GREENHOUSE GAS EMISSIONS INVENTORY FOR METROPOLITAN WASHINGTON – 2005 AND 2012

April 2016

Metropolitan Washington Council of Governments

nvrc Northern Virginia Regional Commission

Acknowledgements

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Greenhouse Gas Emissions Inventory for Metropolitan Washington (2005-2012)

EXECUTIVE SUMMARY

This report presents greenhouse gas (GHG) inventory results for metropolitan Washington. Development of community and local government operations GHG inventories are priorities in the regional Climate and Energy Action Plan. The work presented here provides a consistent methodology to measure and analyze greenhouse gas emissions across the region. The Metropolitan Washington Council of Governments (COG) prepared this inventory report, building on the work of the Northern Virginia Regional Commission (NVRC), which completed inventories for Northern Virginia localities in 2015. The methodology and approach used for this inventory is consistent with the NVRC approach and uses the ICLEI US Community Protocol.

The greenhouse gases analyzed in this report include:

- Carbon dioxide (CO_2),
- Methane (CH_4),
- Nitrous Oxide (N_2O), and
- Hydrofluorocarbons (HFCs).

The inventory presented here is at the community scale. Additional locality-specific inventories were also developed and can be provided upon request.

About the Region

Metropolitan Washington is comprised of cities, counties, and towns located within the following jurisdictions: District of Columbia, Charles County, Frederick County, Montgomery County, Prince George's County, the City of Alexandria, Arlington County, Fairfax County, Falls Church, Loudoun County, Manassas, Manassas Park, and Prince William County. In 2012, the region had a population of 5,261,974 residents living in 2,010,575 households.

The source sectors in this report include:

- Electricity consumption,
- Natural gas and other non-utility fuel use (termed Residential, Commercial, and Industrial non-electricity sources or "RCI fuel"),
- On-road motor vehicle transportation,
- Off-road motor vehicles and equipment,
- Commercial aviation,
- Emissions from indirect sources including hydrofluorocarbons (HFCs), and
- Methane emissions associated with wastewater treatment and the use of landfills.

Milestone years analyzed included 2005[1] (the base year for the COG regional GHG reduction goals), and 2012 (the first reduction target year – 10 percent reduction below business as usual projections, equating to returning to 2005 levels).

The results of the GHG inventories are presented below, in Tables ES-1.

Table ES-1. Metropolitan Washington Greenhouse Gas Emissions

	2005	2012	Percent Change
Regional MT CO_2e	69,171,422	68,857,146	-0.5%
Regional Population	4,738,900	5,261,974	+9.9%
MT CO_2e per Capita	14.60	13.09	-10.3%

As shown, the region was able to slightly exceed the 2012 goal, keeping emissions below 2005 baseline levels. Additional results include:

- Electricity consumption is the largest contributor to regional GHG emissions, at about 40 percent of the total, while mobile transportation contributes 34 percent;
- Natural gas and stationary fuel combustion were the only sectors with emissions decreases, which contributed in large part to the region meeting its 2012 target; and
- Significant increases in electrical grid efficiency, leading to reductions in grid emissions factors, also contributed to the region's ability to achieve its goal.

Although metropolitan Washington has made substantial progress in reducing energy use and emissions with actions such as energy efficiency, solar installation, green buildings, renewable energy programs, and reducing VMT per capita, moving forward, sustained and intensified actions will be needed at all levels of government and the community to meet future goals and targets. The region's next goal is to reach 20 percent below 2005 levels by 2020. COG's Multi-Sector Working Group analyzed potential local, state, regional, and federal actions in 2015 and in 2016, COG's policy committees will develop action plans to help the region do its part to curb carbon pollution and meet its goals.

[1] For this report, COG refined the 2005 inventory that was developed for the 2008 COG Climate Change Report using an updated methodology consistent with that used for the 2012 inventory.

Metropolitan Washington Council of Governments

Introduction and Background

This report presents greenhouse gas (GHG) emission inventory results for metropolitan Washington. Development of community and local government operations GHG inventories are priorities in the regional Climate and Energy Action Plan. The work presented here provides a consistent methodology to measure and analyze greenhouse gas emissions across the region. The Metropolitan Washington Council of Governments (COG) prepared this inventory report, building on the work of the Northern Virginia Regional Commission (NVRC), which completed inventories for Northern Virginia localities in 2015. The methodology and approach used for this inventory is consistent with the NVRC approach and uses the ICLEI US Community Protocol.

WHAT ARE GREENHOUSE GASES?

Greenhouse gases are natural or synthetic chemical compounds in the Earth's atmosphere that do not allow infrared energy, or heat, to escape back into space. Although many of these gases have a natural place in the atmosphere, anthropogenic GHG emissions have been steadily increasing with human dependence on fossil fuels. Although this 'greenhouse effect' is what allowed the Earth to become hospitable to life, the increasing atmospheric concentration of these gases has created warming that has altered the global climate.

