

2006 - 2016

# GREENHOUSE GAS INVENTORY

★ ★ ★ DEPARTMENT  
OF ENERGY &  
ENVIRONMENT

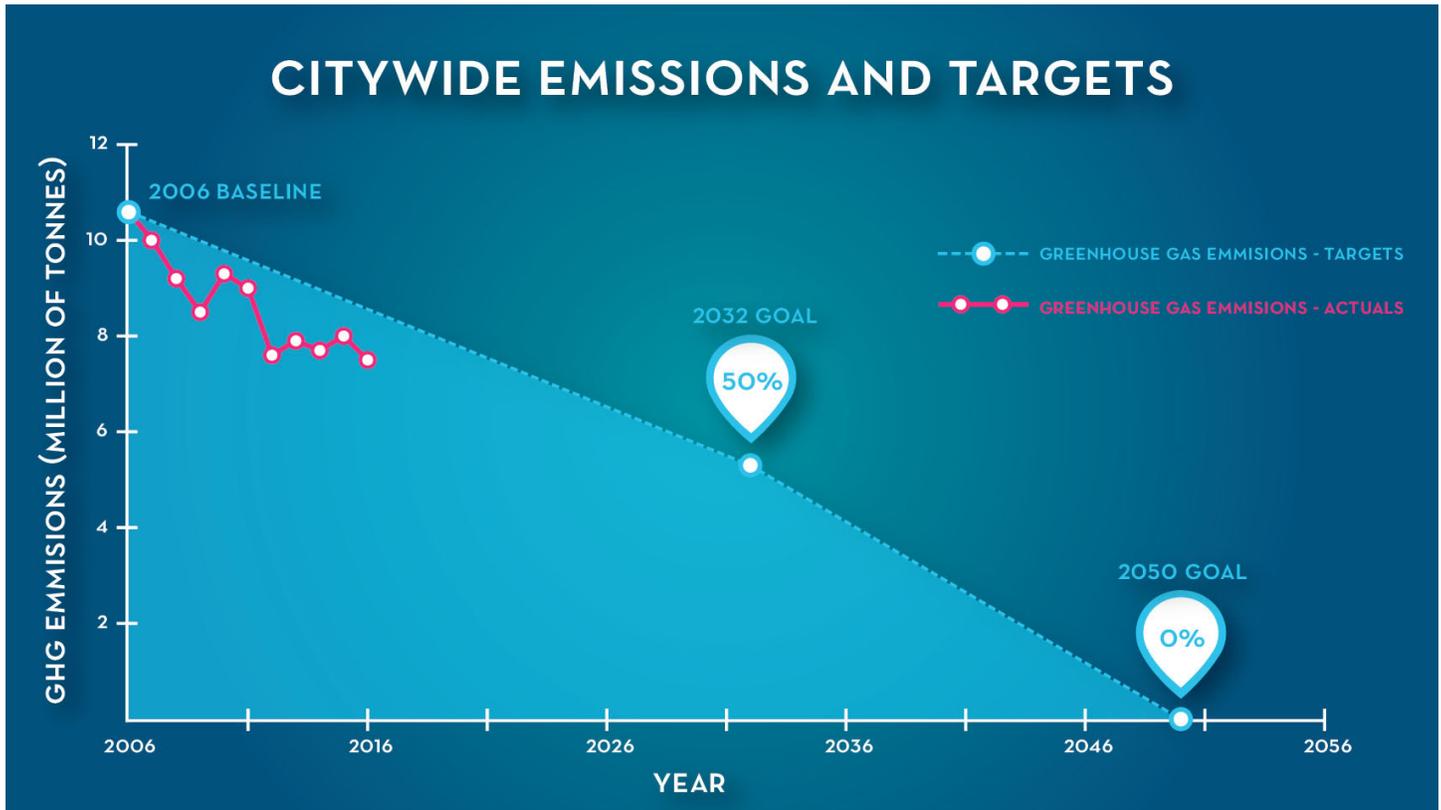
★ ★ ★ WE ARE WASHINGTON  
GOVERNMENT OF THE  
DISTRICT OF COLUMBIA  
DC MURIEL BOWSER, MAYOR

## EXECUTIVE SUMMARY

In 2016, the District’s citywide greenhouse gas emissions totaled 7.5 million metric tons of carbon dioxide equivalent. This is a 28% decrease since the city’s first inventory in 2006 and a 6% decrease since the last report in 2013. Key drivers behind the reductions since 2006 were an increasingly cleaner electric grid, reduced energy use intensity per square foot of building space, and increased vehicle fuel economy.

Similarly, greenhouse gases associated with District Government operations fell 24% since 2006 and 9% since 2013, for a total of 519,636 metric tons in 2016. These reductions were driven by lower emissions from buildings and facilities, partly due to the cleaner regional electric grid. Since the 2013 inventory, DC Water has also reduced its emissions and energy consumption thanks to its investment in onsite clean energy generation which produces enough power to meet a third of the plant’s needs.

The District is on track to meet its ambitious goals to halve emissions by 2032, and to become carbon neutral by 2050. However, we still have a long way to go. The District’s Clean Energy DC plan, finalized in 2018, calls for ongoing local action to cut energy use in buildings, shift to clean energy sources, and shift the way we move residents, employees, and goods in and around the city, all of which will be critical to meeting these long-term goals. The District’s annual inventory will continue to record progress as the city begins implementing Clean Energy DC.



## INTRODUCTION

In 2017, Mayor Bowser committed to making the District carbon neutral and climate resilient by 2050. As the District works with urgency toward a carbon-free future, a number of interim reduction targets ensure that we remain on track. The 2013 Sustainable DC plan established a goal to reduce emissions 50% below 2006 levels by 2032. This inventory shows that the District surpassed its 2015 target to reduce emissions by 20%, and is on track to meet its 35% reduction target by 2020. This report demonstrates the District's ability to grow without increasing its contribution toward global greenhouse gas emissions, but there is much more to do in order to achieve our climate targets.

Understanding the current sources of the District's emissions, and the drivers behind the District's reductions to date is important to helping shape our path forward. That is why the District regularly measures and reports its emissions. The District conducted its first greenhouse gas inventory for 2006, establishing the baseline against which subsequent emissions reductions are compared. Updated inventories followed annually beginning in 2009. This report, covering 2014-2016 (the District's sixth, seventh, and eighth inventories) provides an updated look at the emissions profiles over these three years. As data quality and accounting procedures have continued to improve since 2013, previous emission estimates have been revised where necessary in order to more accurately calculate and compare annual emissions. A more detailed account of these updates is provided in Appendix I.

Emissions are measured and reported according to leading national and international greenhouse gas reporting protocols. The citywide emission inventory follows the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) and the District Government operations inventory is calculated per the Local Government Operations Protocol (LGOP). This report summarizes both inventories, but because the data for these inventories is collected using separate protocols, the government operations inventory should be considered as overlapping, but not completely contained within the citywide inventory. The District also [reports annually to CDP](#) its greenhouse gas emissions as well as actions taken to reduce emissions and make the District more resilient.

