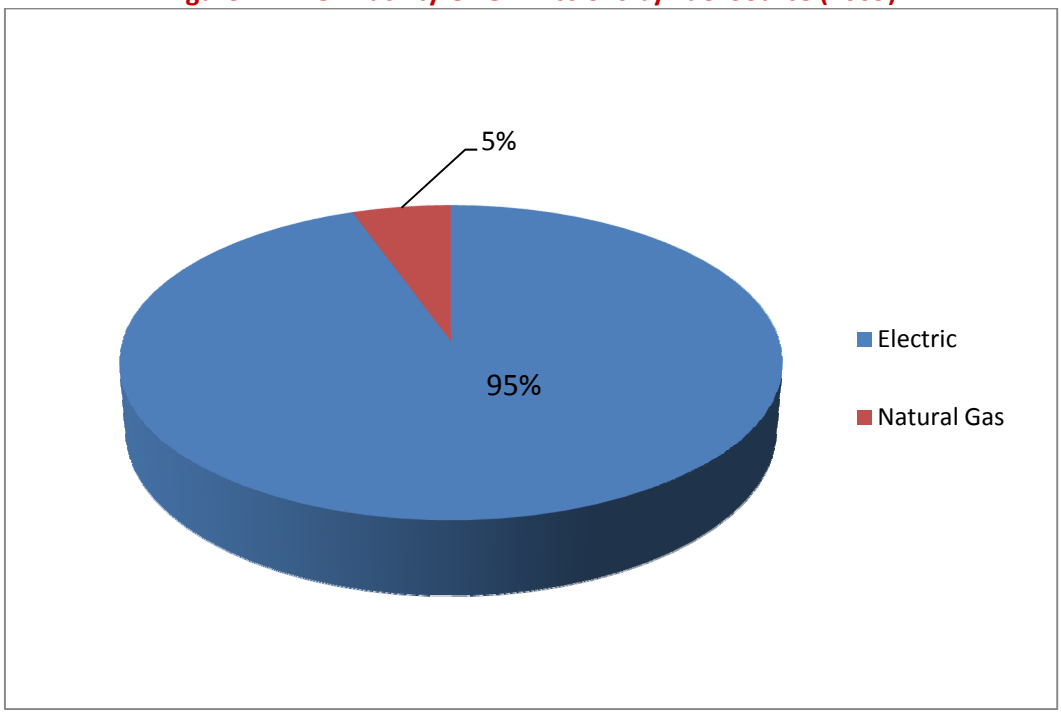


Figure 7: DDOT Facility GHG Emissions by Fuel Source (2009)



According to the DDOE's ***Climate of Opportunity***, the EPA recognized the District as the third leading city nationwide in purchasing renewable power (DDOE, 2010a). As of 2011, 50 percent of the District government's energy for electricity comes from renewable energy (primarily wind) sources (DDOE, 2012a). With the District ***Green DC*** and ***Sustainable DC*** initiatives, it is likely that the District government will continue to purchase renewable energy at this rate to advance its move toward a "green" energy future. The District government's renewable energy purchase serves to offset direct emissions associated with fossil fuel consumptions in its buildings and facilities. In 2011, the DDOT consolidated its buildings and moved its headquarters moved from the Reeves Center to a *Leadership in Energy and Environmental Design* (LEED) Gold building at 55 M St. SE. In 2009, Reeves Center accounted for 21 percent of DDOT facility GHG emissions.

On average, LEED buildings use 24 to 50 percent less energy than their conventional counterparts (USGBS, 2009). Therefore, to account for the move to the LEED DDOT headquarters, a conservative 25 percent reduction in emissions was applied to the 2009 emissions from Reeves Center for the forecast year. Overall a 50 percent reduction was applied to all facilities as a result of renewable energy purchase. Other than these two changes, it was assumed that energy consumption in these DDOT facilities would stay the same. GHG emissions from natural gas were assumed to be the same as in 2009, since there is currently no initiative for reducing natural gas consumption for the District government. Table 9 provides the GHG emissions from facilities operated and occupied by DDOT in 2009 compared to 2040.