About the Region

Metropolitan Washington is comprised of cities, counties, and towns located within the following jurisdictions: District of Columbia, Charles County, Frederick County, Montgomery County, Prince George's County, the City of Alexandria, Arlington County, Fairfax County, Falls Church, Loudoun County, Manassas, Manassas Park, and Prince William County. In 2012, the region had a population of 5,261,974 residents living in 2,010,575 households.

The greenhouse gases emitted into the atmosphere as a result of anthropogenic activities include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Naturally-occurring GHGs have some overlap with anthropogenic sources and include water vapor, carbon dioxide, methane, nitrous oxide, and ozone (O_3).

HOW IS METROPOLITAN WASHINGTON ADRESSING GHGs?

Based on the need to control GHG emissions and avoid the negative effects of climate change, the member jurisdictions of COG have set region-wide goals to reduce greenhouse gas emissions. These goals include:

- By 2012, reduce to 10% below business-as-usual emissions (bringing emissions back down to 2005 levels),

- By 2020, reduce emissions to 20% below 2005 levels, and
- By 2050, reduce emissions to 80% below 2005 levels.

COG completed a greenhouse gas inventory for the year 2005 for metropolitan Washington to serve as a baseline for future targets, as published in the 2008 National Capital Region Climate Change Report. This report measured and analyzed emissions from various sectors across the region and provided recommendations for how to achieve reduction targets going forward. This inventory updates the emission inventory reported in the 2008 report and measures the progress made toward the first emission reduction goal for 2012.

The targets laid out in the regional climate change report have informed policy decisions and led to the creation of committees and working groups to assist the implementation and analysis of these targets. In 2009, the COG Board of Directors established the Climate, Energy & Environmental Policy Committee to advise on energy and environmental matters and guide the region towards its greenhouse gas goals. In 2015, the Multi-Sector Working Group (MSWG) was established to conduct an in-depth, comparative analysis of potential emissions-reducing strategies. The Working Group's analysis, along with this inventory, will help inform development of a new 2017-2020 Regional Climate Action Plan.

Methodology

INVENTORY TOOL

COG completed this GHG inventory using the ICLEI Clear Path tool. This tool provides a common methodology to measure community-scale greenhouse gas emissions for planning purposes. The ICLEI Clear Path tool measures emissions from residential and business activities over which the region has a certain level of control. This avoids double or undercounting emissions that result from activities in the region but do not occur within the actual jurisdictional boundaries. For example, electricity import and waste management often produce emissions outside the jurisdictional boundaries, but are caused by activity within the region and therefore are accounted for in this activity-based inventory.

The ICLEI Clear Path Community-Scale[1] Tracking tool breaks out emissions into Residential, Commercial, and Industrial, Transportation (mobile and non-mobile sources), Water and Wastewater, Solid Waste, Process and Fugitive Emissions, and Agriculture. This differs from previous ICLEI inventory methodologies that separated emissions into Scopes 1, 2, and 3. In past inventories, these scopes were defined as:

- Scope 1 - all direct greenhouse gas emissions.

[1] This inventory is at the community scale. Additional locality-specific inventories were also developed and can be provided upon request.

- Scope 2 - indirect or upstream emissions generated from the import of electricity, heat, or steam.
- Scope 3 - all other indirect emissions, which typically include emissions from waste disposal, electricity transmission and distribution losses, and other sources.

Within the ICLEI Clear Path tool, all Scope 1 emissions are accounted for; however, some Scope 2 and 3 emissions are not calculated. The tool does not account for Scope 2 emissions directly originating from generated electricity, heat, or steam *consumed* outside the jurisdictional boundaries.[2] It also does not separately account for Scope 3 system losses from electricity transmission and distribution.[3]

GASES ACCOUNTED FOR

This inventory accounts for four of the six primary greenhouse gases monitored under the Kyoto Protocol: carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. This inventory does not account for the emission of perfluorocarbons or sulfur hexafluoride. There is no data available for the region's PFC emissions, so they are not quantified. Sulfur hexafluoride emissions are created primarily from industrial processes, which are assumed to be negligible in metropolitan Washington.

The ICLEI Clear Path tool reports regional emissions in metric tons of carbon dioxide equivalent (MT CO_2e). The use of CO_2e normalizes the emission of chemicals that have different heat-trapping effects by converting them to a single denominator. The Clear Path tool uses Global Warming Potential (GWP) factors provided by the U.S. Environmental Protection Agency (EPA) and the Intergovernmental Panel on Climate Change (IPCC). Methane emissions have a GWP of 21 and nitrous oxide emissions have a GWP of 310. This means that the identical mass emission of methane or nitrous oxide would have 21 or 310 times more global warming potential than carbon dioxide. The GWP for the hydrofluorocarbon quantified in this inventory (HFC- 404a) is 3,922 times that of carbon dioxide.