## LOOKING AHEAD

In 2018 the Department of Energy & Environment (DOEE) released the [Clean Energy DC](#) plan which provides a roadmap to meeting our 2032 greenhouse gas emissions reduction goal, while simultaneously reducing energy consumption and increasing the proportion of renewable energy consumed in the city. Its recommendations focus on cutting energy use in our buildings, modernizing the energy system, and shifting our transportation system away from fossil fuels. The District is also implementing its [Climate Ready DC](#) plan, our strategy for adapting to a changing climate. Finally, DOEE released [Sustainable DC 2.0](#) in April 2019, an update to the original 2013 plan, which reaffirms the District's climate targets.

# CITYWIDE INVENTORY

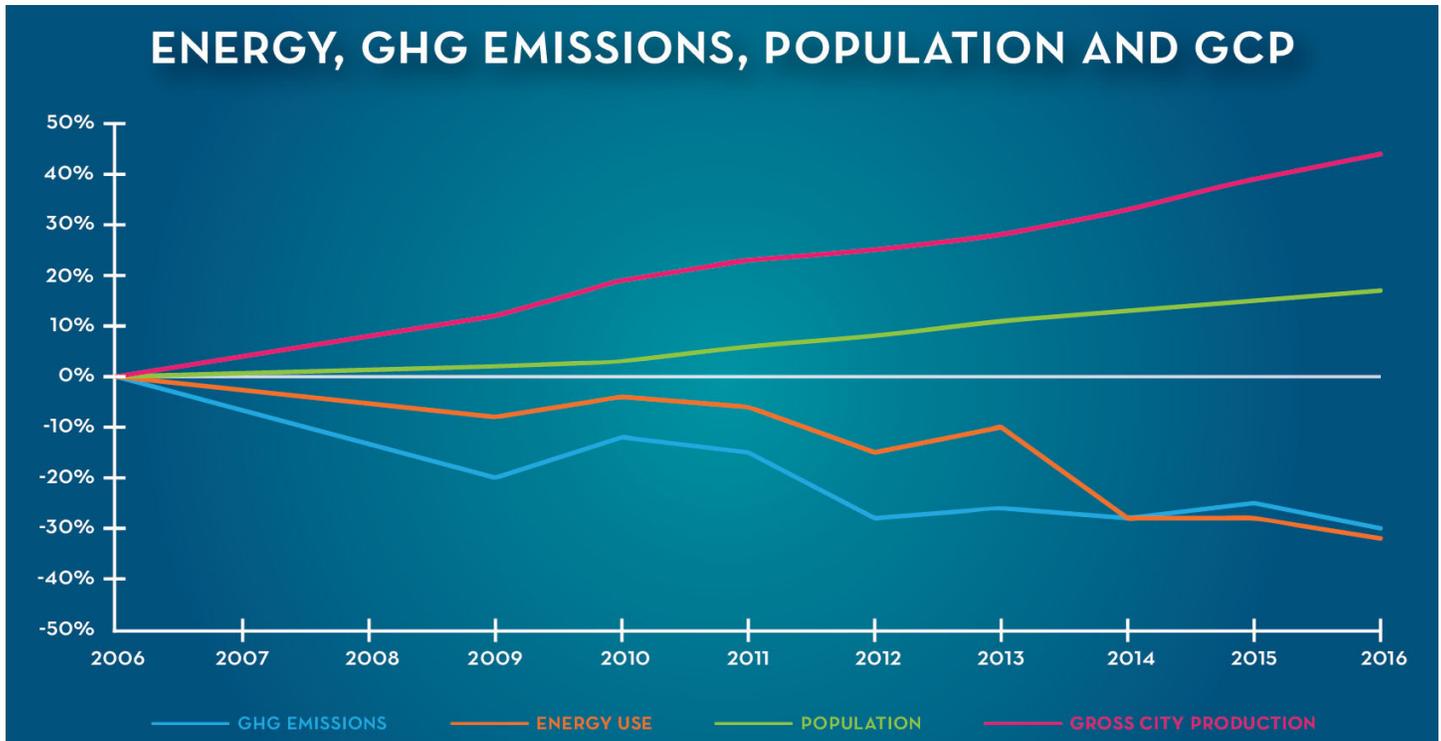
## TRENDS IN EMISSIONS & CITY GROWTH

In 2016, the District's citywide emissions totaled 7.5 million metric tons of carbon dioxide equivalent (MMtCO<sub>2</sub>e), or approximately 11 tons of CO<sub>2</sub>e per resident.

This represents a 28% decrease in citywide emissions and a 38% decrease in per capita emissions since 2006.



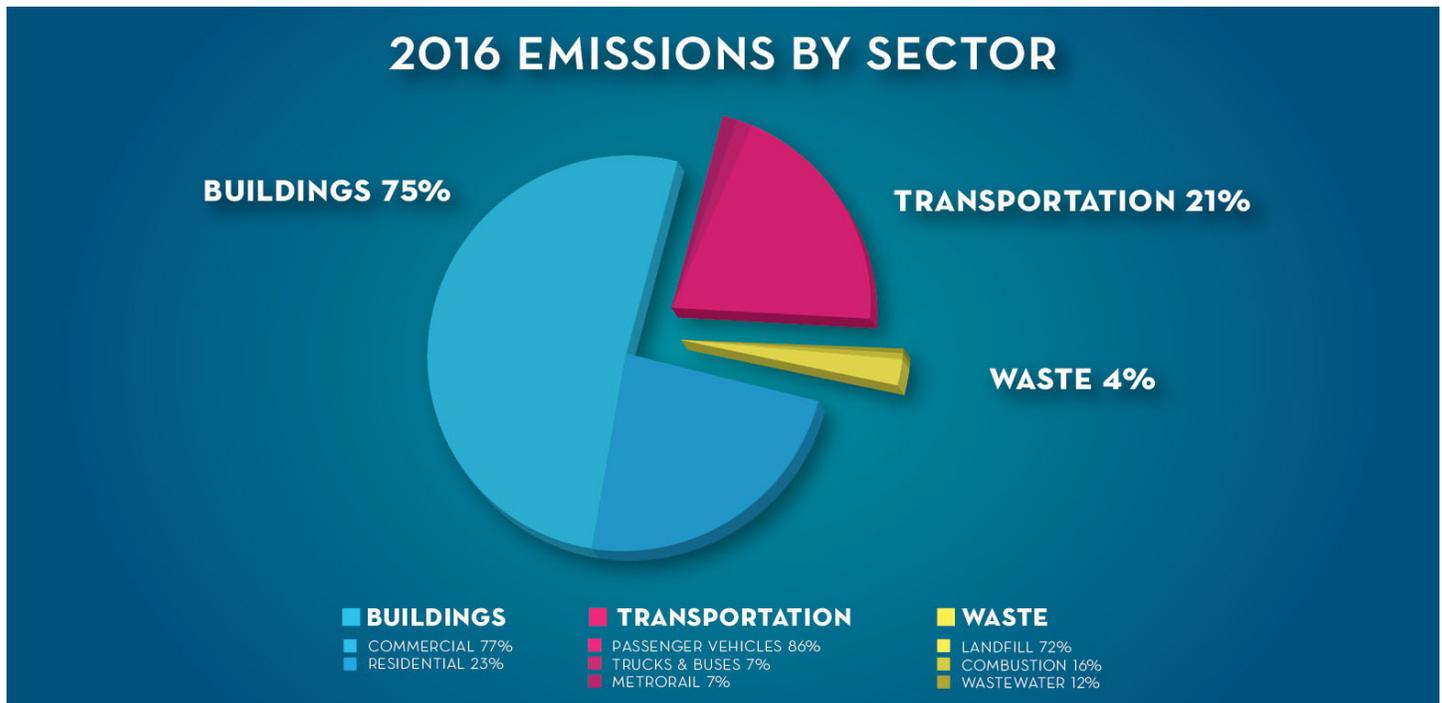
These reductions are particularly notable when factoring in the District's population and economic growth over the same period, 17% and 44% respectively. These trends show that District has decoupled its economic and population growth from its energy use and GHG emissions, demonstrating that future growth is possible while still reducing the city's contribution to global greenhouse gases. The data also shows that the District has passed its peak emissions level, which is another important milestone for meeting our 2050 goals. While these trends are encouraging, there is much more to do to achieve our climate targets which the District will address in its forthcoming carbon neutrality strategy.