Table 9: DDOT Facility GHG Emissions (2009 vs. 2040)

Source	2009 CO_2e (metric tons)	2040 CO_2e (metric tons)
Electrical	5,976	2,995
Natural Gas	347	347
Total	***6,323***	***3,342***

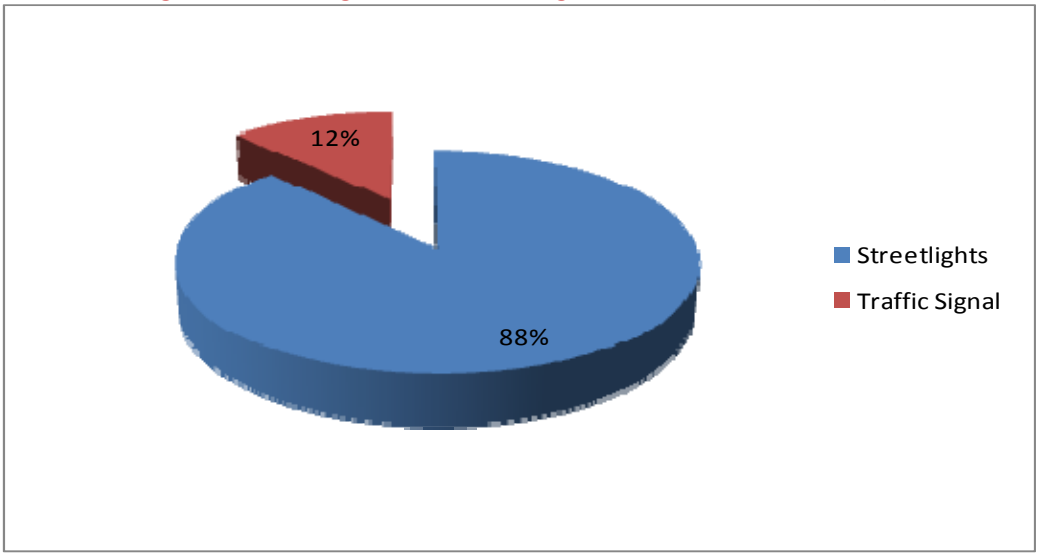
4.4. Streetlights and Traffic Signals

DDOT is responsible for thousands of streetlights and traffic signals throughout the District. The GHG emissions (see Table 10) associated with the electricity use for streetlights and traffic signals were calculated based upon electrical costs, as supplied by DDOT, TOA. Emissions factors from eGRID2012 were applied to calculate GHG emissions (see Appendix A). In 2009, 44 percent of the electricity from DDOT's streetlights and traffic signals were purchased from renewable sources. As shown in Figure 8, streetlights represent 88 percent of the GHG emissions, while traffic signals represent 12 percent. The lesser GHG emissions from traffic signals is a direct result of DDOT's complete conversion of all 1,600 of its traffic signals to light-emitting diodes (LED) modules in 2005.

Table 10: Streetlights and Traffic Signals GHG Emissions (2009)

Account	CO_2e (metric tons)
Streetlights	31,283
Traffic Signals	4,421
Total (Overall)	***35,704***

Figure 8: Streetlights and Traffic Signals GHG Emissions (2009)



The 68,000 streetlights (including alley streetlights) in the District currently consist of high pressure sodium lights, incandescent lights, metal halide lights, and mercury vapor lights. In 2012, DDOT converted 1,360 alley streetlights to LED (DDOT, 2012a); a two percent conversion. According to EPA, LED bulbs are approved under the Energy Star label because they use up to 75 percent less energy; thereby reducing GHG emissions from associated energy use at an equal rate (EPA, 2012b). Also in 2012, 50 percent of the District government purchased energy was renewable energy. DDOT estimated the 2040 emissions GHG emissions from DDOT streetlight and traffic signals system taking into account the two percent conversion of streetlights to LED and the 50 percent renewable energy use overall (see Appendix A for details). Table 11 provides a comparison of 2009 and 2040 emissions.