SOURCE SECTORS

This inventory reflects greenhouse gas-emitting activities of regional residents, businesses, and visitors. These activities use energy, materials, and services that directly or indirectly create greenhouse gases. Emissions sources within regional boundaries include:

- Electricity consumption within the region,
- Combustion of natural gas and other fuels,

[2] Emissions from electricity generated outside the region associated with consumption in the region are covered through use of emission factors associated with the portion of the PJM electric grid that serves the region.
[3] Scope 3 system losses from electricity transmission and distribution are calculated in the tool but not reported in the final inventory.

- Mobile transportation, including on-road vehicular travel, air travel undertaken by residents, businesses and visitors in the region, and non-road activities such as use of construction and landscaping equipment,
- Collection and treatment of solid waste produced by residents and activities within the regional boundaries, including landfill and waste-to-energy emissions,
- Pumping and treatment of water and wastewater used or produced by regional residents and activities, and
- Hydrofluorocarbons released into the atmosphere.

WHAT IS NOT COUNTED

This inventory does not account for the upstream emissions impacts of material extraction, transportation, and manufacturing of goods or life-cycle emissions of business production. These emissions would be accounted for in the inventories in which these activities take place. This GHG inventory also assumes the emissions from agricultural and forestry activities in the region to be de minimis and does not include these source sectors.

This inventory does not account for carbon sinks, such as CO_2 removed from the atmosphere by the regional tree canopy or agricultural land management practices, nor does it account for non-anthropogenic greenhouse gas sources such as naturally-occurring methane. Therefore, this inventory does not calculate *net* emissions.

INPUTS

The inputs used to develop the regional GHG inventories are provided below:[4]

Electricity Use

- Electricity consumption data is provided to COG by each of the investor-owned, cooperative, and municipal utilities in the region. Utilities include: Pepco, Dominion Virginia Power, Potomac Edison, NOVEC, BGE, SMECO, and City of Manassas Utilities. The consumption data is provided in most cases by zip code and by sector (residential, commercial, industrial, and government).[5]
- The emission factor used to estimate GHG emission from electricity consumption is based on the U.S. Environmental Protection Agency's Emissions and Generation Resource Integrated Database (eGRID) for the RFCE and SRVC PJM subregions.

[4] Further details on methodological approach, inputs, and data sources are available from COG upon request.
[5] The approach did not attempt to estimate the direct emissions from electric generating units (EGUs) in the region and did not separately estimate emissions associated with electricity imported from outside the region. Instead, the focus was to capture all electricity consumption in the region and apply the relevant emission factors for the portion of the PJM grid that serves the region.

Natural Gas and Stationary Fuel Combustion

- The quantity of fuels (kerosene, LPG, residual fuel oil, and distillate fuel oil) consumed within the region was estimated using state-level data scaled to the region by household or population. State-wide data on the stationary combustion of distillate fuel oil, residual fuel oil, kerosene, and liquefied petroleum gases was collected from the United States Energy Information Administration (EIA). This data was scaled to the region based on population and household information collected from the U.S. Census Bureau and the Weldon Cooper Center for Public Service.
- Natural gas consumption is based on data provided by the local natural gas distribution companies, including Washington Gas, BGE, and Columbia Gas.

Transportation

- On-road mobile emissions were developed using EPA's on-road Motor Vehicle Emission Simulator (MOVES) model, which uses inputs related to fuel characteristics, Inspection & Maintenance Programs, meteorology, vehicle registration data, vehicle miles traveled (VMT), and vehicle speed profile. Trips within, and originating from, the region are calculated using using COG's Travel Demand Model, developed for use in the National Capital Region Transportation Planning Board's Constrained Long-Range Transportation Planning (CLRP) Process, including COG's Cooperative Land Use Forecast 8.3.
- Non-road transportation emissions within the COG region, including landscaping and construction equipment and off-road vehicles, were developed using EPA's National Mobile Inventory Model Non-Road Version (NMIM).
- U.S. air travel emissions data were collected from U.S. EPA Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012 and the Center for Transportation Analysis Energy and Transportation Science Division's Transportation Energy Data Book: Edition 32. National emissions were scaled to the region based on passenger mileage data from the region's three commercial airports collected from the Bureau of Transportation Statistics' Research and Innovative Technology Administration (RITA) and the 2011 Washington-Baltimore Regional Air Passenger Survey. National airline passenger information was collected from the U.S. Department of Transportation, Bureau of Transportation Statistics' Research and Innovative Technology Administration (RITA).

Non-Fuel Sources

- Non-fuel sources including HFCs were developed using national emissions from the 1990-2012 U.S. EPA United States Greenhouse Gas Inventory (2014) scaled to the region using population information from the U.S. Census Bureau.