## 2016 SNAPSHOT

The District's greenhouse gas inventory tracks emissions by both source and sector: sources refer to the fuels that produce energy, and sectors are the main energy-consuming areas of the economy. In the District, emissions come from three main sectors: buildings, transportation, and waste. In 2016, buildings continued to

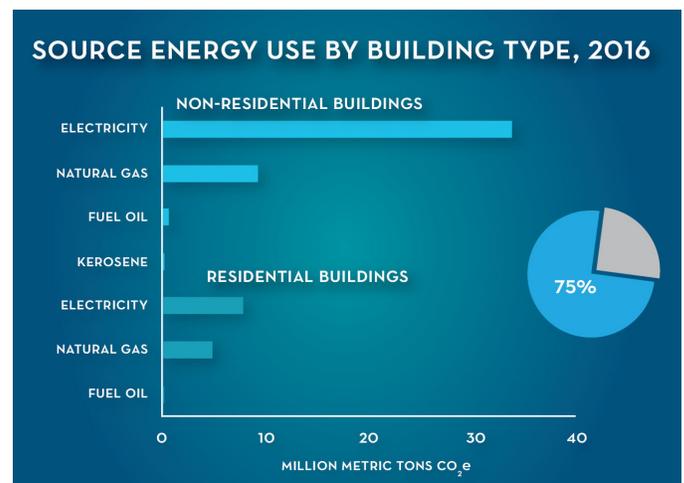
be the main driver of citywide emissions (75%) followed by transportation (21%) and waste (4%). Within these sectors, the main sources of emissions are electricity (57%), gasoline (19%) and natural gas (17%).



## BUILDINGS (STATIONARY) SECTOR

In 2016, 75% of citywide emissions came from buildings. This includes emissions from energy used to heat, cool, and power buildings in the District as well as energy lost in the distribution system, such as between a power plant and the buildings using electricity, or along the network of natural gas pipelines that feed the city. Of the total 5.6MMtCO<sub>2</sub>e emitted by this sector, 96% of emissions were a direct result of energy consumed in buildings, while the remaining 4% were from system losses – electricity grid losses and fugitive natural gas emissions. Overall, emissions from the building sector have fallen 31% since 2006 and 11% since 2013, even as total building floor area has grown by more than 7%.

Large commercial, institutional, and master-metered multifamily buildings contribute 77% of this sector’s emissions while residential buildings make up only 23%. Across all building types, electricity (74%) and natural gas (24%) are the main sources of emissions from buildings. Less than 2% of emissions come from using other fuels such as fuel oil and kerosene.

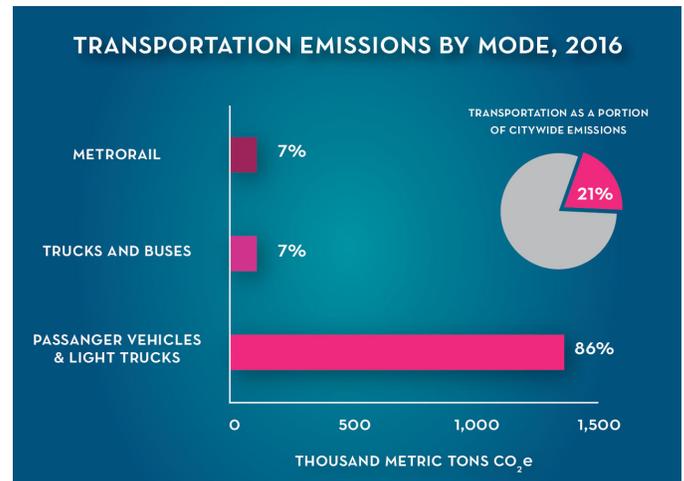


## TRANSPORTATION SECTOR

Fuel used for vehicle travel and transit is the second largest source of citywide emissions, accounting for 21% (1.58 MMtCO<sub>2</sub>e) of the total emissions in 2016. This represents a 19% decrease since 2006, but a marginal (less than 1%) increase over 2013. The District’s citywide inventory includes estimates of vehicle miles traveled (VMT) on District roads by personal vehicles, buses, and trucks, as well as the portion of electricity used by

the Washington Metropolitan Area Transit Authority’s (WMATA) Metrorail in the District.

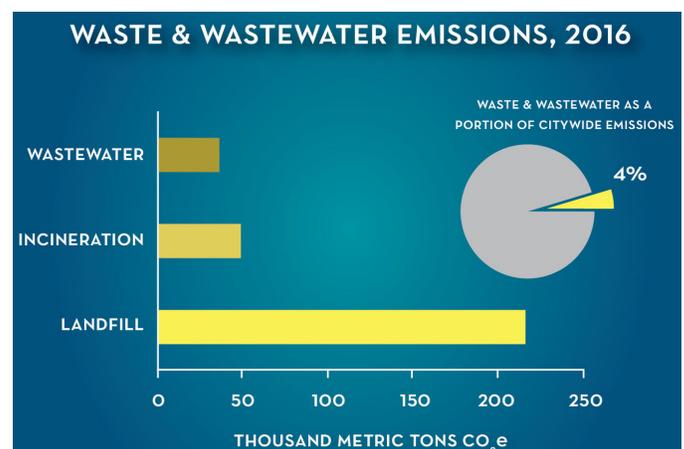
On-road transportation, particularly from passenger vehicles and light trucks, is the largest contributor of emissions from the transportation sector. Passenger vehicles and light trucks alone made up 86% of the transportation sector’s emissions, while heavy trucks and buses and Metrorail each accounted for 7% of emissions. The major sources of energy used in the transportation sector are vehicle fuels (gasoline and diesel) and electricity for the Metrorail.