Table 11: Streetlight and Traffic Signals GHG Emissions (2009 vs. 2040)

2009 CO_2e (metric tons)	2040 CO_2e (metric tons)
35,704	***25,369***

DDOT is also exploring the use of solar and wind energy as alternative power sources to reduce its use of fossil fuel as energy.

4.5. Roadways Network

The GHG emissions from vehicles travelling on all DDOT roadways were developed by the agency based on information obtained from MWCOG/TPB. MWCOG/TPB provided travel-related output data from its regional travel demand forecasting model based on the 2011 CLRP. MWCOG/TPB also provided VMT and MOVES-ready input databases (at the county-level for Washington DC) such as: vehicle population based on the 2011 VIN database, fuel supply, fuel formulation, I/M programs and meteorology data for years 2007, 2017 and 2025. DDOT ran the MOVES model to estimate CO_2e emissions for 2007, 2017 and 2025. However, since these planning horizons did not coincide with DDOT's inventory years of 2009 (baseline) and 2040 (forecast), DDOT extrapolated both VMT and CO_2 emissions for 2009 and 2040 independently from MWCOG/TPB using methodologies and calculations suggested by FHWA (FHWA, 2012). The VMT is estimated using the following formula: [***Present VMT X (1 + Growth Rate)^time***]. For the year 2009, the growth rate between years 2007 and 2017 was used. Once the VMT for 2009 is estimated the VMT for year 2040 is calculated using the growth rate between the years 2009 and 2025. Details of the estimations and methodology are provided in Appendix A. The latest version of EPA's MOVES, MOVES2010a was used throughout the analyses.

The roadway network GHG emissions include the GHG emissions from all types of vehicles as they travel on roadways within the District. These estimates capture emissions from roadway sources that were not specifically separated out and calculated in this inventory (e.g., WMATA buses, vehicles other than DDOT's, commuter buses, and employee commute, etc.). Table 12 presents the VMT and GHG emissions from vehicular traffic on Washington D.C. roadway by vehicle type for the year 2009.

Table 12: Washington D.C. Roadway Vehicle Miles Traveled (2009)

Vehicle Type	Vehicle Miles Travelled (miles)	CO_2e (metric tons)
Motorcycles	28,253,903	680
Passenger Cars	2,329,033,699	59,896
Light Duty Trucks (e.g., Pick-ups)	1,506,550,194	55,492
Buses (e.g., Transit, School)	26,394,320	2,282
Heavy Duty Trucks (e.g., Refuse/Haul, Motor Home)	107,182,375	11,387
Total	***3,997,414,492***	***129,736***

Passenger cars contribute the most vehicle miles traveled (58 percent) on the District roads and the most GHG emissions (46 percent) to the District atmosphere, followed by light duty trucks (38 and 43 percent respectively), and heavy duty trucks (three and nine percent, respectively). Buses and motorcycles contribute three percent or less of the VMT and GHG emissions. The reason for this is because motorcycles produce low emissions. Most of the DDOT/WMATA buses that are in operations within the District are clean vehicle buses or have been retrofitted to use clean vehicle.

Figure 9 shows the percentage of roadway GHG emissions by day (weekday or weekend day) as calculated using MOVES2010a. As shown, travel during the average weekday generates more GHG emissions as compared to an average weekend day. This result is indicative of the commuting pattern in the District. According to the 2000 U.S. Census data, the city's population grows by about 72 percent during the weekdays, as almost 450,000 workers travel into the city on a daily basis from surrounding states. The U.S. Census data also shows that about 78 percent of the District's residents work in the city. According to the MWCOG Household Travel Survey, most residents in the region drive for the purpose of shopping or running errands, which are more likely to occur on the weekends (MWCOG, 2009). This would explain the relatively high rate of weekend travel in the District.