- Water and wastewater treatment data were collected from regional water and wastewater treatment utilities, the COG Cooperative Forecast Round 8.3, and the Interstate Commission on the Potomac River Basin (ICPRB).
- Solid waste data on total disposal and incineration rates was collected from the Washington Metropolitan Region Waste Report prepared by the Northern Virginia Regional Commission and the Maryland Solid Waste Management and Diversion Report. Emissions were calculated using the EPA WARM Waste Estimation Spreadsheet tool.

Results

As shown in Table 1, greenhouse gas emissions from metropolitan Washington totaled to 68.9 million metric tons of carbon dioxide equivalent (MT CO_2e) in 2012; or 13.1 MT CO_2e per resident per year. This indicates a 0.5 percent decrease in total regional emissions, and a 10.3 percent decrease in per capita emissions from the 2005 baseline.[6] These results demonstrate that the metropolitan Washington region met its 2012 goal of reducing GHG emissions to 2005 levels.

Table 1. Metropolitan Washington Greenhouse Gas Emissions

	2005	2012	Percent Change
Regional (MT CO_2e)	69,171,422	68,857,146	-0.5%
Regional Population	4,738,900	5,261,974	+9.9%
MT CO_2e per Capita	14.6	13.1	-10.3%

As Tables 2 and 3 demonstrate, the overall decrease in emissions in the metropolitan Washington region can be largely attributed to the following factors:

- There was a significant decrease in natural gas and fuel use, including Residential, Commercial, and Industrial (RCI) fuel use, resulting in a reduction of almost three million metric tons of carbon dioxide equivalent in seven years. This resulted in a 3 percent decrease in total regional emissions.
- Electrical grid efficiency in the region increased significantly between 2005 and 2012, allowing for slower growth in emissions from electricity. Building code improvements and the increased price of fuel could have also influenced slower

[6] The GHG inventory presented in the 2008 COG Climate Change Report was recalculated for this report using the ICLEI Protocol.

increases from this sector. The effect of increase in emissions from electricity on total regional emissions was approximately 1 percent.

- Along with electricity, mobile transportation emissions increased, affecting total regional emissions by approximately 1 percent.
- For non-energy resources, emissions from HFCs increased, but had a minimal effect on total regional emissions. Waste and wastewater emissions stayed the same despite regional growth.

Table 2. Greenhouse Gas Emissions (2005 – 2012) (MT CO2e)

Emission Source	2005	2012	Difference	Percent Change
Electricity	26,409,633	27,240,147	+830,514	+3.1%
Natural Gas	8,429,579	7,706,865	-722,714	-8.6%
Residential, Commercial, and Industrial (RCI) Fuels	4,359,014	2,277,911	-2,081,103	-47.7%
Mobile	27,183,340	28,183,368	+1,000,028	+3.7%
Non-Energy Resources	2,789,856	3,448,855	+658,999	+23.6%
Total	69,171,422	68,857,146	-314,276	-0.5%

Table 3. Regional Indicators (2005 - 2012)

Indicator	2005	2012	Percent Change
Population	4,738,900	5,261,974	+9.9%
Households	1,879,016	2,010,575	+6.5%
Employment	2,693,401	2,789,269	+3.4%
Electricity Use (kwh)	58,924,515,193	60,175,521,843	+2.1%
eGrid Factors (lbs CO_2e/MWh)	1,202-1,152	953-1,042	-9.7 to -13.5%
RCI Fuel Use (gallons)	471,798,890	319,917,118	-32.2%
Natural Gas Use (therms)	1,589,317,362	1,453,056,576	-8.6%
Annual VMT (miles)	41,833,286,780	43,945,174,893	+4.8%
VMT Per Capita (miles)	8,828	8,351	-5.4%

Sector Analysis

This section breaks down emissions by energy resource and by activity, providing background and context to the regional details illustrated in Table 4. The inventory results are also broken down as either mobile (on-road vehicles, trains, airplanes, and off-road equipment) or stationary sources (buildings and facilities).

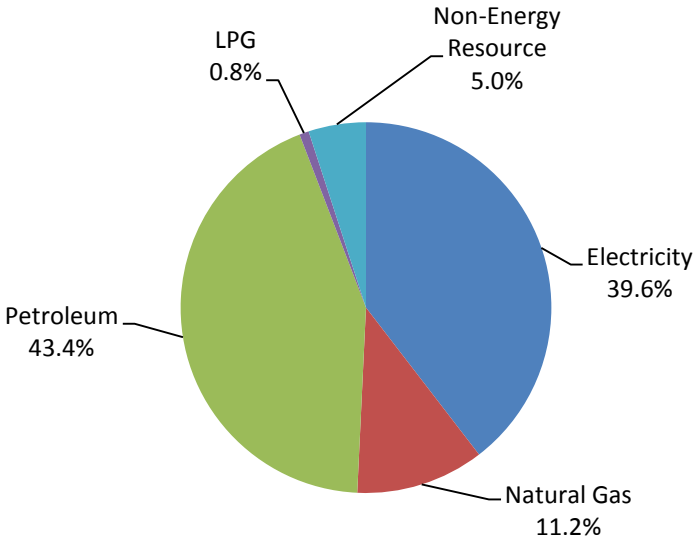
EMISSIONS BY ENERGY RESOURCE

Evaluating greenhouse gas emissions by energy resource illustrates which resources are contributing most to the region's overall emissions. Table 4 and Figure 1 show that electricity and petroleum products together generate the vast majority (83 percent) of regional emissions. Only 5 percent of the total emissions come from non-energy resources. Non-energy resources are defined as emissions sources that are not used to provide energy for the region, such as waste disposal and water treatment.