## WASTE & WASTEWATER SECTOR

Treating and disposing of wastewater and solid waste generated in the District accounts for 4% (326,368 MtCO<sub>2</sub>e) of citywide emissions. Though there are no solid waste treatment facilities within the District, the citywide inventory accounts for emissions associated with landfilling, incinerating and composting waste generated in the District that is not reused or recycled. In 2016, 89% of this sector’s emissions came from the treatment of solid waste -- 74% from landfilling, 15% from combustion, and <1% from composting. The remaining 11% of emissions are attributed to the processes used to treat wastewater at DC Water’s Blue Plains Advanced Wastewater Treatment Plant. The facility’s energy use, however, is captured in the building sector.

Since 2009 the amount of solid waste generated per capita has remained nearly flat, however emissions have increased over time as the District’s population has grown, the materials in the waste stream have changed, and global markets have changed what is recyclable. Though the emissions inventory only accounts for final disposal of materials (as opposed to all the energy used to create and transport those materials) waste is an important sector, which the District has acknowledged through its [Zero Waste](#) efforts. To track its progress toward its goal of achieving 80% waste diversion from landfills and incinerators by 2032, the Office of Waste Diversion now publishes an annual report on the diversion rate, which was 22.98% in 2016. As the city increases the percent of materials that are reused, recycled, and composted, emissions from the waste sector will fall.



## DRIVERS OF CHANGE

Analyzing factors that have driven changes in the District’s greenhouse gas emissions since 2006 allows us to look beyond year-on-year weather fluctuations to identify longer-term trends and inform our continued path forward. The table below highlights the factors that have both increased and decreased emissions over time. The following section discusses the three biggest drivers of change over the last 11 years: shifts in the fuel sources powering our regional electrical grid (70%), reduced energy consumption in non-residential buildings (28%), and increased vehicle fuel economy (14%).

MAJOR DRIVERS OF EMISSIONS CHANGE 2006 TO 2016	% OF EMISSIONS REDUCTIONS SINCE 2006**	
Greening the Electrical Grid	70%	↓ Factors reducing emissions
Reduced Non-Residential Energy Consumption	28%	
Increased Vehicle Fuel Economy	14%	
DC Sustainable Energy Utility Programs	5%	
Decreased Per Capita VMT	5%	
Warmer Summer	-15%	↑ Factors increasing emissions
Floor Area Growth	-13%	
Colder Winter	-7%	

\*\* Cumulative reductions exceed 100% because the combined weather impacts of a colder winter and warmer summer would have increased emissions 21% over the 2006 baseline if not for these factors.

## GRID CHANGES

Changes to the regional electrical grid were by far the most significant factor driving emissions reductions between 2006 and 2016. This is largely due to the increasing share of electricity generated by natural gas power plants and the corresponding decline in power generation from coal-fired power plants power plants shifting from burning coal to natural gas, which has reduced the greenhouse gas emissions associated with each kilowatt of electricity used in the city. The impact of the grid is most evident in the 31% decrease in emissions from the building sector, but it also impacts emissions from the transportation sector as Metrorail also uses electricity. As the share of electric vehicles and buses increases, the carbon intensity of our electricity supply will play a critical role in our citywide emissions.

As DC imports nearly all of its electricity from the larger regional electric grid, our direct control over the mix of generation sources is limited. However, local action, combined with efforts in neighboring states, will continue to shift generation towards cleaner, less carbon intensive sources including wind and solar energy. The District passed legislation in December 2018 to further strengthen its Renewable Portfolio Standard (RPS) to require 100% of electricity supplied to District come from renewable energy sources by 2032. That legislation also requires 10% of the renewable energy come from locally-sited solar by 2041<sup>1</sup>. By April 2017, there were 2,769 solar photovoltaic systems and 110 solar thermal systems with a capacity of 33.8 megawatts (MW) approved by the District of Columbia Public Service Commission<sup>2</sup>. Further, a number of District policies and programs are helping to deploy more local solar. In 2015, the Department of General Services executed an 11 MW power purchase agreement to install solar on over 50 District government-owned sites. Other local policies enable community solar projects in the city, and the Solar For All program will provide 100,000 low-income households the benefit of solar to lower their bills 50% by 2032. While solar is still a small fraction of the District's overall energy use, distributed solar will continue to grow as required by the RPS, displacing an increasing amount of energy use and carbon emissions in future.

1. Clean Energy DC Omnibus Amendment Act of 2018, signed on January 18, 2019. Available at <http://lims.dccouncil.us/Legislation/B22-0904>

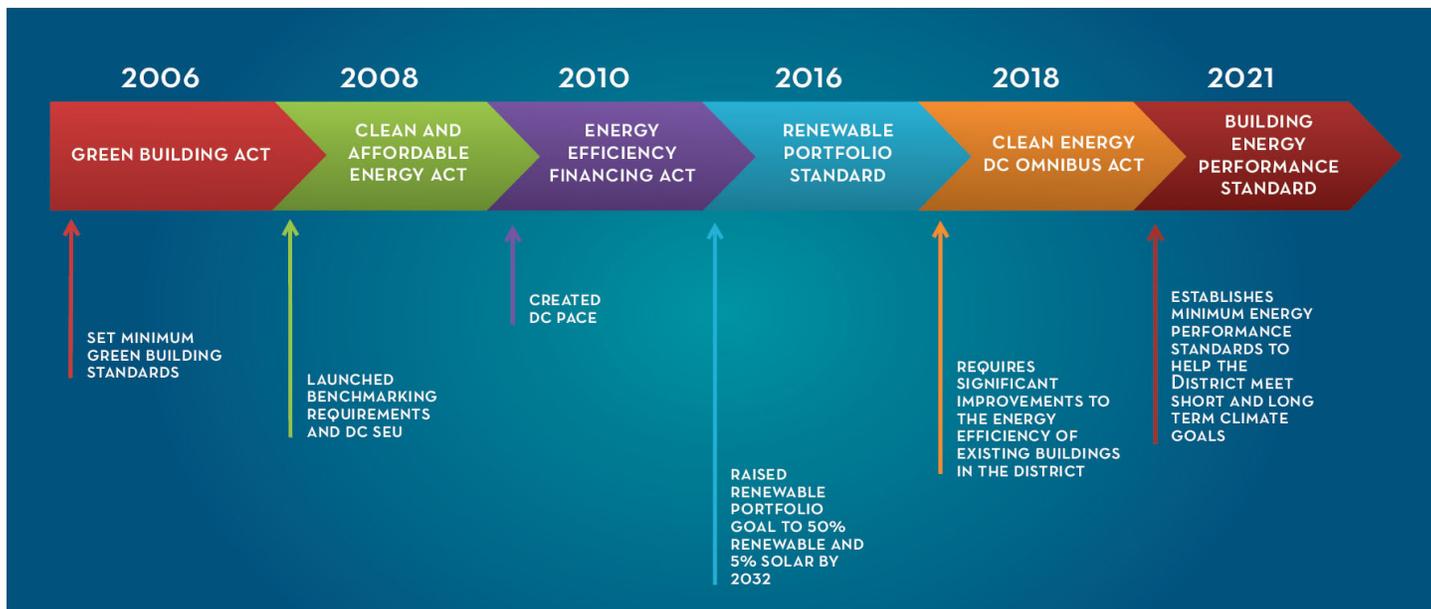
2. District of Columbia Public Service Commission, Report on the Renewable Energy Portfolio Standard for Compliance Year 2016 available at <https://dcpsc.org/PSCDC/media/Images/Renewable-May-2017.pdf>

## DECREASED NON-RESIDENTIAL BUILDING ENERGY USAGE INTENSITY

In addition to our energy mix getting cleaner, buildings are more efficient and use less energy per square foot which has helped to decrease emissions since 2006. In a city growing as quickly as the District, this is an important factor that is driven by a combination of green building policies and programs (outlined in **Figure 1**, below) including local building and energy codes, energy benchmarking requirements, and a forthcoming building energy performance standard (BEPS) which will launch in 2021.

