

# Greenhouse Gas Emissions Inventories

## **METHODOLOGY GUIDE**

This report describes step-by-step procedures to support technical staff in the development of local and regional community-scale greenhouse gas inventories in metropolitan Washington.

**May 2019**

## **GREENHOUSE GAS EMISSION INVENTORIES METHODOLOGY REPORT**

Prepared for COG staff and the Built Environment and Energy Advisory Committee (BEEAC)  
January 2019

### **ABOUT COG**

The Metropolitan Washington Council of Governments (COG) is an independent, nonprofit association that brings area leaders together to address major regional issues in the District of Columbia, suburban Maryland, and Northern Virginia. COG's membership is comprised of 300 elected officials from 24 local governments, the Maryland and Virginia state legislatures, and U.S. Congress.

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# INTRODUCTION

## Purpose

This guide comprehensively outlines the methodologies and steps to carry out the next set of COG's local and regional greenhouse gas (GHG) inventory work, providing for completeness, consistency, accuracy, replicability, transparency, and quality control. The ability to develop relevant, robust sets of inventories supports COG's Climate, Energy and Environment Policy Committee (CEEPC) and member local governments track progress towards local and regional GHG emission reduction goals and support decision-making around policies and programs that support emission reduction.

The primary purpose of this document is to guide the COG Climate and Energy Team in completion of the community-wide GHG inventories for COG members and metropolitan Washington. It provides context and guidance to support COG staff from other teams and departments as well as provides clarity to technical staff from COG member jurisdictions.

## Background

COG's Climate, Energy and Environment Policy Committee (CEEPC) was created by the COG Board in 2009 and is responsible for managing implementation of the *National Capital Region Climate Change Report* adopted by the COG Board in 2008. This responsibility includes development of a regional climate change strategy to meet the regional GHG reduction goals adopted by the board. Since the development of its first strategy, CEEPC has made it a priority to track progress towards emissions reduction and set goals for all COG members and the region to complete GHG inventories.

Over the next five years, COG supported its members on inventory development by coordinating GHG inventory work group meetings and a series of trainings with national experts from ICLEI. COG also participated in development of a national protocol for developing local community-scale inventories, provided consultant support for COG member local inventory development, and began working with the Northern Virginia Regional Commission (NVRC) on applying consistent methodologies across jurisdictions in northern Virginia (NOVA).

Members of both CEEPC and its sub-committees requested additional support to insure 100 percent of COG members were able to have consistent, comparable GHG inventories completed and have updates on their inventories completed to track progress towards GHG emission reduction goals. As of 2018, COG completed more than 80 community-scale GHG inventories for all COG members, NOVA, and metropolitan Washington over three inventory years – 2005, 2012, and 2015. CEEPC directed COG staff to complete additional sets of inventories for 2018 and 2020.

## Methodology Basics

COG completes GHG community-scale inventories for all 24 local government members, northern Virginia, and metropolitan Washington. COG makes every effort to capture an accurate picture of GHG trends for each of its local government members, while also providing for a consistently applied methodology across all its members' communities.

COG GHG inventories strive to be compliant with both the [U.S. Communities Protocol for Accounting and Reporting Greenhouse Gas Emissions](#) (USCP) and [Global Protocol for Community-Scale Greenhouse Gas Inventories](#) (GPC). The Protocols provide guidance on what emission types should at minimum be included in all local community GHG inventories. Additional guidance on approaches to calculating emissions are offered, but not prescribed. COG mainly follows the calculation guidance from USCP as the USCP identifies sources of data widely available to communities in the US. If COG has reliable local data available that could provide more accurate results then an alternative approach, calculation, or tool is used.

COG inventories use public data readily-available on a consistent basis for all its local government members. Data sources used must be available for past, current, or potential future inventories to accurately capture trends. While both accuracy and consistency are important to GHG inventories, consistency will be given a higher priority. Any models used are applied as consistently as possible. If a new version of the model is used, it must be noted. Consistent Global Warming Potential Factors (GWP) are applied; COG inventories use GWP Factors from the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC AR4).

COG inventories follow an activities-based approach, meaning emissions are calculated based on the result of an activity happening in a community. An example of this is that solid waste emissions are calculated based on the tonnage of trash the community sends to a landfill. Simply because they do not have a landfill within city boundaries, does not mean that they are not contributing to landfill emissions. This approach accounts for these types of activities for the emissions types reported.

The broad categories of emission types covered by COG’s GHG inventory work include the built environment, transportation and mobile emissions, wastewater treatment, agriculture, solid waste treatment, and some process and fugitive emissions. Most of these are required elements to be compliant with the USCP and GPC. Neither require agriculture; however, it was requested for inclusion by COG member counties.

Emissions Types	COG Inventory?	USCP Required?	GPC Required?
Built Environment	✓	✓	✓
Transportation and Mobile	✓	✓	✓
Wastewater Treatment	✓	✓	✓
Agriculture	✓	X	X
Solid Waste Treatment	✓	✓	✓
Some Process and Fugitive	✓	X	✓

These emission types are further broken down into 16 emissions activities and 22 separate inventory records that are calculated and added together to get total emissions by type and overall emissions. The gases calculated within these inventory records include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), Nitrous oxide (N<sub>2</sub>O), Hydrofluorocarbons (HFCs), and Perfluorocarbons (PFCs).

See Appendix A to review a detailed table of the emission types, activities calculated, GHGs and methodologies covered, and data confidence levels. See Appendix B for details on data inputs needed for the GHG inventory work and when they typically become available.

One area in which the COG inventories are not compliant with the Protocols is that the USCP requires identifying how much of commercial energy consumption is attributable to providing water supply and wastewater services. COG will continue to work with the drinking water and wastewater utilities to incorporate it into future inventories.

## Process

### STAKEHOLDER ENGAGEMENT

COG needs to continue to work with its local government members to capture as accurate of a picture as possible for each community while providing consistent data inputs and methodologies across all communities. In order to accomplish this, COG staff needs to help members understand the existing process and methodologies, provide opportunities for their input on methodologies and the products, and support them on how they want to communicate results to their communities. The local government stakeholder engagement process should include the following:

1. Make COG members aware of the inventory procedure at the beginning of the process and listen to and address any questions/comments/concerns. Discuss any new priorities that need to be considered, potential methodology refinements, etc. from COG members.
2. Present draft results to each community. Address questions/comments/concerns. Revise as needed.
3. Offer and provide one-on-one meetings, as needed, to COG local government members.
4. Provide final products to each community.
5. Support local governments, as needed, in how to communicate results to their communities.

### INTERNAL SHARED DRIVE

COG's internal shared drive is called the LAN. All documentation for the inventories are saved in the Department of Environmental Programs I drive. <I:/CLIMATE ENERGY/Projects/Inventory>. Each year of inventories are saved in the folder. Create a file with the year of the inventory being completed and include the following sub-folders: Data, DRAFT Inventories, FINAL Products, Methodologies, and Stakeholder Review.

Under data have subfolders for the main emission types. Save every piece of data, charts, reports, etc. used in the inventory process. Any calculations done outside of the Master Template and ClearPath should be saved here, as well. Staff completing quality control checks or future versions of the inventories need to be able to access the original sources and calculations. They need to be able to understand what exactly was received from the sources and what is the final number used in the inventory. To support version control, data spreadsheets can be saved as raw, working, or final.

- Raw = document received from surveys, data sources and COG staff
- Working = data analyses underway to prepare data for input into the GHG inventory
- Final = mark the final document as such for quality control purposes

## MASTER TEMPLATE

The Master Template is the Excel file that contains the data inputs, emission results, sources and notes for all the emissions activities calculated for all COG members and the region. The source of all final products developed should use data derived from the Master Template. The Master template provides for completeness, consistency, accuracy, replicability, transparency, and quality control of COG's inventory work. A few basics about the Master Template include:

- The Master Template's structure aligns with ClearPath.
- There is a high-level summary tab, a detailed summary tab, tabs for each emissions activity calculated, a demographics tab, methodology summary tab, and a template tab.
- The Master Template ensures that the calculations align bottom-up (local to regional) and top-down (regional to local) so that methodologies and results are consistent throughout.
- A consistent tab structure is used throughout. The Legend guides staff on where to enter data (shaded blue), where formulas are built in (shaded green – do not alter these cells), where data should be copied into ClearPath (type = maroon), where a data point needs to be re-checked (yellow shaded – adjust as needed).

COG staff should save drafts of the Master Templates with date and save often. COG staff should also make sourcing and taking notes in the Master Template a top priority. Take the time to source and take notes as you go and be thorough and detailed. Staff conducting quality control checks, future staff working on inventories, or COG members reviewing the work should be able to easily find, for instance, that one number you pulled from a table in a 100-page report and they should understand any assumptions or caveats that may affect the inputs or results.

## CLEARPATH

ICLEI's ClearPath tool is an online tool for preparing local GHG inventories, forecasts, climate action plans, and monitoring reports. The tool is consistent with both US and global accounting protocols. COG uses the Community Scale Inventory Module to support completing its GHG inventory work for its member and the region.

COG's ClearPath account serves as an umbrella account to its members' accounts (e.g. all COG local government members have a ClearPath account that COG can access through the COG account). COG creates a regional inventory under the Metropolitan Washington account and creates each local jurisdiction's inventories under their own accounts. Local governments can see COG's work as its being completed. COG requests that local governments not alter COG's work in their accounts and COG also does not alter any work they may complete in the account. Inventories may be copied if an analyst wants to test alternative data or calculations.

COG creates inventory records in ClearPath for all emission activities in the inventory for all its members and the region. Some of the tool's calculators are used to calculate emissions as inventory records are created, while in other instances, previously calculated emissions are recorded in the inventory record. Results from any calculations recorded in the tool are copied into the Master Template to support quality control checking and to keep all results in one document.

As inventory records are created, consistency is applied in how records are named. Inventory records in ClearPath are consistent with the Master Template's tabs. As COG staff enter inventory records in ClearPath, they should follow the naming structure as outline in the Inventory Record column in the Master Template's Methodology Summary Table tab.