Table 4. Metropolitan Washington Emissions by Energy Resource Type (MT CO_2e)

Type	Total	Percent of Total
Electricity	27,240,147	39.6%
Natural Gas	7,706,865	11.2%
Petroleum	29,892,748	43.4%
LPG	568,531	0.8%
Non-Energy Resource	3,448,855	5.0%
Total	68,857,146	100%

Figure 1. Regional Greenhouse Gas Emissions 2012 by Energy Resource Type (MT CO_2e)



EMISSIONS BY ACTIVITY

Table 5 and Figure 2 provide information on the relative magnitude of emissions from various activities in the region. Overall, electricity and petroleum use (in mobile transportation) are the leading sources of greenhouse gas emissions in the region, together accounting for nearly 75 percent of total regional GHG emissions. Relative shares include:

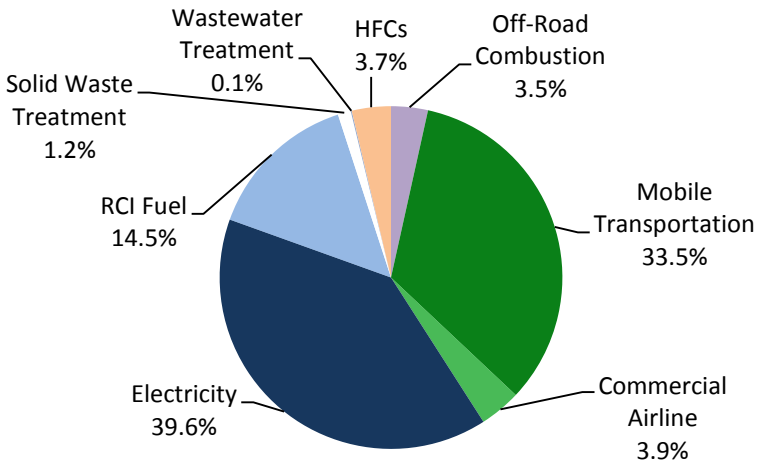
- Electricity consumption - approximately 40% of total emissions.
- Mobile transportation - nearly 34%.
- Use of natural gas, LPG, kerosene, and distillate and residual fuel oil - approximately 15%.
- All others (wastewater, solid waste, HFCs, etc.) - approximately 10%.

Table 5. Metropolitan WashingtonEmissions by Activity (MT CO_2e)

Source	Total	Percent of Total
RCI Fuel	9,984,776	14.5%
Off-Road Combustion	2,391,368	3.5%
Electricity	27,240,147	39.6%
Wastewater Treatment	68,196	0.1%
Solid Waste Treatment	847,047	1.2%
Commercial Airline	2,694,262	3.9%
Mobile Transportation	23,097,738	33.5%
HFCs	2,533,612	3.7%
Total	68,857,146	100%

This analysis shows similar results to the energy resource break out in Table 4, indicating that electricity and petroleum use (in mobile transportation) are the leading sources of greenhouse gas emissions in the region.

Figure 2. Regional Greenhouse Gas Emissions 2012 by Activity (MT CO_2e)



STATIONARY SOURCES

The breakdown in Table 6 shows the composition of stationary source emissions in greater detail. Electricity is the primary source of greenhouse gases from this sector, at 73 percent of total emissions. Commercial electricity use accounts for 56 percent of emissions from electricity use, making the commercial sector the largest contributor to electricity emissions.

Table 6. Stationary Emissions by Fuel Type (MT CO_2e)

Fuel Type	Emissions	Percent of Total
Electricity	27,240,147	73%
Natural Gas	7,706,865	21%
Fuel Oil	1,709,380	5%
LPG	568,531	2%
Total	37,224,923	100%

Table 6 illustrates the impact of stationary fuel use, at almost 60 percent of the total regional GHG emissions. This shows the effect of electricity consumption on the region's greenhouse gas emissions and provides insight into the contribution of the commercial sector toward regional emissions. Results of this breakdown by fuel type include:

- Electricity consumption – 73% of total stationary source emissions.
- Commercial electricity consumption – 56% of electricity total.
- Natural gas – 21% of total stationary source emissions;
- Residential natural gas use – 54% of the natural gas total.
- LPG and fuel oil use – 7% of total stationary source emissions.