Firstly, DOEE has been publically disclosing energy and water consumption for all private residential and commercial buildings 50,000 square feet and larger, and all public buildings 10,000 square feet and larger on an annual basis since 2014. Buildings that benchmarked energy use have become more efficient. Private buildings decreased their weather-normalized energy use by 4.5% between 2013 and 2016, and public buildings saw an 8.3% decrease between 2012-2016<sup>3</sup>. Additionally, the DC Sustainable Energy Utility (DC SEU), established in 2011, provides various incentives to help buildings save energy and install solar. Since 2013, the DC SEU's programs delivered electricity and natural gas savings that were responsible for 5% of total citywide emissions reductions between 2006 and 2016. This impact will continue to grow as the DC SEU serves more clients and because buildings that are made more efficient today will continue to save energy and avoid emissions for the lifetime of the energy efficiency measures that are installed. Together, the District's green building policies and incentives to pursue energy efficiency have made the District a leader in ENERGY STAR certified buildings. Since 2014, ENERGY STAR certified buildings have saved approximately 425 million dollars and prevented greenhouse gas emissions equivalent to that of 235,000 homes. Given the large share of emissions from building energy use, continued progress to improve the efficiency of our buildings is critical to achieving our goals. Knowing that, the District recently passed legislation to implement a building energy performance standard which will target existing buildings for energy efficiency improvements to further the city's progress toward its 2032 and 2050 goals.

**Figure 1. Key Green Building Policies in the District**



3. District Department of Energy & Environment, Green Building Report 2014 – 2016, available at [https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service\\_content/attachments/Green%20Building%20Report\\_2014-2016\\_FINAL.pptx](https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/Green%20Building%20Report_2014-2016_FINAL.pptx)

## IMPROVED VEHICLE FUEL ECONOMY

Across the country, vehicle fuel economy -- particularly for passenger vehicles and medium-duty trucks and buses -- has improved which has helped to drive transportation sector emissions in the District down 19%. While these changes are a result of technological improvements and national fuel economy standards, the District has supported efforts to strengthen tailpipe emissions regulations and has adopted the California emissions standards which will require all cars and light trucks sold to average more than 50 miles per gallon by 2025.

While improved fuel economy is an important driver of emissions reductions, changing the way we travel and reducing the total number of miles driven on the District's roads will also be critical to meet the District's long-term climate goals. As the Washington metropolitan region has grown in population, so have vehicle miles traveled (VMT), which is up more than 7% since 2006. However, VMT per capita has decreased (8% since 2006) and policies and programs that support increased use of alternative transportation will be critical to continued reductions in this area. In 2016, an estimated 37% of residents used public transportation for their commute, with 13% walking and roughly 5% biking<sup>4</sup>. Similar to past years, an estimated 36% of city households did not own a car, down 1% from 2013<sup>5</sup>. The continued rise in biking has been supported by the expansion of bicycling infrastructure in the District, including the installation of more than 80 miles of bike lanes, in addition to the expansion of the Capital Bikeshare program, which now has 278 stations in the District alone<sup>6</sup>. Capital Bikeshare contributes to reducing emissions by replacing vehicle trips and helping to expand access to transit as members ride bikes to and from Metrorail stations and bus stops. Given transportation's significant contribution to the city's emissions, deep cuts will be needed to meet the District's greenhouse gas reduction targets. The District's Clean Energy DC Plan lays the groundwork to support electric vehicle (EV) readiness -- including through the adoption of an EV-ready building code and an EV-ready parking lot requirement, among other proposed policies. The Sustainable DC 2.0 plan sets goals for reducing commuter trips made by car to 25%, and increasing commutes using public transportation (50%) and by biking and/or walking (25%) by 2032.

---

4. United States Census American Community Survey, 5-year Estimates for American Commuting Characteristics by Sex, 2012-2016, available at <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>

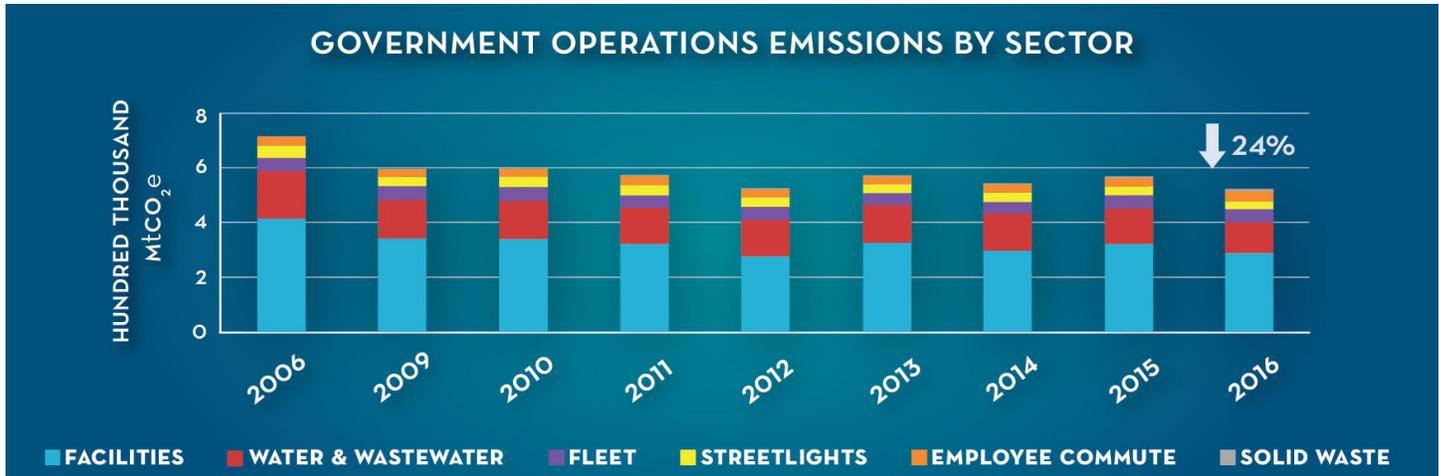
5. United States Census American Community Survey, 5-year Estimates for Physical Housing Characteristics for Occupied Housing Units, 2012-2016, available at <https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>