## METHODOLOGY UPDATES

The practice of developing community-scale inventories is relatively new and has evolved rapidly in recent years. The practice will continue to evolve to provide for more accurate, measured results (rather than modeled). Therefore, the methodologies used in COG inventory work should continue to evolve overtime to incorporate the best available data and methods.

Some methodology updates, like a change in Global Warming Potential Factors, will affect all emission calculations in the inventory. However, more often it may be refinements to the calculations for a specific activity or source. Methodology updates should be prioritized first by how much of an impact they have on the overall inventory. Priority should be given to an activity that accounts for a larger percent of the inventory. Secondly, consider methodology update needs based on current data quality confidence levels (see Appendix A). Activities or sources with low-to-medium data quality confidence levels could be investigated to see if more accurate data or calculations methods could be applied.

If methodology changes to how an activity/source is calculated results in more than a 1-2% difference, if possible, back cast to change the methodologies from previous years. If methodology changes result in less than a 1-2% difference, back casting is not necessary. GPC guidance calls for no more than a 5% difference; therefore, any more than this certainly requires methodology changes across years to ensure consistency. All changes in methodologies between inventory years need to be noted in all final products and this methodology guide needs to be updated to reflect the changes.

To ensure methodology changes are Protocol compliant, refer to the USCP and GPC methodologies for guidance throughout the process. Request review of methodology updates by ICLEI, COG members, and other GHG inventory experts.

## FINAL PRODUCTS

The final products for each round of GHG inventories should include the following:

- **Master File:** One final version of the GHG inventory Master Excel File needs to be saved and include all final inputs, outputs, sources, notes, etc. This serves as the basis from which all other final products are produced. It is used in inventory review with local governments but is not a shared or published document. It should also serve as the basis for the template for the next round of GHG inventories.
- **ClearPath Inventory Record:** A final, official inventory marked as *Complete* for all COG members and region-wide.
- **Input / Output Data Summary:** Individualized Summary Excel Files need to be produced for all COG members, NVRC, and for metropolitan Washington. The files include data inputs, emission results and a summary chart (as ClearPath output) for all completed inventory years and each activity in which emissions were calculated. It also includes sourcing and notes. COG shares individualized summaries with each COG member and NVRC but does not publish it. COG members share it in their communities as they see fit. COG does post online and otherwise share the metropolitan Washington Summary Excel File.
- **Fact Sheets:** Fact Sheets need to be produced for all COG members, NVRC, and for metropolitan Washington. COG shares the Fact Sheets with each COG member and NVRC but

does not publish it. COG members publish and share it in their communities as they see fit. COG does post online and otherwise share the metropolitan Washington Fact Sheet.

- **Updated Methodology Guide:** This document should be updated with information pertinent to staff that will be completing the next round of GHG inventories. A comprehensive update should not be necessary for each round of GHG inventories.
- **Methodology Summary Report:** Moving forward, a Methodology Summary Report template should be developed and updated as new inventories are completed. The summary report should follow guidance from the Protocols on what to include. Generally, it should pull information from the final products listed above. It should summarize trends (in a bit more detail than the fact sheet) but mainly provide a brief, transparent summary of the methodology (e.g. an abbreviated version of this methodology guide).

Final inventory results and products need to be useful to the local governments; and therefore, some customization may be provided upon request. All calculations must be completed using the consistent methodologies outlined in this methodology guide; however, after all calculations are finalized in the Master File and ClearPath a jurisdiction may request that COG take out certain categories of calculations. For instance, one jurisdiction requested the GHG sources/activities that are not required by the USCP and GPC to be taken out of the final documentation provided to them. When a jurisdiction requests to delete certain GHG activities and sources:

- Do NOT modify the Master File Template
- Copy the inventory(ies) in ClearPath and add MODIFIED to the name.  
[MODIFIED – City/County Name – Greenhouse Community Inventory by COG - Year]
- Create an input/output spreadsheet and fact sheet with the modified results. If a jurisdiction want to see the full results, it will still be available to the jurisdiction via ClearPath or the Master File.

## How to Use This Report

The main purpose of this report is to support COG staff members in developing the GHG inventories. COG Climate and Energy Team staff members that are managing the development of the GHG inventory or supporting the project by completing inventory records across multiple emission types should review this report in full and be familiar with all the methodologies to support consistency and quality control for the full inventory.

COG staff members from other teams and departments supporting data collection and analysis within their specific sector (e.g. transportation, solid waste, wastewater, and agriculture) should be familiar with the methodology basics, the Master Template, and review the report sections below for the inventory records they are supporting.

The report also supports transparency of methodologies used in the inventory to COG member local governments. Local government technical staff should review inventory record methodologies in this report as needed to support their own understanding as well as to communicate it to leaders, staff, and stakeholders in their own communities. This methodology guide provides another opportunity for local governments to review the methodology and make recommendations for improvements in the methodology.

As COG staff, local governments, and stakeholders review the methodologies outlined in this report, it's preferable to also have access to the Master Template and ICLEI's online ClearPath tool. The steps to completing the methodologies require access to both and thus it's easier to follow along if the reviewer can refer back to them. The sources, notes, and calculations in this report, mirror and describe what's in the Master Template.

The Master Template follows organizational structure in ClearPath. Therefore, this methodology guide and other final products are also organized in alignment with ClearPath. This consistency will help support data analysts and reviewers in finding what they are looking for in this report and other inventory products.

For each inventory record, this report provides a brief description of the activity, methodology, data collection, steps, calculations, and COG staff contacts for this piece of the inventory. The methodology refers to which calculation was used from the USCP or the basics from another process applied. The calculations section only identifies the calculations embedded into the Master Template and not all the calculations from, for instance, the ClearPath Tool or MOVES model.

For additional details or background information on GHG inventory development or specific methodologies or calculations, please refer to supporting methodologies as needed:

- [U.S. Communities Protocol for Accounting and Reporting Greenhouse Gas Emissions](#) (USCP)
- ClearPath Guidance Document (available within the [ClearPath Tool](#))
- [Global Protocol for Community-Scale Greenhouse Gas Inventories](#) (GPC)
- Other sources identified in this report

From the 2015 inventory, the supporting methodology documents are saved on the COG DEP internal shared drive, the LAN, here: [I:/CLIMATE ENERGY/Projects/Inventory/2015/Methodologies.](#)

The other sources are saved on the LAN here: [I:/CLIMATE ENERGY/Projects/Inventory/2015/Data.](#)

# GETTING STARTED

## Setting up Your Greenhouse Gas Inventory

### FIRST THINGS FIRST

#### DESCRIPTION

Begin by setting up your folder on the LAN. Next, gather and input demographic and economic data. Then, start an inventory in ClearPath for all COG members and the region.

Some of the demographic and economic data is used to estimate GHG emissions. For instance, household and commercial building data is used to estimate non-utility fuel consumption, such as fuel oil. Also, population data may serve as a means to downscale to a local community when local data is unavailable.

The demographic and economic data is also used as a benchmark throughout the inventory to gauge emissions per person, household, employee, etc. Therefore, it is important to gather this information at the start of the inventory process and use it as consistently as possible across all emissions activity calculations. Some of this data is also used to start an inventory in ClearPath.

#### DATA COLLECTION

American Community Survey has data readily available for all COG member local governments. This data is used as much as possible for calculations and benchmarks throughout the inventory. However, COG transportation and wastewater models use COG Cooperative Forecast data; therefore, transportation on-road and off-road and all wastewater calculations use the Cooperative Forecast data for its benchmarking. COG Cooperative Forecast data is not used throughout the inventory because data is not available for all of COG's smaller jurisdictions.

In addition, COG uses CoStar, a commercial building database for metropolitan regions, to track commercial construction in the region. It also provides readily available data for the GHG inventories. Gross Domestic Product data is an input to provide during the creation of an inventory in ClearPath.

#### Data Needs:

American Community Survey (ACS): Data is available for all COG jurisdictions and U.S. totals for the 5-year estimates.

- Population
- Housing Units
- Occupied Housing Units (i.e. Households)
- Employment

MWCOG Cooperative Forecast: Data for all COG members except Takoma Park and cities in Prince George's County.

- Population
- Housing Units
- Employment

CoStar: Data for all COG members.

- Number of Commercial Buildings
- Number of Commercial Square Footage

Bureau of Economic Analysis (BEA)

- Gross Domestic Product

## STEPS

1. Set up files on the LAN at <I:/CLIMATE ENERGY/Projects/Inventory>.
  - a. Create a file with the year of the inventory being completed and include the following sub-folders: Data, DRAFT Inventories, FINAL Products, Methodologies, and Stakeholder Review.
  - b. Save a version of the Master Template under DRAFT Inventories called: [Year] GHG Inventory – Master File – DRAFT [Month Year] month and year it is being worked on)
2. Collect demographic, commercial building and economic data (except GDP) and enter into the Master GHG Inventory Excel File's Demographics tab.

Note: Data entered into the Demographics tab populates data as needed for calculations throughout the rest of the Master File.

  - a. Go to Census Factfinder and look up ACS data as specified under Sources below.
  - b. Contact COG Community and Planning Services (CPS) staff responsible for COG's Cooperative Forecast and request data for the same version of the Forecast used in the version of the MOVES model being used for Transportation emissions.
  - c. Contact COG CPS staff responsible for the Commercial Construction Report. Provide a template of the Demographics tab's relevant data to have them population the table.
3. Start a GHG Inventory in ClearPath.
  - a. Go to [www.clearpath.icleiusa.org](http://www.clearpath.icleiusa.org). Enter log-in information. Click on Community-Scale Track. Click on the New Inventory blue button.
  - b. Log-in Name: [mdavis@mwkog.org](mailto:mdavis@mwkog.org), Password: GreenhouseGas2018!
  - c. In the web form, enter inventory name, select year, enter ACS population, enter regional GDP data from BEA (for regional inventory only), enter currency as 'USD – US Dollar', enter Status as 'In Progress', select IPCC 4<sup>th</sup> Assessment for the Global Warming Potential and click Save.