MOBILE SOURCES

Mobile generated greenhouse gas emissions in metropolitan Washington are attributable to several sources, both public and private, including:

- On-road vehicles, including cars, trucks, buses, and motorcycles, driving within the jurisdictional boundaries, passing through the region, or making trips that start or end within the region,
- Commercial and business air travel attributable to the residents of the region, and
- Non-road vehicles, construction vehicles, and landscaping equipment used within regional boundaries.

The mobile transportation inventory results, as outlined in Table 7 and Figure 3, show that mobile transportation accounts for nearly 34 percent of total regional GHG emissions. Relative shares include:

- Passenger cars and trucks - nearly 60% of total mobile source emissions.
- Commercial trucks – 22%.
- Personal and business airline trips - 9.6%.
- School and transit buses – 1.4%.
- Non-road sources - 8.5%.

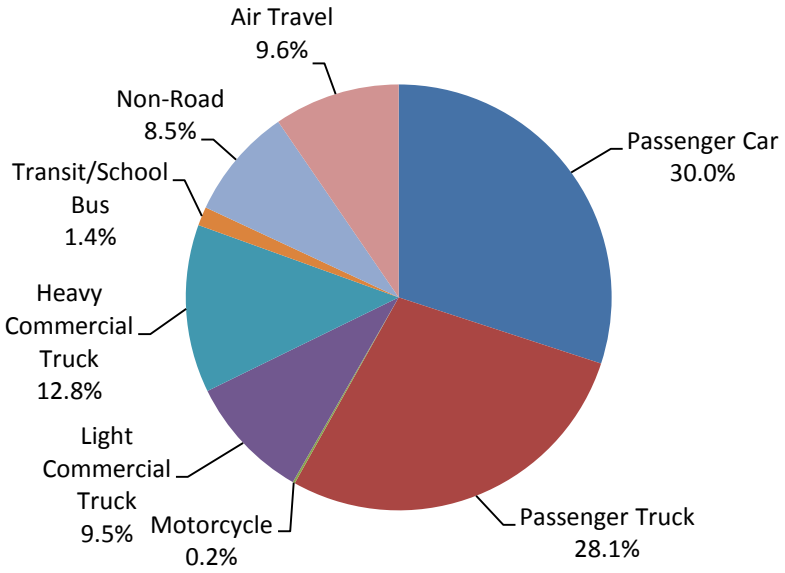
Table 7. Metropolitan Washington Mobile Source Greenhouse Gas Emissions

Type	MT CO_2e	Percent of Total
Passenger Car	8,455,821	30.0%
Passenger Truck	7,909,408	28.1%
Motorcycle	46,711	0.2%
Light Commercial Truck	2,667,113	9.5%
Heavy Commercial Truck	3,592,360	12.8%
School/Transit Bus	401,338	1.4%
Airline	2,694,262	9.6%
Non-Road	2,391,368	8.5%
Total	28,158,380	100%

Based on these results, personal vehicle use is the largest source of greenhouse gas emissions from the transportation sector. One measure of mobile source emissions is vehicle miles traveled (VMT). As Table 3 indicates, between 2005 and 2012, annual VMT increased by 4.8 percent, while per capita VMT decreased by 5.4 percent. Further efforts to increase fuel efficiency in vehicles, expand use of alternative fuels, and to continue to reduce VMT will help reduce the GHG outputs from passenger cars and trucks. Further, providing improved alternatives to the use of single passenger vehicles will help to reduce

the impact these have on the total emissions. Commercial trucks, air travel and non-road vehicles and equipment are also significant sources of mobile emissions.

Figure 3. Regional Transportation Greenhouse Gas Emissions 2012 (MT CO_2e)



Discussion and Conclusion

Even with growing population, jobs, and households, metropolitan Washington exceeded its initial goal of reducing regional emissions to 2005 levels by 2012, reporting 68.9 million MT CO_2e in 2012, from 69.2 million MT CO_2e in 2005. This was primarily a result of large reductions in stationary fuel combustion and natural gas use, as most of the other sectors increased emission outputs as the regional population grew. Per capita emissions dropped over the period from 14.6 to 13.1 MT CO_2e.

The region's success in meeting its 2012 greenhouse gas goal also can be attributed to a wide array of factors including market trends, weather conditions, and federal, state, and local policies and incentives.

The electrical grid greenhouse gas emissions decreased by 130 MT CO_2e from 2005 to 2012, largely due to increased use of natural gas and decreased use of coal, driven by market trends. A large decrease in heating degree days from 2005 to 2012 caused significant emissions reductions in RCI fuel use, which account for a large portion of the overall emissions reductions in the region. However, this was partially offset by an increase in cooling degree days, increasing electricity use. Further, transportation emissions have

increased more slowly than vehicle miles traveled, due to tightening federal vehicle emission standards and changing travel behaviors.