Figure 9: Washington D.C. Roadway GHG Emissions by Day (2009)

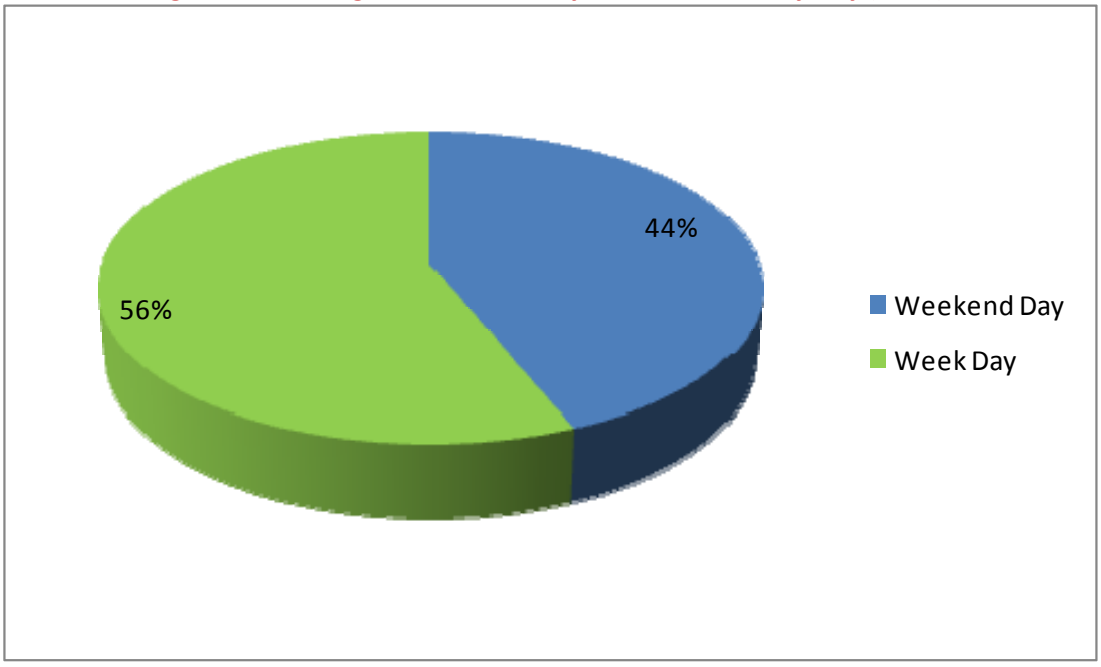


Table 13 presents the estimated Washington D.C. roadway VMT and GHG emissions for the year 2040 compared to year 2009. Total VMT on the District roadways in 2040 was estimated by DDOT to be almost 800 million miles higher than in 2009. However, overall GHG emissions in 2040 were estimated by DDOT to be are lower than those in 2009. This may be due to the stricter emissions controls for cars and trucks in future years.

Table 13: Washington D.C. Roadway Vehicle Miles Traveled and GHG Emissions (2009 vs. 2040)

Year	Vehicle Miles Traveled (miles)	CO_2e (metric tons)
Baseline (2009)	3,997,414,492	129,736
Forecasted (2040)	4,658,868,761	117,138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5.0 Conclusion

DDOT is committed to addressing the impacts of climate change by taking this first step and conducting a GHG Emissions Inventory. This Greenhouse Gas Emissions Inventory report provides an estimate of baseline emissions levels against future forecast levels allowing DDOT to make informed policy decisions that would further help reduce GHG emissions from its activities.

Table 14 and Figure 10 present a summary of GHG emissions from DDOT activities in 2009. Figure 11 presents the emissions by scope. Emissions from vehicles traveling on Washington D.C.'s roadways account for the largest GHG emissions. DDOT's fleet generated the lowest GHG emissions. Scope 1 sources were the lowest emitters overall.