## SOURCES

<sup>1</sup> U.S. Census Bureau. 2011-2015 American Community Survey 5-Year Population Estimates

Demographic and Housing Estimates (2015 ACS, Table DP05)

General Housing Characteristics (2015 ACS, DP04)

General Economic Characteristics (2015 ACS, DP03)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://factfinder.census.gov>

Webpage last accessed: July 2017

<sup>2</sup> MWCOG Cooperative Forecasts 8.4

Round 8.4 Cooperative Forecasting Summary Tables - Adopted October 14, 2015 (Excel Spreadsheet)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://www.mwcog.org/documents/2016/11/16/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/>

*Webpage last accessed: July 2017*

<sup>3</sup> CoStar. (2015). Commercial Property Records.

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel>  
[www.costar.com](http://www.costar.com)

<sup>4</sup> Bureau of Economic Analysis. (2017). Gross domestic product (GDP) by metropolitan area.

Washington-Arlington-Alexandria, DC-VA-MD-WV (Metropolitan Statistical Area); All Industry

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://www.bea.gov/data/gdp/gdp-metropolitan-area>

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# BUILT ENVIRONMENT

## Residential Energy

### EMISSIONS FROM GRID ELECTRICITY

Under the ClearPath Residential Energy tab, the *Emissions from Grid Electricity Calculator* is used to calculate emissions from residential electricity.

#### Residential Electricity

##### DESCRIPTION

Residential Electricity accounts for emissions resulting in electricity use in residential buildings. Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

##### METHODOLOGY

The Residential Electricity emission calculations follow the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.2.1 from Version 1.1 of the Protocol. See COG's Utility Data Summary Template for detailed information on how energy consumption data from utilities is analyzed.

##### DATA COLLECTION

COG annually collects aggregated account and consumption data from the 7 electric utilities that serve metropolitan Washington.

##### Data Needs:

- Accounts: Number of residential electric accounts from all utilities serving metropolitan Washington.
- Consumption: Annual residential electricity use in kilowatt hours from all utilities serving metropolitan Washington.
- eGRID: U.S. Environmental Protection Agency (EPA) eGRID Subregion Output Emission Rates – Greenhouse Gases. Subregions RFC East (RFCE) and SERV Virginia/Carolina (SRVC) total output emission rates of CO<sub>2</sub> (lb/MWh), CH<sub>4</sub> (lb/GWh), and N<sub>2</sub>O (lb/GWh).

##### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

##### STEPS

1. Review COG's completed Utility Data Summary Template for the inventory year. Complete any unfinished work for the inventory year or quality control check the already completed work. Complete simultaneously with the Commercial Electricity calculations.

2. Copy residential account and annual consumption data from the completed Utility Data Summary Template into the Master Excel File's Residential Electricity tab.
3. Research the most recent U.S. EPA eGRID factors. Enter CO<sub>2</sub> lbs/MWh, CH<sub>4</sub> lbs/GWh, and N<sub>2</sub>O lbs/GWh for RFCE and SRVC into the Master Excel File Residential Electricity tab's lower table. These factors should match those used in the Commercial Electricity calculations.
4. Input eGRID factors into ClearPath for the region and each jurisdiction's account. The region should include a Factor Set entered for both RFCE and SRVC. RFCE should be entered for DC and MD jurisdictions and SVRC should be entered for VA jurisdictions.
  - a. In ClearPath, click on *Factor Sets*. Under Factor Sets, click on *Grid Electricity*. Click on + *Add Factor Set*.
  - b. Name your factor sets *Electricity [Year] – DC/MD – RFCE* and/or *Electricity [Year] – VA – SRVC*.
  - c. Select the year of the inventory being completed in the drop-down list.
  - d. Enter appropriate eGRID data (either RFCE or SRVC) for CO<sub>2</sub> lbs/MWh, CH<sub>4</sub> lbs/GWh, and N<sub>2</sub>O lbs/GWh. Make sure the factors entered in ClearPath matches the factors entered into the Master Excel File's Residential Energy tab.
  - e. Click *Save Factor Sets*.
5. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Residential Energy*
  - b. Click on the Calculator titled: *Emissions from Grid Electricity*
  - c. Create an Inventory Record titled: *Residential Electricity [Year]*
    - i. For the Metropolitan Washington Inventory, there will be 2 records, one for DC/MD and one for VA.
  - d. Under *Factor Sets Grid Electricity*, (depending on which state the jurisdiction is in) select *Electricity [Year] – DC/MD – RFCE* or *Electricity [Year] – VA – SRVC*.
  - e. Select "No" for the question *Is this a Direct Entry Record?*
  - f. From the Master Excel File's Residential Electricity tab, enter *Annual Electricity* in ClearPath's Electricity Used cell for each jurisdiction and sub-region. Select *kWh* from the drop-down list.
  - g. From the Master Excel File's Demographics tab, enter *Number of Households* and *Population* (use the ACS numbers).  
Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per person*.
  - h. Click *Save*.
6. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Residential Energy tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- For jurisdictions that have multiple (2 - 3) electric utilities serving their community:
 

Total Jurisdiction # of Accounts = Utility A # of Accounts + Utility B # of Accounts + Utility C # of Accounts

Total Jurisdiction Annual Electricity Consumption = Utility A kWh + Utility B kWh + Utility C kWh

- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = Maryland/DC Sub-Total + Northern VA Sub-Total  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>5</sup> 2015 Metropolitan Washington Energy Utility Data Survey Analysis

[I:/CLIMATE ENERGY/Projects/Utility Data/2005-2015 Data Re-Scrub Files/FINAL](#)

<sup>6</sup> US Environmental Protection Agency. (2017). Emissions and Generation Resource Integrated Database (eGRID2014v2)

Subregion GHG output emission rates v2. Table 3.

[I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Electric and Natural Gas Utility/eGRID](#)

<https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>

Website last accessed: September 2017

## STAFF CONTACTS

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Tim Masters, COG Department of Environmental Programs

## EMISSIONS FROM STATIONARY FUEL

Under the ClearPath Residential Energy tab, the *Emissions from Stationary Fuel Calculator* is used to calculate emissions from residential natural gas, fuel oil and liquified petroleum gas (LPG).

### Residential Natural Gas

#### DESCRIPTION

Residential Natural Gas consumption accounts for combustion emissions from stationary fuel applications, such as furnaces. Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

#### METHODOLOGY

The Residential Natural Gas emission calculations generally follow the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.1 from Version 1.1 of the Protocol. See COG's Utility Data Summary Template for detailed information on how energy consumption data from utilities is analyzed.

## DATA COLLECTION

COG annually collects aggregated account and consumption data from the 3 natural gas utilities that serve metropolitan Washington.

Data Needs:

- Accounts: Number of residential natural gas accounts from all utilities serving metropolitan Washington.
- Consumption: Annual residential consumption of natural gas in Therms from all utilities serving metropolitan Washington.

Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

## STEPS

1. Review COG's completed Utility Data Summary Template for the inventory year. Complete any unfinished work for the inventory year or quality control check the already completed work. Complete simultaneously with the Commercial Natural Gas calculations.
2. Copy residential account and annual consumption data from the completed Utility Data Summary Template into the Master Excel File's Residential Natural Gas tab.
3. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Residential Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel Consumption*
  - c. Create an Inventory Record titled: *Residential Natural Gas [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - a. From the Master Excel File's Residential Natural Gas tab, enter Annual Natural Gas in ClearPath's *Fuel Use* cell for each jurisdiction and region. Select *Therms* from the drop-down list.
  - b. From the Master Excel File's Demographics tab, enter *Number of Households* and *Population* (use the ACS numbers).

Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per person*.
  - e. Click Save.
4. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Residential Natural Gas tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- For jurisdictions that have two natural gas utilities serving their community:  
Total Jurisdiction # of Accounts = Utility A # of Accounts + Utility B # of Accounts  
Total Jurisdiction Annual Natural Gas Consumption = Utility A Therms + Utility B Therms
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County

- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park + Unassigned  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>7</sup> 2015 Metropolitan Washington Energy Utility Data Survey Analysis

<I:/CLIMATE ENERGY/Projects/Utility Data/2005-2015 Data Re-Scrub Files/FINAL>

## STAFF CONTACTS

Maia Davis, COG Department of Environmental Programs

Tim Masters, COG Department of Environmental Programs

## Residential Fuel Oil

### DESCRIPTION

Residential Fuel Oil accounts for both distillate fuel oils and kerosene used in stationary applications. Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

Distillate fuel oils include both fuel oils and diesel fuels that are further classified by level of volatility, listed from least to greatest (No. 1, No. 2, and No. 4). Residential fuel oils are less volatile than gasoline and are burned for space heating or water heating by private household consumers. No.2 fuel oil (Heating Oil) is the most common type used by households for the specific purpose of heating their home, water heating, cooking, etc., excluding farm houses, farming, and apartment buildings. No. 1 fuel oil is used by households mainly for portable outdoor stoves and portable outdoor heaters. Kerosene is a distilled product of oil or coal with the generic name kerosene, having properties like those of No. 1 fuel oil.

### METHODOLOGY

The Residential Fuel Oil emission calculations follows the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.2 from Version 1.1 of the Protocol. This methodology estimates residential fuel oil consumption in gallons (including distillate fuel oil and kerosene) by estimating per household consumption in DC, MD and VA and multiplying that by the estimated number of households using fuel oil as a home heating fuel in the region and each jurisdiction. Gallons are used to estimate emissions.

### DATA COLLECTION

Local data on households and consumption related to fuel oil is not readily available for all COG members. However, the Energy Information Administration (EIA) has readily available data on state-wide fuel oil consumption and the American Community Survey (ACS) has readily available data on number of households using fuel oil as a home heating fuel.

#### Data Needs:

- Households using Fuel Oil: Number of households using fuel oil data for all COG jurisdictions and states collected from the ACS' Selected Housing Characteristics.
- Statewide Residential Fuel Oil Consumption: EIA State Energy Data System (SEDS) data for Statewide Residential Distillate Fuel Oil and Kerosene consumption in thousands of barrels (000' Barrels).