State and local efforts also helped hold emissions steady even while the region grew. The region boasts the highest number of green buildings and highest green power purchase among 15 comparable metropolitan regions in the United States. Strong renewable portfolio standards (20 percent in Maryland by 2022, 15 percent in Virginia by 2025, and 20 percent in the District of Columbia by 2020[7]) also contribute to the region's emissions reductions. Although still a small percentage of electricity generation, solar photovoltaic energy is rapidly increasing as shown in Table 8.

Table 8. Net-Metered Solar Capacity Growth in the Region, 2009 - 2014

	Washington, DC		Suburban Maryland		Northern Virginia		Region Total	
	Systems	Capacity (kW)	Systems	Capacity (kW)	Systems	Capacity (kW)	Systems	Capacity (kW)
2009	103	660	275	2,907	79	277	457	3,844
2010	273	1,694	585	7,222	200	879	1,058	9,795
2011	524	3,579	950	12,559	177	833	1,651	16,971
2012	792	5,431	1,811	19,704	284	1,649	2,887	26,785

Metropolitan Washington is already a national leader in LEED certified and ENERGY STAR rated buildings, as shown in Figures 4 and 5. Compared to other similar metropolitan regions in the country, the metropolitan Washington has the largest number of LEED certified buildings, the third largest number of ENERGY STAR rated buildings, and the most square feet of total ENERGY STAR rated space.

[7] The RPS standards in Maryland and the District of Columbia are mandatory; Virginia's RPS standards are voluntary.

Figure 4. Regional Comparison of LEED Certified Buildings (2014)

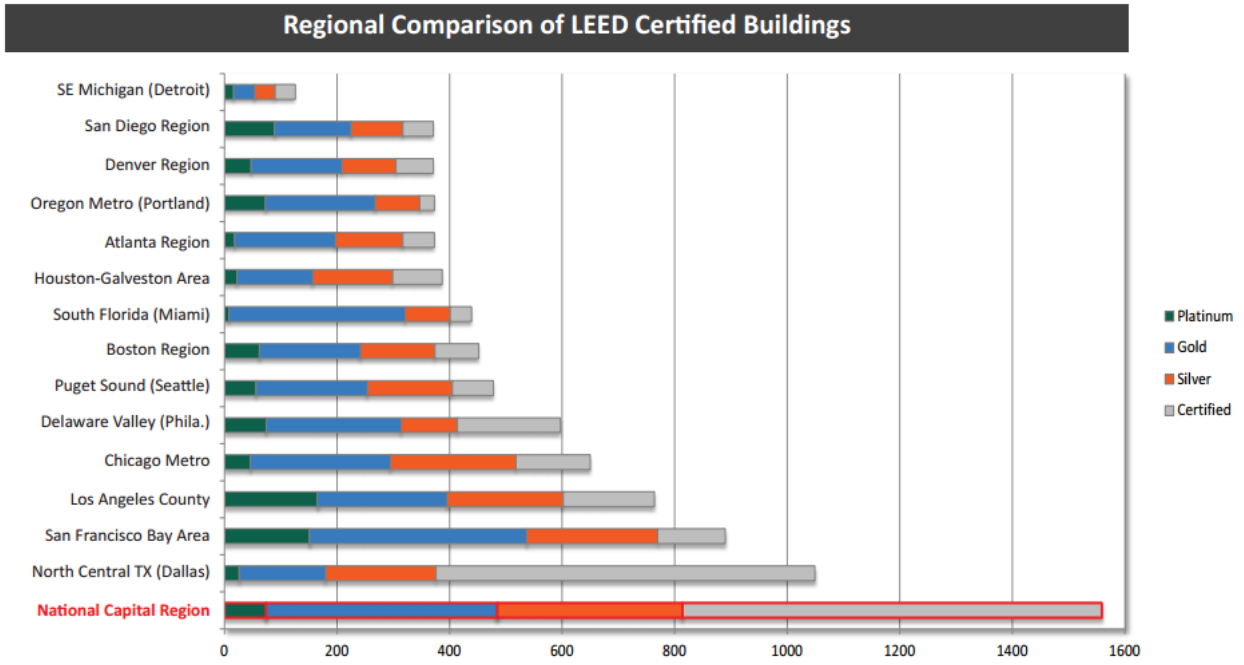
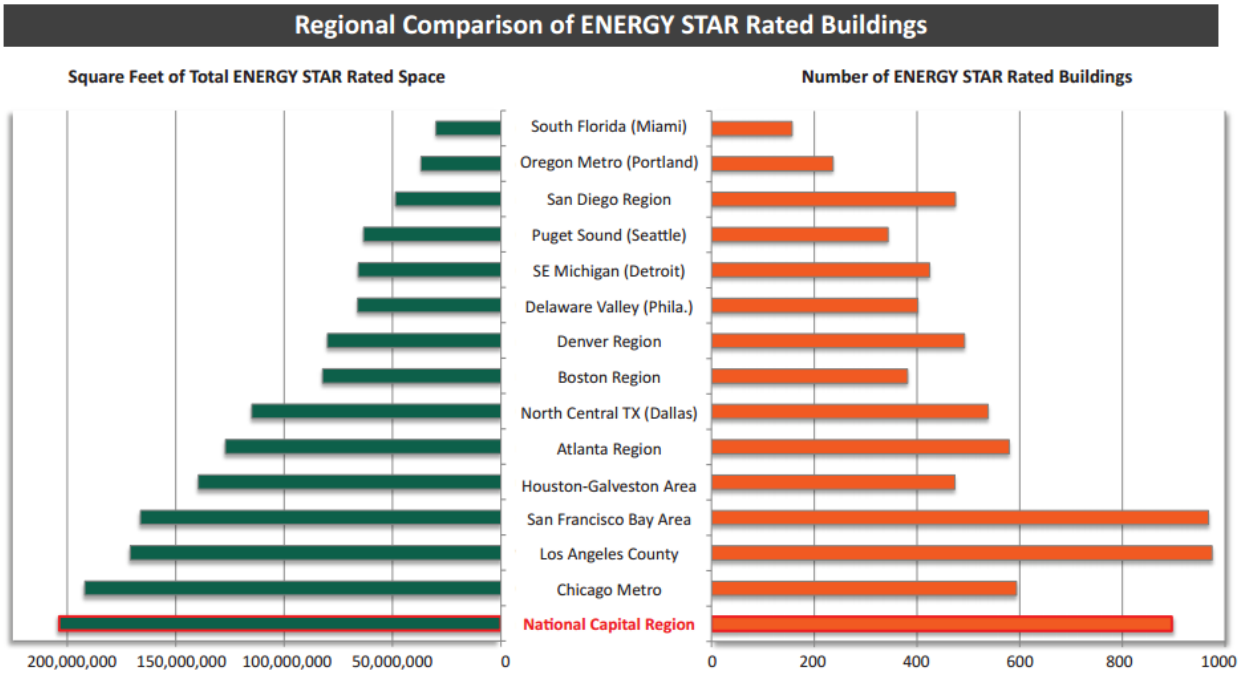