6. Small, Andrew. "How Washington, D.C., Built a Bike Boom," CityLab, available at <https://www.citylab.com/transportation/2017/12/how-washington-dc-built-a-bike-boom/548903/>

# DISTRICT GOVERNMENT OPERATIONS INVENTORY

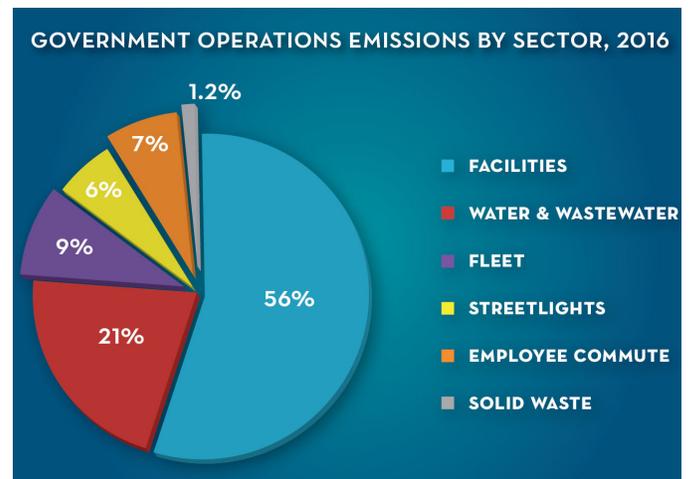
## SUMMARY & BACKGROUND

While the District's key climate targets are focused on citywide emissions, the city also calculates an annual inventory for greenhouse gases associated with government operations. This inventory captures emissions associated with District government buildings, solid waste, vehicle fleet, commuting choices by its employees, streetlights and traffic lights, and wastewater treatment. In 2016, emissions from District government operations totaled 519,636 MtCO<sub>2</sub>e, 24% below the 2006 baseline.



Like the citywide inventory, emissions from government operations are mostly driven by building energy consumption (56%). Wastewater treatment from the Blue Plains Advanced Wastewater Treatment Facility is the second largest source, making up 21% of government operation emissions. Emissions from the District's vehicle fleet are the third largest source (9%), with employee commuting (7%) and streetlights (6%) close behind.

New for the 2016 inventory is an adjusted emissions figure to reflect the renewable electricity purchased by the District's Department of General Services (DGS) through their wind and solar power purchase agreements (PPAs) and through the purchase of renewable energy certificate (RECs). These purchases cover two thirds of the electricity consumed by District government and have resulted in a 45% decrease since 2006. A detailed breakdown of the calculations using the Scope 2 Guidance from the GHG Protocol's Corporate Standard can be found in Appendix I.

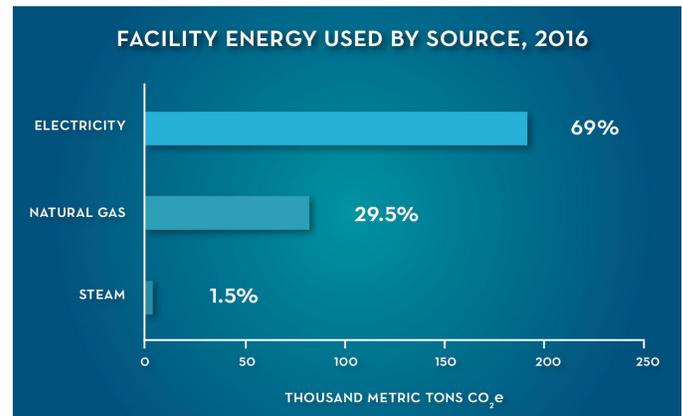


## GOVERNMENT FACILITIES

Just over half of the District Government's emissions come from the energy used by the buildings and facilities owned by the District. In total, the energy used in buildings produced 278,494 MtCO<sub>2</sub>e in 2016. This includes energy used to heat, cool, and power a range of buildings owned or controlled by the District, including schools,

government offices, recreation centers, libraries, public housing, fire and police stations, and the University of the District of Columbia. Per the inventory protocol which we follow, this does not include leased facilities or energy used at wastewater treatment facilities, which are accounted for separately.

Electricity is the leading source of emissions (69%), followed by natural gas (29.5%). Steam makes up only a small share of emissions (<2%) and includes several District government facilities that are part of the U.S. General Services Administration's Central Heating Plant district energy system.



Emissions from District government buildings have decreased 24% since 2006, and 10% compared to 2013.

As in the citywide inventory, the shift toward cleaner electricity generation in the region has significantly cut emissions in this sector. At the same time, the District has improved the efficiency of its buildings. Data from the energy benchmarking program – which includes all District owned properties 10,000 square feet and larger – has shown that public buildings cut weather-normalized site energy use intensity 8.3% from 2012 to 2016. As the District government continues to push its operations to lead by example, the District has a goal to reduce energy use in its buildings 50% by 2032 and to maximize the installation of renewable energy technology at those sites.

## WATER & WASTEWATER

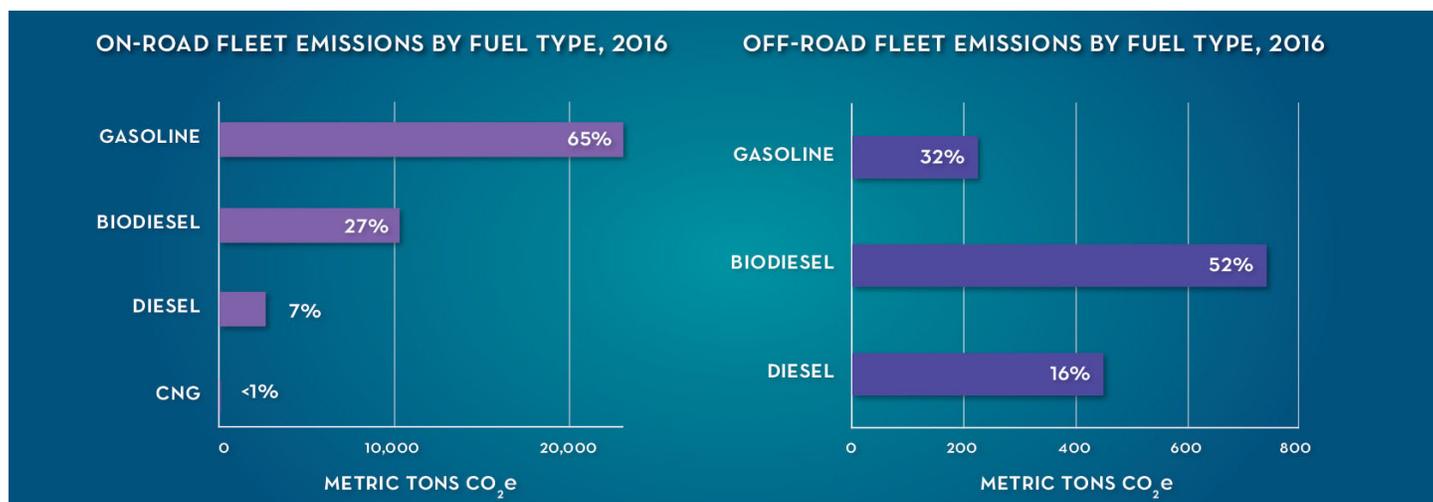
DC Water's operations to distribute, collect, and treat drinking water and wastewater make up nearly a quarter of the District government's emissions. The Blue Plains Advanced Wastewater Treatment Plant serves more than 2.1 million customers in the metropolitan Washington region, not just District residents, and is the single largest energy user in the city. Because the plant is sited within the city, this inventory accounts for all emissions associated with its operations, which totaled 109,688 MtCO<sub>2</sub>e in 2016. The vast majority (63%) of emissions from come from the electricity used to operate the pumping and water treatment equipment, and from losses associated with the transmission of electricity to the facility. Emissions from the wastewater treatment processes account for 29% of emissions, while natural gas makes up the remaining 8%.