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- No.4 Fuel Oil is not included in residential fuel oil calculations because it is a blended mixture composed of distillate fuel oil and residual fuel oil stocks used extensively in industrial plants and commercial burner installations not equipped with preheating facilities.
- Beginning with the 2015 RECS, kerosene is included with fuel oil because kerosene use is relatively rare for households.
- ACS identifies the number of housing units using "kerosene, fuel oil, etc." This category includes fuel oil, kerosene, gasoline, alcohol, and other combustible liquids. In our calculations, we assume that values for other types of fuel oil beside kerosene and heating oil are marginal.

#### STEPS

1. Input Number of Households Using Fuel Oil as Home Heating Fuel corresponding to each jurisdiction and state from the ACS Community Survey, Selected Housing Characteristics into the Master Excel File's Residential Fuel Oil tab.
2. Input statewide residential energy consumption values for distillate fuel oil and kerosene in (000' Barrels) from the EIA SEDS Database into the Master Excel File's Residential Fuel Oil tab.
3. Input residential consumption gallons into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Residential Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel Consumption*
  - c. Create an Inventory Record titled: *Residential Fuel Oil [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. For the *Fuel Type* drop-down list select "Distillate Fuel Oil #2"
  - f. From the Master Excel File's Residential Fuel Oil tab, enter Residential Consumption in ClearPath's *Fuel Use* cell for each jurisdiction and region. Select *Gallons* from the drop-down list.
  - g. From the Master Excel File's Demographics tab, enter *Number of Households* and *Population* (use the ACS numbers).  
Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per person*.
  - h. Click Save.
4. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Residential Fuel Oil tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Total Statewide Residential Fuel Oil Consumption = Residential Distillate Fuel Oil Consumption in 000' Barrels + Residential Kerosene Consumption in 000' Barrels
- Total Statewide Residential Fuel Oil Consumption in Gallons = (Total Statewide Residential Fuel Oil Consumption in 000' Barrels \* 1,000) \* 42  
Note: This conversion is based on EIA Energy Conversion Calculator
- Per Household Consumption in Gallons = Total Statewide Residential Fuel Oil Consumption in Gallons / Statewide # of Households Using Fuel Oil as Home Heating Fuel
- Local Jurisdiction Residential Fuel Oil Consumption in Gallons = Local Jurisdiction # of Households Using Fuel Oil as Home Heating Fuel \* Per Household Consumption
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>8</sup> U.S. Census Bureau. 2011-2015 American Community Survey

General Housing Characteristics (2015 ACS, DP04)

Subheader: Home Heating Fuel; Row: Fuel oil, kerosene, etc

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://factfinder.census.gov>

Webpage last accessed: September 2017

<sup>9</sup> Energy Information Administration (EIA) State Energy Data System (SEDS)

Table CT4. Residential Sector Energy Consumption Estimates, 1960-2015

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non Utility Fuel>

<https://www.eia.gov/state/seds/>

Webpage last accessed: August 2017

<sup>10</sup> Energy Information Administration (EIA). Energy Conversion Calculators

Crude oil conversion - 1 barrel = 42 U.S. gallons

[https://www.eia.gov/energyexplained/index.php?page=about\\_energy\\_conversion\\_calculator](https://www.eia.gov/energyexplained/index.php?page=about_energy_conversion_calculator)

## **STAFF CONTACTS**

Maia Davis, COG Department of Environmental Programs

## **Residential LPG**

### **DESCRIPTION**

According to the Energy Information Administration (EIA), Liquefied Petroleum Gases (LPG's) are a group of hydrocarbon gases, primarily propane, normal butane, and isobutane, derived from crude oil refining or natural gas processing. These gases may be marketed individually or mixed. They can be liquefied through pressurization (without requiring cryogenic refrigeration) for convenience of transportation or storage. LPG's, often referred to as simply propane or butane, are used as fuel in heating appliances, cooking equipment, and vehicles. Propane is the most common type of LPG supplied to U.S. residences. It is usually delivered by tank trucks and stored near a housing unit in a tank or cylinder until used; however, propane stored in canisters can also be purchased from retail stores. For our purposes, LPG's are equated with propane, yet propane also encompasses similar fuel gases, such as butane, supplied to a residence in liquid form.

Energy use in buildings account for a significant portion of GHG emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

### **METHODOLOGY**

The Residential LPG emission calculations follows the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.2 from Version 1.1 of the Protocol. This methodology estimates residential LPG consumption in gallons by estimating per household consumption in DC, MD and VA and multiplying that by the estimated number of households using fuel oil as a home heating fuel in the region and each jurisdiction. Gallons are used to estimate emissions.

### **DATA COLLECTION**

Local data on households and consumption related to fuel oil is not readily available for all COG members. However, the EIA has readily available data on state-wide fuel oil consumption and the American Community Survey (ACS) has readily available data on number of households using fuel oil as a home heating fuel.

#### Data Needs:

- Households using LPG: Number of households using LPG data for all COG jurisdictions and states collected from the American Community Survey's Selected Housing Characteristics.
- Statewide Residential LPG Consumption: EIA State Energy Data System (SEDs) data for Statewide Residential LPG consumption in thousands of barrels (000' Barrels).

#### Data Notes:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- The ACS identifies the number of homes using "bottled, tank, or LP gas." This category includes liquid propane gas stored in bottles or tanks that are refilled or exchanged when empty.

## STEPS

1. Input Number of Households Using LPG as Home Heating Fuel corresponding to each jurisdiction and state from the ACS Community Survey, [Year] Selected Housing Characteristics into the Master Excel File's Residential LPG tab.
2. Input statewide residential energy consumption values for LPG in (000' Barrels) from the EIA SEDS Database into the Master Excel File's Residential LPG tab.
3. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Residential Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel Consumption*
  - c. Create an Inventory Record titled: *Residential LPG [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. For the *Fuel Type* drop-down list select "LPG"
  - f. From the Master Excel File's Residential LPG tab, enter Residential Consumption in ClearPath's *Fuel Use* cell for each jurisdiction and region. Select *Gallons* from the drop-down list.
  - g. From the Master Excel File's Demographics tab, enter *Number of Households* and *Population* (use the ACS numbers).  
Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per person*.
  - h. Click *Save*.
4. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Residential LPG tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Total Statewide Residential LPG Consumption in Gallons = (Total Statewide Residential LPG Consumption in 000' Barrels \* 1,000) \* 42  
Note: This conversion is based on EIA Energy Conversion Calculator
- Per Household Consumption in Gallons = Total Statewide Residential LPG Consumption in Gallons / Statewide # of Households Using LPG as Home Heating Fuel
- Local Jurisdiction Residential LPG Consumption in Gallons = Local Jurisdiction # of Households Using LPG as Home Heating Fuel \* Per Household Consumption
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

- <sup>11</sup> U.S. Census Bureau. 2011-2015 American Community Survey  
General Housing Characteristics (2015 ACS, DP04)  
Subheader: Home Heating Fuel; Row: Bottled, tank or LP gas  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics](https://factfinder.census.gov)  
<https://factfinder.census.gov>  
Webpage last accessed: September 2017
- <sup>12</sup> Energy Information Administration (EIA) State Energy Data System (SEDS)  
Table CT4. Residential Sector Energy Consumption Estimates, 1960-2015  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non Utility Fuel](https://www.eia.gov/state/seds/)  
<https://www.eia.gov/state/seds/>  
Webpage last accessed: August 2017
- <sup>13</sup> Energy Information Administration (EIA). Energy Conversion Calculators  
Crude oil conversion - 1 barrel = 42 U.S. gallons  
[https://www.eia.gov/energyexplained/index.php?page=about\\_energy\\_conversion\\_calculator](https://www.eia.gov/energyexplained/index.php?page=about_energy_conversion_calculator)

## STAFF CONTACTS

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# Commercial Energy

## EMISSIONS FROM GRID ELECTRICITY

Under the ClearPath Commercial Energy tab, the *Emissions from Grid Electricity Calculator* is used to calculate emissions from non-residential electricity.

### Commercial Electricity

#### DESCRIPTION

Commercial Electricity accounts for emissions resulting in electricity use in commercial, government, industrial, and other non-residential buildings and facilities. Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

#### METHODOLOGY

The Commercial Electricity emission calculations follow the USCP recommended methodology as outlined in Appendix C, BE.2.1 from Version 1.1 of the Protocol. See COG's Utility Data Summary Template for detailed information on how energy consumption data from utilities is analyzed. Consumption data and the U.S. EPA eGRID emission data are factored into the emission estimates calculated in ClearPath.

## DATA COLLECTION

COG annually collects aggregated account and consumption data from the 7 electric utilities that serve metropolitan Washington.

### Data Needs:

- Accounts: Number of commercial electric accounts from all utilities serving metropolitan Washington.
- Consumption: Annual commercial electricity consumption in kilowatt hours from all utilities serving metropolitan Washington.
- eGRID: U.S. Environmental Protection Agency (EPA) eGRID Subregion Output Emission Rates – Greenhouse Gases. Subregions RFC East (RFCE) and SERV Virginia/Carolina (SRVC) total output emission rates of CO<sub>2</sub> (lb/MWh), CH<sub>4</sub> (lb/GWh), and N<sub>2</sub>O (lb/GWh).

### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

## STEPS

1. Review COG's completed Utility Data Summary Template for the inventory year. Complete any unfinished work for the inventory year or quality control check the already completed work. Complete simultaneously with the Residential Electricity calculations.
2. Copy commercial account and annual consumption data from the completed Utility Data Summary Template into the Master Excel File's Commercial Electricity Energy tab.
3. Research the most recent U.S. EPA eGRID factors. Enter CO<sub>2</sub> lbs/MWh, CH<sub>4</sub> lbs/GWh, and N<sub>2</sub>O lbs/GWh for RFCE and SRVC into the Master Excel File Commercial Electricity tab's lower table. These factors should match those used in the Residential Electricity calculations.
4. (Skip this step if already entered Factor Sets while completing Residential Energy steps). Input eGRID factors into ClearPath for the region and each jurisdiction's account. The region should include Factor Set entered for both RFCE and SRVC. RFCE should be entered for DC and MD jurisdictions and SVRC should be entered for VA jurisdictions.
  - a. In ClearPath, click on *Factor Sets*. Under Factor Sets, click on *Grid Electricity*. Click on *+ Add Factor Set*.
  - b. Name your factor sets *Electricity [Year] – DC/MD – RFCE and/or Electricity [Year] – VA – SRVC*.
  - c. Select the year of the inventory being completed in the drop-down list.
  - d. Enter appropriate eGRID data (either RFCE or SRVC) for CO<sub>2</sub> lbs/MWh, CH<sub>4</sub> lbs/GWh, and N<sub>2</sub>O lbs/GWh. Make sure the factors entered in ClearPath match the factors entered into the Master Excel File's Commercial Electricity tab.
  - e. Click *Save Factor Sets*.
5. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Commercial Energy*
  - b. Click on the Calculator titled: *Emissions from Grid Electricity*
  - c. Create an Inventory Record titled: *Commercial Electricity [Year]*

- i. For the Metropolitan Washington Inventory, there will be 2 records, one for DC/MD and one for VA.
- d. Under *Factor Sets Grid Electricity*, (depending on which state the jurisdiction is in) select *Electricity [Year] – DC/MD – RFCE* or *Electricity [Year] – VA – SRVC*.
- e. Select “No” for the question *Is this a Direct Entry Record?*
- f. From the Master Excel File’s Commercial Electricity tab, enter *Annual Electricity* in ClearPath’s Electricity Used cell for each jurisdiction and sub-region. Select *kWh* from the drop-down list.
- g. From the Master Excel File’s Demographics tab, enter *Commercial Workforce Size* (use the ACS numbers), *Number of Commercial Establishments* (CoStar data), and *Commercial Floor Area in 1000 Square Feet*.  
Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per Employee*.
- h. Click Save.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- For jurisdictions that have multiple (2 - 3) electric utilities serving their community:  
Total Jurisdiction # of Accounts = Utility A # of Accounts + Utility B # of Accounts + Utility C # of Accounts  
Total Jurisdiction Annual Electricity Consumption = Utility A kWh + Utility B kWh + Utility C kWh
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George’s County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = Maryland/DC Sub-Total + Northern VA Sub-Total  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

- <sup>14</sup> 2015 Metropolitan Washington Energy Utility Data Survey Analysis  
<I:/CLIMATE ENERGY/Projects/Utility Data/2005-2015 Data Re-Scrub Files/FINAL>
- <sup>15</sup> US Environmental Protection Agency. (2017). Emissions and Generation Resource Integrated Database (eGRID2014v2)  
Subregion GHG output emission rates v2. Table 3.  
<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Electric and Natural Gas Utility/eGRID>  
<https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid>  
Website last accessed: September 2017

## STAFF CONTACTS

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## EMISSIONS FROM STATIONARY FUEL

Under the ClearPath Commercial Energy tab, the *Emissions from Stationary Fuel Calculator* is used to calculate emissions from commercial natural gas, fuel oil and LPG.

### Commercial Natural Gas

#### DESCRIPTION

Natural gas consumption in the non-residential setting produces combustion emissions from stationary applications, such as boilers and furnaces. Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

#### METHODOLOGY

The Commercial natural gas emission calculations generally follow the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.1 from Version 1.1 of the Protocol. See COG's Utility Data Summary Template for detailed information on how energy consumption data from utilities is analyzed.

#### DATA COLLECTION

COG annually collects aggregated account and consumption data from the 3 natural utilities that serve metropolitan Washington.

#### Data Needs:

- Accounts: Number of commercial natural gas accounts from all utilities serving metropolitan Washington.
- Consumption: Annual commercial consumption of natural gas in Therms from all utilities serving metropolitan Washington.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

#### STEPS

1. Review COG's completed Utility Data Summary Template for the inventory year. Complete any unfinished work for the inventory year or quality control check the already completed work. Complete simultaneously with the Residential Natural Gas calculations.
2. Copy commercial account and annual consumption data from the completed Utility Data Summary Template into the Master Excel File's Commercial Natural Gas tab.
3. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Commercial Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel Consumption*
  - c. Create an Inventory Record titled: *Commercial Natural Gas [Year]*

- d. Select “No” for the question *Is this a Direct Entry Record?*
  - a. From the Master Excel File’s Commercial Natural Gas tab, enter Annual Natural Gas in ClearPath’s *Fuel Use* cell for each jurisdiction and region. Select *Therms* from the drop-down list.
  - b. From the Master Excel File’s Demographics tab, enter *Commercial Workforce Size* (use the ACS numbers), *Number of Commercial Establishments* (CoStar data), and *Commercial Floor Area in 1000 Square Feet*.  
 Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per Employee*.
  - e. Click Save.
4. Enter ClearPath’s calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File’s Commercial Natural Gas tab’s MTCO<sub>2</sub>e column.

### **CALCULATIONS**

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- For jurisdictions that have two natural gas utilities serving their community:  
 Total Jurisdiction # of Accounts = Utility A # of Accounts + Utility B # of Accounts  
 Total Jurisdiction Annual Natural Gas Consumption = Utility A Therms + Utility B Therms
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George’s County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
 Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George’s County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park + Unassigned  
 Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

### **SOURCES**

- <sup>16</sup> 2015 Metropolitan Washington Energy Utility Data Survey Analysis  
<I:/CLIMATE ENERGY/Projects/Utility Data/2005-2015 Data Re-Scrub Files/FINAL>

### **STAFF CONTACTS**

Maia Davis, COG Department of Environmental Programs  
 Tim Masters, COG Department of Environmental Programs

## **Commercial Fuel Oil**

## **DESCRIPTION**

Commercial Fuel Oil refers to a liquid petroleum product used as an energy source that is less volatile than gasoline. Commercial Fuel Oil is comprised of distillate fuels (No. 1, 2 and 4), residual fuels (No.5 and 6) and kerosene (No. 1). Distillate fuel oils represent the lighter petroleum fractions produced in conventional distillation processes that include both fuel oils and diesel fuels that are further classified by level of volatility, listed from least to greatest (No. 1, No. 2, and No. 4). Products known as No. 1, No. 2, and No. 4 fuel oils are lighter oils primarily used for space heating and electric power generation. Residual fuels are generally classified as heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations. Kerosene is a light petroleum distillate with properties like those of No. 1 fuel oil; primarily used in space heaters, cook stoves, and water heaters and is suitable for use as a light source when burned in wick-fed lamps.

Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

## **METHODOLOGY**

The Commercial Fuel Oil emission calculations follows the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.3 from Version 1.1 of the Protocol, with one exception. This methodology calculates percent of square footage using fuel oil instead of percent of number of buildings using fuel oil.

Values for commercial building square footage using Fuel Oil were scaled locally by multiplying the local jurisdictional commercial square footage by the percentage of commercial building square footage using Fuel Oil in the broader South Atlantic Region. These values, in turn, were multiplied by the fuel energy intensity in gallons per square foot (gallons/ft.<sup>2</sup>) to get total Fuel Oil consumption per locality and region. Consumption was converted to emissions in ClearPath.

## **DATA COLLECTION**

The number of commercial buildings and total square footage for each COG member jurisdiction is readily available from the 2015 CoStar Commercial Property Records. There is not data readily available on stationary fuel use for these buildings. The Energy Information Administration (EIA) does have data available for larger regions on total commercial buildings and square footage; number and square footage of buildings using Fuel Oil; and energy intensity. EIA's South Atlantic Region in the Commercial Building Energy Consumption Survey (CBECS) includes DC, MD, VA, DE, WV, NC, SC, GA, and FL.

### **Data Needs:**

- Commercial buildings and total square footage: Data for all COG jurisdictions and region are collected from the CoStar Commercial Property Records. This database is available via subscription by COG's Department of Community Planning and Services Department (CPS).
- Total Commercial Floorspace and Commercial Square Footage using Fuel Oil: Values for the South Atlantic Region (most specific region) were derived from the EIA CBECS.
- Fuel Oil Energy Intensity: A value for the South Atlantic Region was derived directly from the EIA CBECS.

### **Notes on Data:**

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- CoStar:
  - The Commercial Construction Inventory focuses on “non-residential” projects that have been completed in metropolitan Washington. These include office, retail, industrial, flex, healthcare, religious, educational, utility, and some government properties and other projects that develop employment space, and in many cases, include associated parking structures. The inventory is limited to projects that create new or additional space. Metropolitan Washington Council of Governments (COG) staff compiled this report by analyzing commercial property records from the CoStar subscription database.
  - All buildings are classified by their majority use. Therefore, a building with 100% office space will be indistinguishable in the database from one with 51 percent office space and 49 percent retail or other use.
  - Flex buildings are: “A type of building(s) designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. Flex buildings typically have ceiling heights under 18', with light industrial zoning. Flex buildings have also been called Incubator, Tech and Showroom buildings in markets throughout the country.”
  - CoStar groups industrial buildings like distribution, warehouses and data centers with Flex space interchangeably, as those classes of buildings have been included in both categories. However, Flex space is more likely to include some office and retail uses, so for the GHG inventory, flex and industrial classes are lumped together.
  - Multi-family buildings (includes only rental buildings, not condos and co-ops) have been omitted from this section of the CoStar data.
- EIA CBECS:
  - A building in the CBECS constitutes “a structure totally enclosed by walls extending from the foundation to the roof, containing over 1,000 square feet of floorspace and intended for human occupancy. Included in the survey as a specific exception were structures erected on pillars to elevate the first fully enclosed level but leaving the sides at ground level open. Excluded from the survey as non-buildings were the following: structures (other than the exception just noted) that were not totally enclosed by walls and a roof (such as oil refineries, steel mills, and water towers), street lights, pumps, billboards, bridges, swimming pools, oil storage tanks, construction sites, and mobile homes and trailers, even if they housed commercial activity. Since 1995, the CBECS has excluded enclosed parking garages and commercial buildings on manufacturing sites”.