Figure 5. Regional Comparison of ENERGY STAR Rated Buildings (2014)



Methane emissions from wastewater and solid waste treatment have remained fairly static over the seven year period, despite a growing population. This success could be attributed to installation of more efficient wastewater treatment processes and increased recycling rates.

Electricity consumption in the built environment and passenger vehicle mobile transportation are still the largest contributors to metropolitan Washington's total greenhouse gas emissions. These are important emissions reduction targets needed to meet the goals set by the region. The next emissions goal is to reach 20 percent below 2005 levels by 2020 -- a reduction of almost 10 MMT CO_2e from 2012 levels. This will be a large undertaking for the region; especially in the sectors with the largest emissions.

This inventory combined with the analysis being undertaken by COG's Multi-Sector Greenhouse Gas Working Group will help the region prioritize actions and develop an action plan in 2016 to meet future targets. Strategies needed span the energy, built environment, transportation, and land use sectors, and include efforts such as reducing the energy and water consumption in new and existing buildings, reducing power sector emissions, increasing infrastructure efficiency, increasing renewable energy use, encouraging sustainable development, reducing emissions from waste, construction, and transit, and educating the public through community engagement efforts.

The region has made progress in the built environment, transportation, and other aspects of energy conservation. The efforts and dedication of local residents and businesses as well as local and regional agencies to continue to strive for a clean energy economy, along with the policies and assistance of the federal government, will help to move metropolitan Washington toward its 2020 and 2050 goals.

Appendices

Greenhouse Gas Emissions Inventory for Metropolitan Washington (2005-2012)

Appendix A: Acronym List

BAU	Business-as-usual
CEEPC	Climate, Energy, and Environment Policy Committee
CH_4	Methane
COG	Council of Governments
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
eGRID	US EPA Emissions and Generation Resource Integrated Database
EIA	Energy Information Administration
GHG	Greenhouse gas
GWP	Global warming potential
HFC	Hydrofluorocarbon
IPCC	International Panel on Climate Change
LPG	Liquefied petroleum gas
MOVES	US EPA Motor Vehicle Emission Simulator
MSWG	Multi-Sector Working Group
MT/MMT	(Million) metric tons
NMIM	US EPA National Mobile Inventory Model
N_2O	Nitrous oxide
O_3	Ozone
PFC	Perfluorocarbon
RCI	Residential/Commercial/Industrial
RITA	Department of Transportation Research & Innovative Technology Administration
SF_6	Sulfur hexafluoride
VMT	Vehicle miles traveled
WARM	US EPA Waste Reduction ModelA