Since 2006, DC Water's emissions have fallen 36%, driven by a 57% decrease in emissions from electricity. That drop is a result of both the cleaner regional electric grid, but also a 35% decrease in electricity consumption largely due to the facility's anaerobic digester, which converts collected sewage into methane gas that is then cleaned and used to generate power. This groundbreaking project came online in 2015 and produces about 10 megawatts of electricity annually, approximately a third of the plant's power needs.

## VEHICLE FLEET

The District's vehicle fleet includes more than 7,000 vehicles and pieces of equipment ranging from on-road vehicles like police motorcycles, fire trucks, and garbage and recycling trucks to off-road construction and landscaping equipment. As shown below, these vehicles run on gasoline, diesel, compressed natural gas,

and ethanol and biodiesel. The fuel used by the District's vehicle fleet accounts for 9% of total government emissions, including a small amount of emissions from refrigerants used in those vehicles.



Vehicle fleet emissions have fallen 14% since 2006 due to more efficient vehicles, efforts to reduce vehicle trips, and the use of cleaner fuels. Emissions from the fleet peaked in 2010 when the Department of Public Works (DPW), which manages the District's vehicle fleet, began a comprehensive greenhouse gas mitigation program. Since then, DPW has employed a number of strategies to reduce emissions, including right-sizing, i.e. requiring compact, passenger vehicles unless there is a specific programmatic need for a larger vehicle, and one-for-one replacement, i.e. one vehicle must be removed from the fleet for each new vehicle purchased, to improve the fleet's fuel efficiency and reduce vehicle trips. To further reduce fleet size and improve efficiency, the District has a car-sharing service (DC Fleet Share), and has moved toward alternative fuel usage for its more than 2,000 biodiesel and CNG vehicles in the District's fleet. The agency continues to work to maximize fuel efficiency, including through the introduction of electric vehicles to the fleet.

## TRANSIT FLEET

The District Department of Transportation (DDOT) owns the DC Circulator bus system whose six routes operate primarily inside the District's boundaries. Beginning in 2015 data became available to measure the fuel consumption for the Circulator bus fleet, and emissions for 2015 and 2016 are reported in this inventory. In 2016, DC Circulator buses emitted 4,585 MtCO<sub>2</sub>e, less than 1% of total government operations emissions. Future inventories will continue to report on these emissions, and will include electricity usage for the Circulator's new all battery-electric buses put into service in 2018. In addition, the DC Streetcar began operating in February 2016, and its electricity usage is reported in this inventory for 2016 (935 MtCO<sub>2</sub>e).

## EMPLOYEE COMMUTE

The District employed more than 37,800 staff in 2016. Based on the last employee survey on commuting habits in 2009, an estimated 40% of District employees drive to work, either alone or in carpools. The fuel used by employees who drive to work accounted for 7% of the District Government's emissions in 2016. As the District works to achieve its new Sustainable DC 2.0 targets of reducing commutes by car to 25% by 2032, updating the employee survey would allow for an analysis of shifts in commuting behavior among employees, for example, an increase in the share of employees taking public transit or bicycling.

## STREET & TRAFFIC LIGHTS

There are more than 75,000 streetlights and traffic signals across the District, which accounts for 6% of the government's total emissions. Since 2006, emissions from streetlights and traffic signals have fallen 32% (11% since 2013), primarily due to the shift toward cleaner electricity generation. The amount of electricity consumed by streetlights and traffic signals has increased very slightly: just 1% since 2013. Currently there are a number of inefficient bulb technologies used across the District, only 5% of these lights are equipped with more efficient light-emitting diode (LED) bulbs. The District is working to modernize these lights and as they are replaced, future inventories will reflect the resulting reduction in energy use and emissions from this sector.

## SOLID WASTE

The disposal of solid waste generated by District Government operations including agencies and schools accounts for 1% of the government's overall emissions. Emissions have increased since 2013 in part due to a change in the waste stream and strains on the regional disposal capacity forcing some additional material to landfill.

In 2016, 64% of the trash collected from District Government operations was sent to landfill; the remainder (36%) was combusted. In 2014, the District passed the Sustainable Solid Waste Management Amendment Act which requires the District to develop a plan to divert 80% of waste from landfills and waste-to-energy. In 2016, the District Government Operations Diversion Rate (that is, diversion from trash collection and transport) was 15.96% -- down from 17.05% in 2015<sup>7</sup>.

---

7. District of Columbia Department of Public Works, Solid Waste Diversion Progress Report: Fiscal Year 6 Data Addendum, available at [https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page\\_content/attachments/Waste%20Diversion%20Report-%20FY%2016%20Addendum.pdf](https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page_content/attachments/Waste%20Diversion%20Report-%20FY%2016%20Addendum.pdf)

## APPENDIX I – METHODOLOGY

### UNCERTAINTY

The inventory is compiled using measured data, projections, models, and, where data is unavailable, best estimates. The inventory is regularly revised as new and better data become available, as models are improved, and as international standards and guidance evolve. For these reasons, longer-term trends are likely more reliable than absolute numbers or year-to-year changes.

### CITYWIDE INVENTORY

This report is the first following the Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC). Previous inventories had followed guidance from ICLEI – Local Governments for Sustainability, C40 Cities Climate Leadership, and the World Resources Institute. Each previous inventory has been updated to reflect the changes in moving to the GPC, including accounting for fugitive emissions from the natural gas supply system, accounting for grid loss in the electricity system by sector, and reporting the ethanol content of gasoline as a separate biogenic source of emissions. The District reports at the GPC BASIC level which includes scope 1 and scope 2 emissions from buildings and transportation, and scope 1 and scope 3 emissions from waste. These scopes distinguish between emissions that occur within the District's boundaries and those that occur outside the District but are attributed to activities within the city.

- Scope 1: emissions within the District
- Scope 2: emissions occurring as a result of the use of grid-supplied electricity within the District
- Scope 3: all other emissions that occur outside the city boundary as a result of activities taking place within the District

Data sources and the methodology used to calculate emissions for each sector are described below. The District's GHG inventories are reported in carbon dioxide equivalents (CO<sub>2</sub>e) which is a universal unit of measurement that accounts for the global warming potential (GWP) of different greenhouse gases. CO<sub>2</sub>e for all years is calculated using the GWP for methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) determined by the International Panel on Climate Change (IPCC) 5th Assessment.