## STEPS

1. Request CoStar Commercial Property Records data from COG CPS. Provide CPS template so they know how the data needs to be organized.
2. Input number of commercial buildings and total commercial square footage per jurisdiction from CoStar into the GHG Inventory Master Excel File’s Demographic Summary tab. This data will automatically be populated into the Commercial Fuel Oil tab.

3. Input EIA CBECS South Atlantic Region values for Total Commercial Floorspace (million square feet) and Commercial Square Footage Using Fuel Oil (million square feet) into the lower table in the Master Excel File's Commercial Fuel Oil tab.
4. Input EIA CBECS South Atlantic Region value for Energy Intensity (gallons/square foot) into the lower table in the Master Excel File's Commercial Fuel Oil tab.
5. Formulas are in place in the Master Excel File Commercial Fuel Oil tab to calculate the estimated Total Fuel Oil Consumption by jurisdiction. Input consumption values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Commercial Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel*
  - c. Create an Inventory Record titled: *Commercial Fuel Oil [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. Select "Distillate Fuel Oil No. 2" for *Fuel Type*.
  - f. Enter consumption number from the Master Excel File into the *Fuel Use* cell. Select "Gallons" from the drop-down list.
  - g. From the Demographics tab, enter *Commercial Workforce Size* (use the ACS numbers), *Number of Commercial Establishments* (CoStar data), and *Commercial Floor Area in 1000 Square Feet*.  
 Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per Employee*.
  - h. Click Save.
6. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Commercial Fuel Oil tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- % of Commercial Square Footage Using Fuel Oil = South Atlantic Commercial Square Footage Using Fuel Oil / Total South Atlantic Commercial Floor Space in million square feet
- Local Jurisdiction Square Footage of Commercial Buildings Using Fuel Oil = Total Square Footage of Commercial Buildings \* % of Commercial Buildings Using Fuel Oil
- Local Jurisdiction Fuel Oil Consumption = Square Footage of Commercial Buildings Using Fuel Oil \* Energy Intensity
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
 Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

- <sup>17</sup> CoStar. (2015). Commercial Property Records.  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel](http://www.costar.com/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel)  
[www.costar.com](http://www.costar.com)
- <sup>18</sup> Energy Information Administration (EIA). (2012). Commercial Buildings Energy Consumption Survey (CBECS)  
Table B23. Energy Sources, Floorspace, 2012, South Atlantic  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel](http://www.eia.gov/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel)  
<https://www.eia.gov/consumption/commercial/data/2012/>  
*Webpage last accessed: September 2017*
- <sup>19</sup> Energy Information Administration (EIA). (2016). Commercial Buildings Energy Consumption Survey (CBECS)  
Table C35. Fuel oil consumption and conditional energy intensity by Census region, 2012  
Row: Energy Sources, Fuel Oil; Column: Fuel Oil Energy Intensity, South  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel](http://www.eia.gov/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel)  
<https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c35.php>  
*Webpage last accessed: September 2017*

## STAFF CONTACTS

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## Commercial LPG

### DESCRIPTION

Liquefied Petroleum Gas (LPG) refers to a group of hydrocarbon gases derived from crude oil refining processing. Propane is the most common LPG. In the U.S. and Canada, commercially available propane (LPG) is not totally pure; its typically at least 90% propane, with the rest being ethane, propylene, butane, and odorants including ethyl mercaptan.

Energy use in buildings account for a significant portion of greenhouse gas (GHG) emissions. According to the U.S. Communities Protocol (USCP), local jurisdictions can often influence electricity use through building codes, incentives, and technical assistance.

### METHODOLOGY

In this methodology, any LPG reported was assumed to be propane. The Commercial LPG emission calculations follows the U.S. Communities Protocol recommended methodology as outlined in Appendix C, BE.1.3 from Version 1.1 of the Protocol. This methodology calculates percent of square footage using fuel oil instead of percent of buildings using fuel oil.

Values for commercial building square footage using LPG were scaled locally by multiplying the local jurisdictional commercial square footage by the percentage of commercial building square footage

using LPG in the broader South Atlantic Region. These values, in turn, were multiplied by the fuel energy intensity in gallons per square foot (gallons/ft.<sup>2</sup>) to get total LPG consumption per locality and region. Consumption was converted to emissions in ClearPath.

## **DATA COLLECTION**

The number of commercial buildings and total square footage for each COG member jurisdiction is readily available from the 2015 CoStar Commercial Property Records. There is not data readily available on stationary fuel use for these buildings. The Energy Information Administration (EIA) does have data available on total commercial buildings and square footage or larger regions; number and square footage of buildings using LPG; and energy intensity. EIA's South Atlantic Region in the Commercial Building Energy Consumption Survey (CBECS) includes DC, MD, VA, DE, WV, NC, SC, GA, and FL.

### Data Needs:

- Commercial buildings and total square footage: Data for all COG jurisdictions and region are collected from the CoStar Commercial Property Records. This database is available via subscription by COG's Department of Community Planning and Services Department (CPS).
- Total Commercial Floorspace and Commercial Square Footage using LPG: Values for the South Atlantic Region (most specific region) were derived from the EIA CBECS.
- LPG Energy Intensity: A value for the South Atlantic Region was derived directly from the EIA CBECS.

### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- CoStar:
  - The Commercial Construction Inventory focuses on “non-residential” projects that have been completed in metropolitan Washington. These include office, retail, industrial, flex, healthcare, religious, educational, utility, and some government properties and other projects that develop employment space, and in many cases, include associated parking structures. The inventory is limited to projects that create new or additional space. Metropolitan Washington Council of Governments (COG) staff compiled this report by analyzing commercial property records from the CoStar subscription database.
  - All buildings are classified by their majority use. Therefore, a building with 100% office space will be indistinguishable in the database from one with 51 percent office space and 49 percent retail or other use.
  - Flex buildings are: “A type of building(s) designed to be versatile, which may be used in combination with office (corporate headquarters), research and development, quasi-retail sales, and including but not limited to industrial, warehouse, and distribution uses. At least half of the rentable area of the building must be used as office space. Flex buildings typically have ceiling heights under 18', with light industrial zoning. Flex buildings have also been called Incubator, Tech and Showroom buildings in markets throughout the country.”
  - CoStar groups industrial buildings like distribution, warehouses and data centers with Flex space interchangeably, as those classes of buildings have been included in both

- categories. However, Flex space is more likely to include some office and retail uses, so for the GHG inventory, flex and industrial classes are lumped together.
  - Multi-family buildings (includes only rental buildings, not condos and co-ops) have been omitted from this section of the CoStar data.
- EIA CBECS:
  - A building in the CBECS constitutes “a structure totally enclosed by walls extending from the foundation to the roof, containing over 1,000 square feet of floorspace and intended for human occupancy. Included in the survey as a specific exception were structures erected on pillars to elevate the first fully enclosed level but leaving the sides at ground level open. Excluded from the survey as non-buildings were the following: structures (other than the exception just noted) that were not totally enclosed by walls and a roof (such as oil refineries, steel mills, and water towers), street lights, pumps, billboards, bridges, swimming pools, oil storage tanks, construction sites, and mobile homes and trailers, even if they housed commercial activity. Since 1995, the CBECS has excluded enclosed parking garages and commercial buildings on manufacturing sites”.

## STEPS

1. Request CoStar Commercial Property Records data from COG CPS. Provide CPS template so they know how the data needs to be organized.
2. Input number of commercial buildings and total commercial square footage per jurisdiction from CoStar into the GHG Inventory Master Excel File’s Demographic Summary tab. This data will automatically be populated into the Commercial LPG tab.
3. Input EIA CBECS South Atlantic Region values for Total Commercial Floorspace (million square feet) and Commercial Square Footage Using LPG (million square feet) into the lower table in the Master Excel File’s Commercial LPG tab.
4. Input EIA CBECS South Atlantic Region value for Energy Intensity (gallons/square foot) into the lower table in the Master Excel File’s Commercial LPG tab.
5. Formulas are in place in the Master Excel File Commercial LPG tab to calculate the estimated Total LPG Consumption by jurisdiction. Input consumption values into ClearPath for the region and each jurisdiction’s account.
  - a. Go to the main ClearPath tab titled: *Commercial Energy*
  - b. Click on the Calculator titled: *Emissions from Stationary Fuel*
  - c. Create an Inventory Record titled: *Commercial LPG [Year]*
  - d. Select “No” for the question *Is this a Direct Entry Record?*
  - e. Select “LPG” for *Fuel Type*.
  - f. Enter consumption number from the Master Excel File into the *Fuel Use* cell. Select *Gallons* from the drop-down list.
  - g. From the Demographics tab, enter *Commercial Workforce Size* (use the ACS numbers), *Number of Commercial Establishments* (CoStar data), *Commercial Floor Area in 1000 Square Feet*.

Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per Employee*.

  - h. Click *Save*.
6. Enter ClearPath’s calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File’s Commercial LPG tab’s MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- % of Commercial Square Footage Using LPG = South Atlantic Commercial Square Footage Using LPG / Total South Atlantic Commercial Floor Space in million square feet
- Local Jurisdiction Square Footage of Commercial Buildings Using Propane = Total Square Footage of Commercial Buildings \* % of Commercial Buildings Using LPG
- Local Jurisdiction Total LPG Consumption = Square Footage of Commercial Buildings Using LPG \* Energy Intensity
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>20</sup> CoStar. (2015). Commercial Property Records.