Table 14: Summary of Total DDOT GHG Emissions (2009)

DDOT Scope of Activities	CO_2e (metric tons)	Percentage of Scope*	Percentage of All Total*
SCOPE 1			
Fleets	1,695	37%	1%
Circulator Bus	2,870	63%	2%
Total	***4,565***	***Scope 1 = 3%***	
SCOPE 2			
Facilities	6,323	15%	4%
Streetlights & Signals	35,704	85%	20%
Total	***42,028***	***Scope 2 = 24%***	
SCOPE 3			
Roadways (including commuting)	129,736	100%	74%
Total	***129,736***	***Scope 3 = 74%***	
Total 2009 DDOT GHG Emissions	***176,328***		

Note: Percentages are rounded up.

Figure 10: Distribution of Total DDOT GHG Emissions (2009)

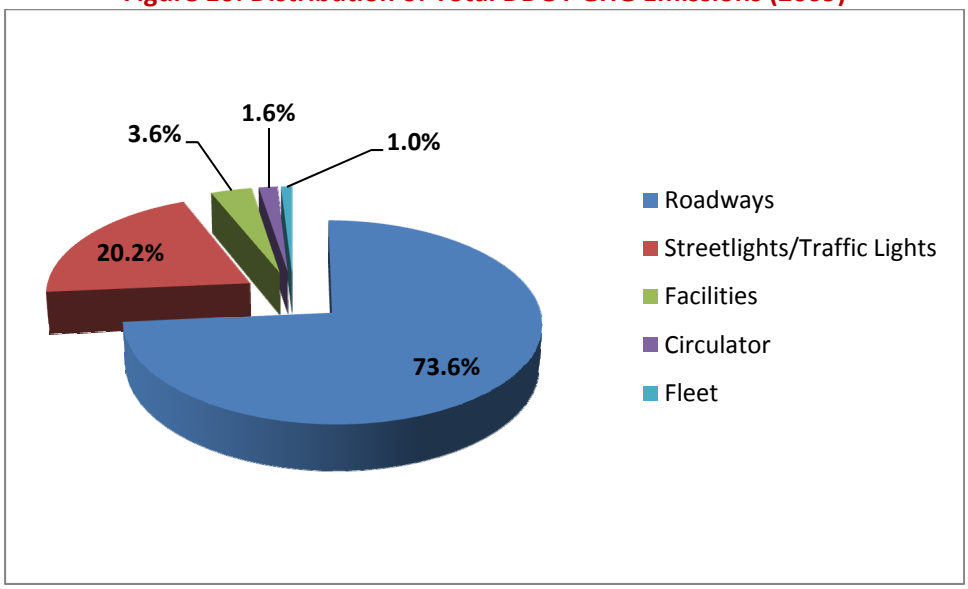


Figure 11: 2009 DDOT GHG Emissions by Scope

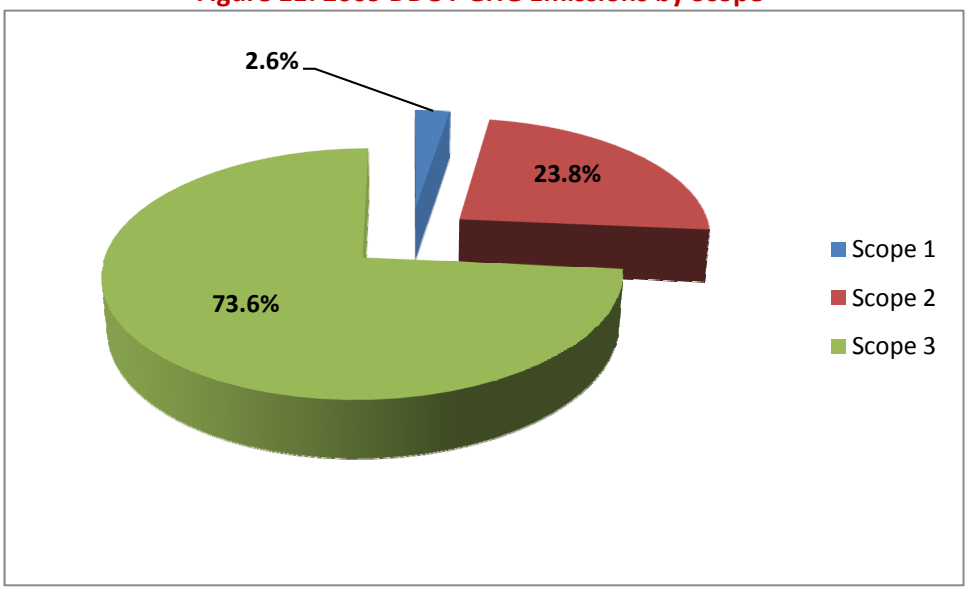


Table 15 and Figure 12 present a summary of GHG emissions from DDOT activities for 2040 forecast year. Figure 13 presents the emissions by scope. As is