The District's inventory data, including emissions factors used to calculate the CO<sub>2</sub>e figures can be accessed online at: [doee.dc.gov/service/greenhouse-gas-inventories](https://doee.dc.gov/service/greenhouse-gas-inventories)

### BUILDINGS (STATIONARY) SECTOR:

Electricity and natural gas consumption by sector was provided by Pepco and Washington Gas respectively to the Metropolitan Washington Council of Governments (MWCOCG) as part of an annual energy survey. Fuel oil and kerosene sales were downloaded from the U.S. Department of Energy's Energy Information Administration (EIA) and include off-road fuels used for construction equipment. Emissions from grid-supplied electricity were calculated using emission factors and grid loss estimates from the U.S. Environmental Protection Agency's (EPA) [Emissions & Generation Resource Integrated Database \(eGRID\)](#) for the RFC East subregion. Fugitive emissions

from the natural gas supply system were provided by Washington Gas for 2014-2016, based on data on the pipeline system in the District that aligns with their annual greenhouse gas reporting to the EPA. Previous inventories, however, were calculated using a default national leakage rate, therefore figures are not comparable between 2006-2013 and 2014-present. The District does not have any industry, agriculture, forestry or mining so emissions reported for the Stationary sector are limited to those associated with building energy use.

## **TRANSPORTATION SECTOR:**

The Washington Metropolitan Area Transit Authority (WMATA) provided data on electricity used for traction power, as well as station usage. Where specific data was not available for only the usage inside the District, we used the District's share of WMATA's budget responsibility as a proxy for its responsibility in energy usage (33.3% in 2014; 33.4% in 2015-2016). As with buildings, transmission losses in the electrical grid were calculated by multiplying electricity usage for Metro by the eGRID factor for the RFC East region.

For on-road transportation, MWCOC generated estimates of vehicle miles traveled (VMT) on District roads, by vehicle type, using the 2016 Constrained Long Range Plan, Round 9.0 Cooperative Forecasts, Version 2.3.66 travel demand model, 2014 Vehicle Registration Data, and EPA's MOVES2014a model.

## **WASTE & WASTEWATER:**

The District Department of Public Works (DPW) provided data on waste collected by their residential curbside collection program, and the final disposition of the materials collected. Larger properties (4+ units) and commercial properties are not served by DPW's curbside service, and instead employ private waste haulers. That data has not been available to DPW historically, but will be shared starting for 2018. Given the information available, waste data presented in all inventories to date has been estimated based on an assumption that the DPW-managed waste stream is 50% of the total waste generated in the District, and that 100% of the privately-hauled waste has been sent to landfill. As DPW receives hauling data starting for 2018, inventory calculations will be updated to incorporate the new data.

Emissions data for the treatment of wastewater at the Blue Plains Advanced Wastewater Treatment Facility (Blue Plains) was provided by DC Water. This includes nitrous oxide emissions resulting from the denitrification process, the use of methanol in denitrification, and effluent discharge.

## GOVERNMENT OPERATIONS INVENTORY

The District continues to report its emissions from government operations using the Local Government Operations Protocol (LGOP) and uses ICLEI's Clear Path online account software to calculate emissions. As with the citywide inventory, emissions are reported in carbon dioxide equivalents (CO<sub>2</sub>e) which is a universal unit of measurement that accounts for the global warming potential (GWP) of different greenhouse gases. CO<sub>2</sub>e for all years is calculated using the GWP for methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) determined by the International Panel on Climate Change (IPCC) 5th Assessment.

New for 2016: Using the [GHG Protocol's Scope 2 guidance](#), the 2016 inventory accounts for DGS' renewable electricity purchases. Per protocol guidance, the District reports both a location-based figure, which calculates emissions based on the makeup of the electric grid that feeds the city, and a market-based figure, which takes into account certified renewable energy purchases made by District government. This was calculated using the data on electricity usage by District buildings and facilities (see paragraph above), Green-e certified purchases of Renewable Energy Certificates (RECs) from DGS, emissions factors from EPA's eGRID for the RFC East subregion, and 2016 Green-e energy residual mix emissions rates for the RFC region.

	ELECTRICITY CONSUMPTION (MWH)	EMISSIONS FACTOR (CO <sub>2</sub> e/MWh)**	CALCULATED EMISSIONS (MtCO <sub>2</sub> e)
<b>Location Based</b>	836,452	.3439	289,150
<b>Market Based</b>	836,452		
	561,049 - REC purchases		
	275,403 – Residual Emissions	1,248.99	156,026
<i>Difference</i>			-46% due to green electricity purchases

\*\* Location-based emissions factors are based on the IPCC 5th Assessment. Market-based residual emissions factors are from Green-e's [2016 Residual Mix Emissions Rates](#) for the RFC region.

## BUILDINGS & FACILITIES

The government operations inventory captures energy used by District-owned facilities, as well as those operated by instrumentalities of the District government, including the District of Columbia Housing Authority, Events DC, and the University of the District of Columbia. Data for District-owned facilities was provided by the District's Department of General Services (DGS) and the District of Columbia Courts. Emissions from grid-supplied electricity and associated grid losses were calculated using the emissions factors from eGRID factors for the RFC East subregion, the same as were used for the citywide inventory.

## STREETLIGHTS & TRAFFIC SIGNALS

Electricity usage for streetlights and traffic signals was provided by the District Department of Transportation (DDOT). Emissions from grid-supplied electricity and grid losses were calculated using the emissions factors from eGRID for the RFC East subregion.

## SOLID WASTE

Solid waste generation data was provided by the Department of Public Works (DPW) and DGS using data collected at the District's waste transfer station and disposition information from DPW's [FY16 Waste Diversion Report Addendum](#).

## WATER & WASTEWATER

DC Water provided data for its energy usage to operate the drinking water, sewer, and wastewater treatment systems, as well as emissions from the wastewater treatment process (denitrification, use of methanol, and effluent discharge) which mirror the process emissions figures used in the citywide inventory.

## VEHICLE FLEET

DPW's Fleet Management Administration conducts an annual inventory and provides data on mileage and fuel consumption for all vehicles and equipment used by District agencies, including Fire & Emergency Management Services, the Metropolitan Police Department, and DC Public Schools. Fugitive emissions from the use of refrigerants are based on average leakage rates by vehicle as provided by the ICLEI LGOP.

## TRANSIT FLEET

DDOT provided information on VMT and diesel fuel usage by its fleet of DC Circulator buses for 2015 and 2016. DDOT also provided information on electricity used to power the DC Streetcar for 2016. Starting for the 2018 inventory, transit fleet emissions will also include electricity used to power the battery-electric buses which began service in spring 2018.

## EMPLOYEE COMMUTES

Emissions associated with employee commutes are estimated based on a 2009 survey of District employee commuting habits. The share of employees driving to work is assumed to be constant and is used to estimate fuel usage based on the current number of employees and national average vehicle fuel economy. Employee data was provided by the Department of Human Resources and fuel economy data for passenger vehicles was downloaded from the U.S. Department of Transportation's annual [Highway Statistics table](#).