[I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel  
www.costar.com](I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel/www.costar.com)

<sup>21</sup> Energy Information Administration (EIA). (2012). Commercial Buildings Energy Consumption Survey (CBECS)

Table B23. Energy Sources, Floorspace, 2012, South Atlantic

[I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel  
https://www.eia.gov/consumption/commercial/data/2012/](I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel/https://www.eia.gov/consumption/commercial/data/2012/)

Webpage last accessed: September 2017

<sup>22</sup> Energy Information Administration (EIA). (2016). Commercial Buildings Energy Consumption Survey (CBECS)

Table C35. Fuel oil consumption and conditional energy intensity by Census region, 2012

Row: Energy Sources, Fuel Oil; Column: Fuel Oil Energy Intensity, South

[I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel  
https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c35.php](I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Non-Utility Fuel/https://www.eia.gov/consumption/commercial/data/2012/c&e/cfm/c35.php)

Webpage last accessed: September 2017

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# TRANSPORTATION AND MOBILE EMISSIONS

## Transportation and Mobile Emissions

### ON ROAD TRANSPORTATION

Under the ClearPath Transportation and Mobile Emissions tab, the *On Road Transportation Calculator* is used to enter emissions previously calculated by COG's Department of Transportation Planning.

#### On Road Mobile Emissions

##### DESCRIPTION

On Road Mobile Emissions represent exhaust and evaporative emissions of carbon dioxide (CO<sub>2</sub>), nitrous oxide (N<sub>2</sub>O), and methane (CH<sub>4</sub>) from on road passenger and freight motor vehicles. On road mobile emissions account for approximately 1/3<sup>rd</sup> of metropolitan Washington greenhouse gas emissions. On Road emissions can be influenced by local governments through land use and urban design decisions and transportation infrastructure investments. Advancing electrification of the transportation system, overall improvement of the fuel economy, and increasing alternative trip modes play a particularly important role in reducing on road emissions.

##### METHODOLOGY

The On Road Transportation emission calculations generally follow the U.S. Communities Protocol recommended methodology as outlined in Appendix D, TR.1.A from Version 1.1 of the Protocol.

COG Department of Transportation Planning (DTP) staff prepare estimated greenhouse gas emissions (GHG) and modeled vehicle miles traveled (VMT) data based on planning assumptions including the Transportation Planning Board's (TPB) Constrained Long Range Plan (CLRP), COG Cooperative Forecasts (demographic data), and vehicle registration (VIN) data, and modeling tools including the TPB's travel demand model and the Environmental Protection Agency's (EPA) mobile emissions model.

Data for 2015 was based on the 2015 CLRP, Round 8.4 Cooperative Forecasts, 2014 VIN data, Version 2.3.57a travel demand model, and MOVES2014 mobile emissions model. Data for 2005 and 2012 were based on the 2014 CLRP, Round 8.3 Cooperative Forecasts, 2005 VIN data for 2005, 2011 VIN data for 2012, Version 2.3.57 travel demand model, and MOVES2010a mobile emissions model.

It is very difficult to ascertain whether any differences between models represent actual findings, or whether they are occurring due to differences in methodology or tools. DTP staff conducted a sensitivity analysis to compare MOVES2010a and MOVES2014 and estimated a difference of less than 1%; however, different plans and slightly different years were used in the comparison.

DTP staff provide GHG emissions estimates from EPA's mobile emission model for the District of Columbia, Maryland counties, Virginia counties, and the City of Alexandria. Where needed, DEP staff scales data to individual jurisdictions based on population. The data are provided in both short tons and metric tons. MOVES outputs use Global Warming Potential (GWP) Factors from the Intergovernmental Panel on Climate Change Second Assessment Report (IPCC AR2). Therefore, the

MOVES outputs are converted by DEP staff to metric tons and CO<sub>2</sub> equivalents using GWP Factors from IPCC's Fourth Assessment Report (AR4).

#### **DATA COLLECTION**

DTP staff provide GHG emissions estimates by state, jurisdiction, and vehicle type. Emissions are based on both travel and non-travel related inputs to the MOVES model. Exhibit 10 on page 13 of the [Air Quality Conformity Analysis](#) of the 2016 CLRP Amendment and the FY 2017-2022 TIP provides more information on inputs to the MOVES model. Vehicle types are: passenger cars, passenger trucks, motorcycles, school buses, transit buses, intercity buses, refuse trucks, light commercial trucks, motor homes, single unit short-haul trucks, single-unit long-haul truck, combination short-haul trucks, and combination long-haul trucks.

It is important to note that the modeled jurisdiction-level vehicle VMT input to the model is based on the travel occurring on the roadways in each jurisdiction, regardless of where the trips originate and terminate.

Data is provided by DTP staff for the TPB's Planning Area (excluding the Fauquier County urbanized area): City of Alexandria, Arlington County, Fairfax County (including Fairfax City and City of Falls Church), Loudoun County, Prince William County (including Manassas and Manassas Park), Charles County, District of Columbia, Frederick County, Montgomery County, and Prince George's County.

#### **Data Needs:**

- Population: Population data for all COG jurisdictions and regions, as well as U.S. totals, are collected from COG's Cooperative Forecasts and the American Community Survey.
- Emissions: Emissions in short tons of Atmospheric Carbon Dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), and Nitrous Oxide (N<sub>2</sub>O) from the EPA mobile emissions model is obtained from DTP staff.
- Vehicle Miles Travelled: Modeled VMT data by jurisdiction is obtained from DTP staff. This is not used to further calculate emissions; however, it is used as an indicator/benchmark to support local jurisdictions in their understanding of resultant emissions.

#### **Notes on Data:**

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- Estimates for Maryland cities are subtotals of county estimates based on population. In Virginia, the cities have been separated out from Fairfax and Prince William County based on population; therefore, the county totals do not include cities. Cities of Falls Church and Fairfax have been separated from Fairfax County and the Cities of Manassas and Manassas Park have been separated out from Prince William County.

#### **STEPS**

1. Request On Road emission data from COG's Department of Transportation Data Team. Request Atmospheric CO<sub>2</sub>, Methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O) emissions, and vehicle miles travelled (VMT) summarized by jurisdiction. Data can be provided in short tons for the following jurisdictions:

District of Columbia  
Charles County

Frederick County  
 Montgomery County  
 Prince George's County  
 Alexandria  
 Arlington County  
 Fairfax County (includes Fairfax City and Falls Church)  
 Loudoun County  
 Prince William County (includes Manassas and Manassas Park)

2. Enter Short Tons of CO<sub>2</sub> and CH<sub>4</sub> in the Master Excel File's Off Road Mobile Emissions tab.
3. Input emissions into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Transportation & Mobile Sources*
  - b. Click on the Calculator titled: *On Road Transportation*
  - c. Create an Inventory Record titled: *On Road Mobile Emissions [Year]*
  - d. Select "Yes" for the question *Is this a Direct Entry Record?*
    - From the Master Excel File's On Road Mobile Emissions tab, enter CO<sub>2</sub> Equivalent, Metric Tons in ClearPath's *Previously Calculated CO<sub>2</sub>e* cell for each jurisdiction and region.
    - From the Master Excel File's Demographics tab, enter *Population* (use the MWCOG Forecast numbers, where available, and where not available use ACS numbers).  
 Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *Emissions per Capita*.
  - e. Click Save.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Total On Road Emissions in Short Tons of CO<sub>2</sub>e = Short Tons of Atmospheric CO<sub>2</sub> + (Short Tons of CH<sub>4</sub> \* 25) + (Short Tons of N<sub>2</sub>O \* 298)  
 Note: CO<sub>2</sub>e for CH<sub>4</sub> = 25 and CO<sub>2</sub>e for N<sub>2</sub>O = 298
- Metric Tons = Short Tons \* 0.90718474  
 Note: Used to convert short tons to metric tons for Atmospheric CO<sub>2</sub>, Methane (CH<sub>4</sub>), and Nitrous Oxide (N<sub>2</sub>O)
- For Maryland Cities and Town of Purcellville, VA MT of CH<sub>4</sub> and CO<sub>2</sub> are downscaled from the county by population:  
 City Off Road Emissions in MTCO<sub>2</sub>e = County Off Road Emissions in MTCO<sub>2</sub>e \* City % of County Population
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is in place for quality control:  
 Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

## SOURCES

- <sup>23</sup> Metropolitan Washington Council of Governments. (2015). Transportation Planning Board Constrained Long Range Plan (CLRP), Version 2.3.57a travel demand model, MOVES2014 mobile emissions model, and Round 8.4 Cooperative Forecasts  
Vuksan, D. and Park, J. MWCOG. (2017). Greenhouse Gas Emissions by Jurisdiction and Vehicle Type. Memo prepared for MWCOG Environmental Programs staff, Washington D.C.
- <sup>24</sup> Energy Information Administration (EIA). FAQs. How do I convert between short tons and metric tons?  
<https://www.eia.gov/tools/faqs/faq.php?id=7&t=2>  
*Website last access: November 2017*

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## AVIATION TRAVEL

Under the ClearPath Transportation and Mobile Emissions tab, the *Aviation Travel Calculator* is used to enter emissions previously calculated by COG's Department of Environmental Programs.

### Passenger Air Travel

#### DESCRIPTION

Passenger air travel emissions accounts for commercial aircraft emissions from major commercial airports serving the region and allocates those emissions to local communities based on users of the airport. The U.S. Communities Protocol (USCP) states that aircraft emissions often represent more than 90% of airport related emissions.

#### METHODOLOGY

The Passenger Air Travel emission calculations generally follows the USCP recommended methodology as outlined in Appendix D, TR.6.D from Version 1.1 of the Protocol. In this approach, emissions by community is estimated by taking a GHG inventory completed for a specific airport and allocating emissions in accordance with the percent of passengers traveling from/to the airport. COG's approach uses the best available data to downscale an estimate of air travel passenger emissions by airport and originating passenger survey data.

Commercial aircraft emissions are calculated for air passenger trips originating in COG member jurisdictions. This includes all air passengers leaving a COG member jurisdiction that fly out of Baltimore-Washington International Thurgood Marshall Airport (BWI), Ronald Reagan Washington National Airport (DCA), and Washington Dulles International Airport (IAD). This includes personal travel and business travel by people who live, work, or were visiting a COG member jurisdiction.

To estimate emissions per airport, national aircraft emissions are downscaled based on the local to national ratio of revenue passenger miles for BWI, DCA, and IAD. Its further downscaled by percent of passengers originating from the region. Emissions are applied locally based on their contribution to

each airport's originating passengers. This approach does not account for aircraft emissions and air passengers that are, for instance, flying into IAD and taking a connecting flight elsewhere.