the current situation, emissions from vehicles traveling on Washington D.C.'s roadways are predicted to continue to be the largest source of DDOT's emissions in 2040 and DDOT's fleet will generate the lowest GHG emissions.

Table 15: Summary of Total DDOT GHG Emissions (2040)

DDOT Scope of Activities	CO_2e (metric tons)	Percentage of Scope*	Percentage of All Total*
SCOPE 1			
Fleets	1,328	10%	1%
Circulator Bus	12,202	90%	8%
Total	***13,531***	***Scope 1 =8%***	
SCOPE 2			
Facilities	3,342	12%	2%
Streetlights & Signals	25,369	88%	16%
Total	***28,711***	***Scope 2 =18%***	
SCOPE 3			
Roadways)	117,138	100%	74%
Total	***117,138***	***Scope 3 =74%***	
Total 2040 DDOT GHG Emissions	***159,380***		

Note: Percentages are rounded up.

Figure 12: Distribution of Total DDOT GHG Emissions (2040)

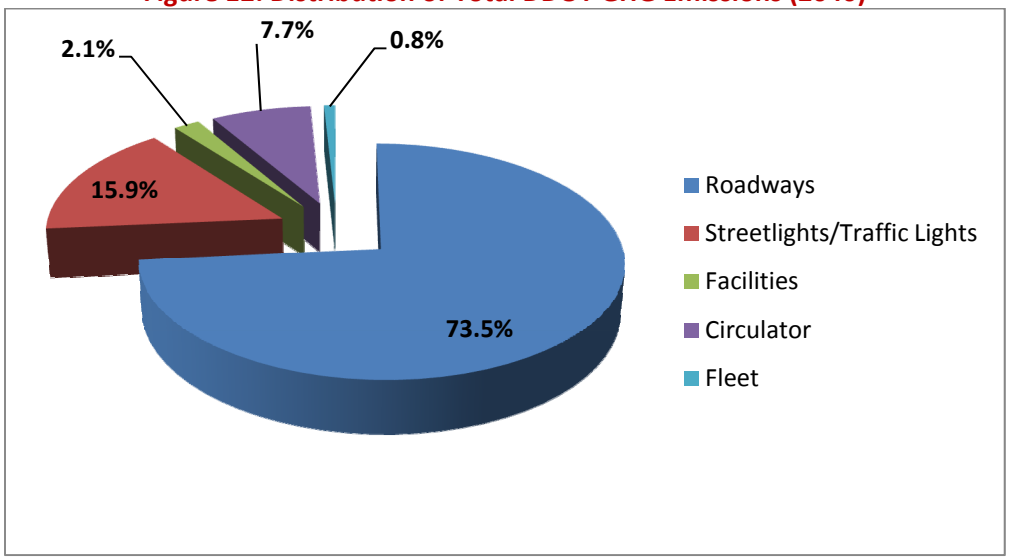
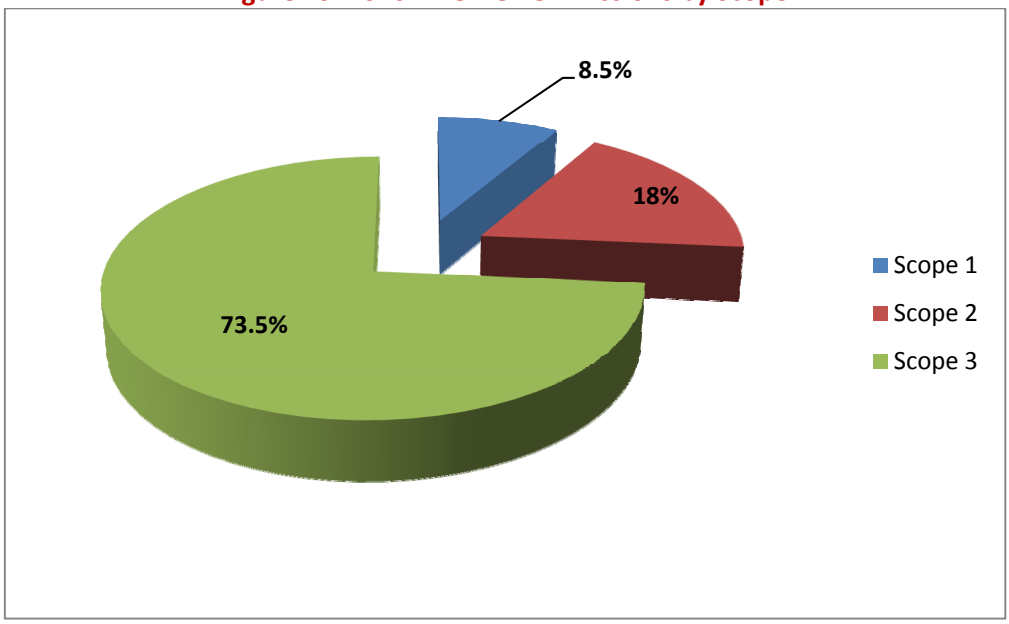


Figure 13: 2040 DDOT GHG Emissions by Scope



The GHG emissions from all DDOT assets and activities are projected to decrease in 2040, as compared to 2009, with the exception of the DC Circulator bus (see Figure 14). The planned expansion of the DC Circulator system would result in a spike in emissions in the future from those buses (see Figure 15). However, although large in percentage, the increased emissions from the expanded DC Circulator system are still a fraction of the emissions that are expected from vehicles on the roadway. Additionally, the growth of the DC Circulator bus system would result in less people using their cars for trips within the city; thereby resulting in further reduction in the future roadway network emissions.

Figure 14: Comparison of Baseline (2009) vs. Forecast (2040) GHG Emissions

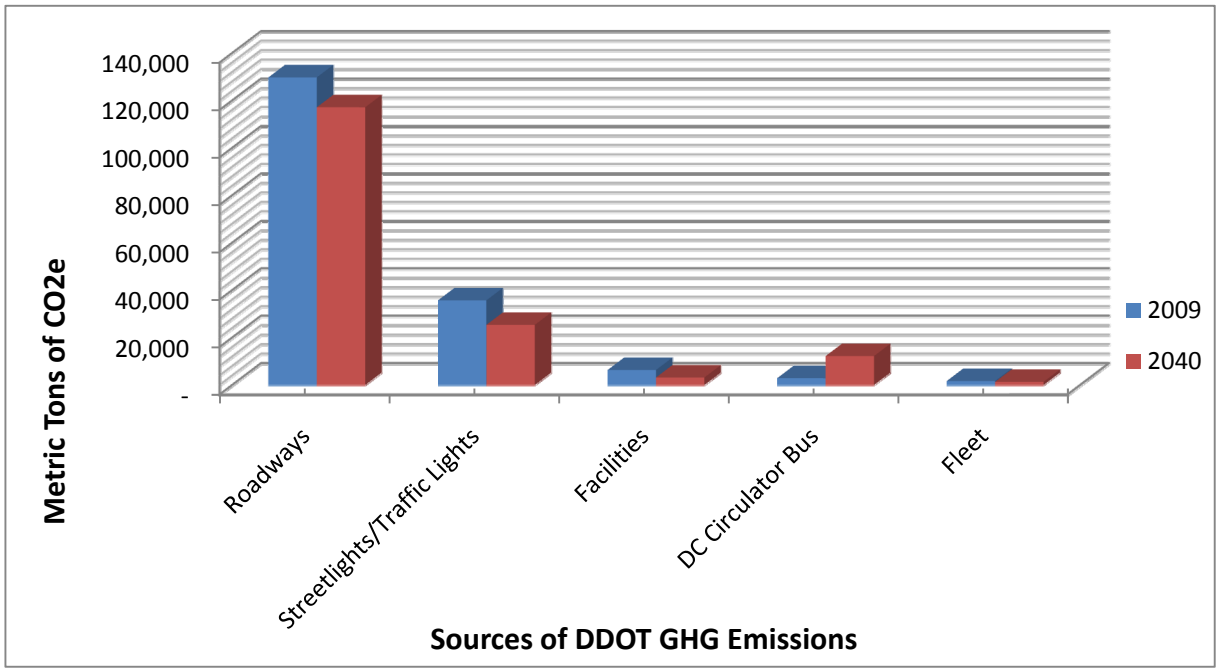
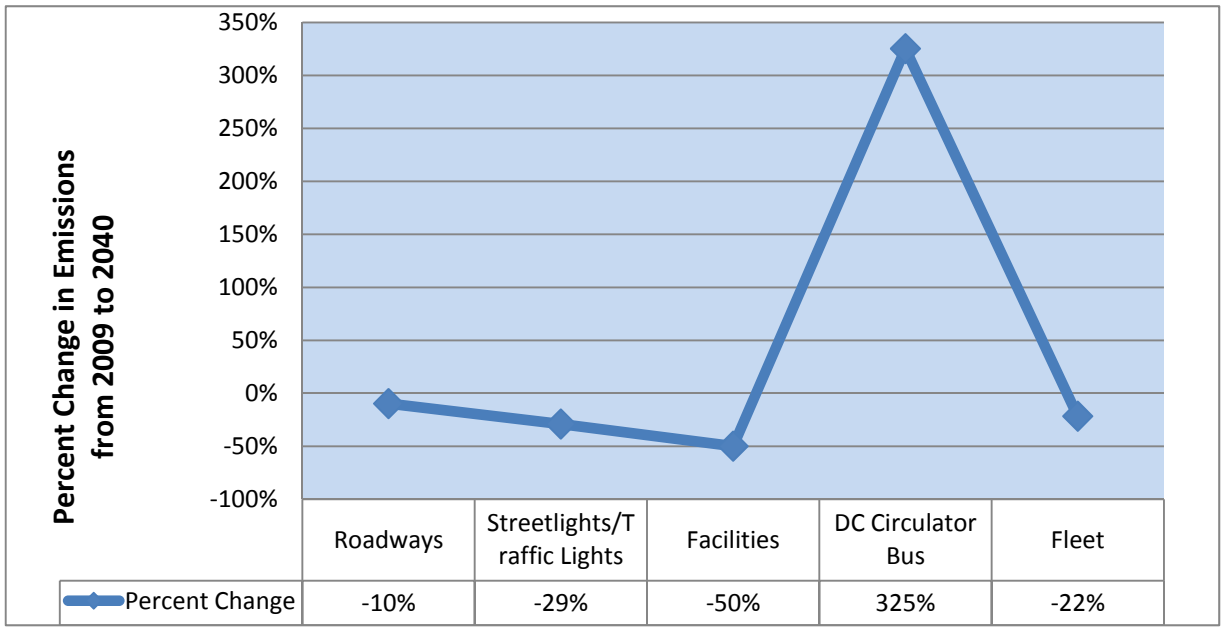


Figure 15: Change in GHG Emissions per Source by the Forecast Year



	Roadways	Streetlights/Traffic Lights	Facilities	DC Circulator Bus	Fleet
Percent Change	-10%	-29%	-50%	325%	-22%

Overall, the total DDOT GHG emissions in 2040 are projected to decrease by approximately 17,000 metric tons of CO_2e from baseline total: a potential 10 percent decrease. Much of this overall reduction predicted for the forecast year is due to DDOT environmental policies and energy saving initiatives that have been in place since 2009 as they affect street and traffic lights.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