COG's approach is generally consistent with the Delaware Valley Regional Planning Commission's (DVRPC) methodology. DVRPC is one of three regional agencies nationwide that conduct regional GHG inventories and include jurisdictional breakouts (MWCOG and LA Regional Commission are the other two).

#### **DATA COLLECTION**

For all originating air passengers departing from the region's three commercial airports – BWI, DCA, IAD – the biennial Washington-Baltimore Regional Air Passenger Survey provides readily available origin-destination data by mode of access, trip origination (home, non-home), resident status (resident, non-resident), and trip purpose (work, non-work), for base and forecast years.

There is also readily available data on commercial aircraft emissions and passenger miles travelled for the airports serving the region through EPA and the Bureau of Transportation Statistics, respectively. This data is used to estimate GHG aircraft emissions by airport because there is not readily available measured data with consistent methodologies applied for GHG emissions for the three airports that serve the region.

#### **Data Needs:**

- **Number of Originating Air Passengers:** Data for number of originating air passengers to each airport for each COG jurisdiction is collected from the Washington-Baltimore Regional Air Passenger Survey Geographic Findings Report. Data is pulled by "Jurisdiction" for the counties, District of Columbia, and the City of Alexandria. Data for the rest of the cities is pulled by "Airport Analysis Zone."
- **Total Revenue Passenger Miles:** Data for each airport and U.S. totals are directly inputted from the Bureau of Transportation Statistics.
- **U.S. Total Commercial Aircraft Emissions:** Value in MMTCO<sub>2e</sub> inputted from: U.S. Environmental Protection Agency Inventory of U.S. GHG Emissions and Sinks.
- **Total Enplanements:** Volume for BWI, DCA, and IAD are directly inputted from the COG. Washington-Baltimore Regional Air Passenger Survey Geographic Findings Report.

#### **Notes on Data:**

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- The Inventory of U.S. GHG Emissions and Sinks Report states U.S. commercial aircraft emissions consist of passenger aircraft, cargo, and other chartered flights. To downscale total US commercial aircraft emissions to each airport serving Metropolitan Washington, it is assumed that all commercial aircraft emissions are all from passenger's miles travelled and not from cargo. This approach is consistent with the Delaware Valley Regional Planning Commission's (DVRPC) methodology.

## STEPS

1. Input Number of Originating Air Passengers to BWI, DCA, and IAD airports from each COG jurisdiction and region in the Master Excel File's Passenger Air Travel tab using data from the most recent Washington-Baltimore Regional Air Passenger Survey Geographic Findings Report.

- a. If the inventory year is not available, interpolate, if possible.
- b. Data is pulled from the "Jurisdiction" table for the counties, D.C., Alexandria. Data for the following cities are pulled directly from the "Airport Analysis Zone" (AAZ) table. The AAZ Code for each city is as follows:

City of Frederick – 96

City of Gaithersburg – 55

City of Rockville – 61

City of Takoma Park – 68

City of Bowie – 76

City of Fairfax – 41

- c. For cities with a significantly smaller footprint than the AAZ, the number of originating passenger input data will be downscaled based on city-to-AAZ demographic data. Pull data from the AAZ table and downscale AAZ number of originating passengers to the city as follows:

City	AAZ #	Downscale Percentage
Bladensburg, MD	69	8%
College Park, MD	70	80%
Greenbelt, MD	74	36%
Hyattsville, MD	69	11%
Laurel, MD	73	49%
Falls Church, VA	34	10%
Manassas, VA	87	39%
Manassas Park, VA	87	14%
Purcellville, VA	94	17%

Note: A one-time analysis was completed to determine the appropriate downscale factors using Transportation Analysis Zones (TAZ) population data. TAZs are small area planning zones with demographic data assigned in line with the COG Cooperative Forecasts. When grouped together, TAZ zones generally geographically align with cities and AAZs. Therefore, TAZ demographic data were analyzed to determine the percent to downscale the AAZ number of originating air passengers to city-scale.

2. Input Total Revenue Passenger Miles for BWI, DCA, IAD and U.S. total (all airports nationwide) in the Master Excel File's Passenger Air Travel tab in the lower table using the Bureau of Transportation Statistics data.
3. Input Million Metric Tons of Carbon Dioxide Equivalent (MMTCO<sub>2e</sub>) of Total Commercial Aircraft Emissions for All Airports Nationwide (U.S. total) in the Master Excel File's Passenger Air Travel tab in the lower table using the annual EPA Inventory of U.S. Emissions and Sinks data.

4. Input number of Annual Total Enplanements for BWI, DCA, and IAD in the Master Excel File's Passenger Air Travel tab in the lower table from the most recent Washington-Baltimore Regional Air Passenger Survey Geographic Findings Report.
  - a. If the inventory year is not available, interpolate, if possible.
5. Input emissions into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Transportation & Mobile Sources*
  - b. Click on the Calculator titled: *Aviation Travel*
  - c. Create an Inventory Record titled: *Passenger Air Travel [Year]*
  - d. Select "Yes" for the question *Is this a Direct Entry Record?*
  - e. Enter 100% for the question on *Local Attribution*.
  - f. From the Master Excel File's Passenger Air Travel tab, enter 2015 Commercial Aircraft Emissions (MTCO<sub>2e</sub>), TOTALS in ClearPath's *Previously Calculated CO2* cell for each jurisdiction and region.
  - g. Click Save.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- By Airport:
  - % of U.S. Revenue Passenger Miles by Airport =  $\text{Airport Specific Passenger Miles} / \text{Total U.S. Passenger Miles}$
  - Commercial Aircraft Emissions by Airport in MMTCO<sub>2e</sub> = % of U.S. Revenue Passenger Miles by Airport \* U.S. Total Commercial Aircraft Emissions in MMTCO<sub>2e</sub>
  - Commercial Aircraft Emissions by Airport in MTCO<sub>2e</sub> = Commercial Aircraft Emissions by Airport in MMTCO<sub>2e</sub> \* 1,000,000
  - % of Local Origination Enplanements =  $\text{Total \# of Originating Passengers by Airport} / \text{Total Enplanements by Airport}$
  - Commercial Aircraft Emissions from Local Origination in MTCO<sub>2e</sub> =  $\text{Total Aircraft Emissions by Airport in MTCO}_2\text{e} * \% \text{ of Local Origination Enplanements}$
- By Jurisdiction:
  - Fairfax County # of Originating Air Passengers =  $\text{Fairfax County, City, and Falls Church Combined \# of Originating Air Passengers} - (\text{Fairfax City} + \text{Falls Church Originating Air Passengers})$
  - Prince William County # of Originating Air Passengers =  $\text{Prince William County, Manassas City, and Manassas Park Combined \# of Originating Air Passengers} - (\text{Manassas City} + \text{Manassas Park Originating Air Passengers})$
  - Local Jurisdiction's % Originating Air Passengers by Airport =  $\text{Local Jurisdiction \# of Originating Air Passengers by Airport} / \text{Regional Total \# of Originating Air Passengers by Airport}$
  - Local Jurisdiction Commercial Aircraft Emissions by Airport in MTCO<sub>2e</sub> =  $\text{Local Jurisdiction \% of Originating Air Passengers} * \text{Commercial Aircraft Emissions from Local Origination}$
  - Commercial Aircraft Emissions in MTCO<sub>2e</sub> by Jurisdiction =  $\text{BWI Commercial Aircraft Emissions} + \text{DCA Commercial Aircraft Emissions} + \text{IAD Commercial Aircraft Emissions}$
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County

- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Metropolitan Washington Airport Totals = BWI + DCA + IAD
- A Totals Check is calculated for quality control:  
Metropolitan Washington Total Emissions = BWI Emissions + DCA Emissions + IAD Emissions

## SOURCES

- <sup>25</sup> MWCOG. (2016). Washington-Baltimore Regional Air Passenger Survey Geographic Findings Report 2015 Section II. Findings. Page 8. Table 1: Annual Trip Originations by Airport Appendix C. Page 45. Air Passenger Originations by AAZ Appendix H. Page 65. Table 16: Originating Passengers by Jurisdiction  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Transportation and Mobile Emissions/Passenger Air Travel](http://www.mwcog.org/documents/2016/11/16/washington-baltimore-regional-air-passenger-survey-geographic-findings-report-airport-access/)  
[www.mwcog.org/documents/2016/11/16/washington-baltimore-regional-air-passenger-survey-geographic-findings-report-airport-access/](http://www.mwcog.org/documents/2016/11/16/washington-baltimore-regional-air-passenger-survey-geographic-findings-report-airport-access/)  
*Webpage last accessed: July 2017*
- <sup>26</sup> Bureau of Transportation Statistics. Airline Information: Revenue Passenger Miles. All Carriers, Domestic and International by Origin Airport for All Airports, BWI, Dulles, and Reagan  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Transportation and Mobile Emissions/Passenger Air Travel](http://www.transtats.bts.gov/Data_Elements.aspx?Data=3)  
[https://www.transtats.bts.gov/Data\\_Elements.aspx?Data=3](https://www.transtats.bts.gov/Data_Elements.aspx?Data=3)  
*Webpage last accessed: July 2017*
- <sup>27</sup> U.S. Environmental Protection Agency. (2017). Inventory of U.S. GHG Emissions and Sinks - 1990-2015 Chapter 3. Energy. Page 3-24. Table 3-12: CO<sub>2</sub> Emissions from Fossil Fuel Combustion in Transportation End-Use Sector (MMT CO<sub>2</sub> Eq.), Commercial Aircraft row, 2015 column  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Methodologies/Other Supporting Methodologies and Models/EPA/EPA Inventory of US GHG Emissions and Sinks - 1990-2015](http://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015)  
[www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015](http://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015)  
*Webpage last accessed: July 2017*

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## RAIL TRANSPORTATION

Under the ClearPath Transportation and Mobile Emissions tab, the *Rail Transportation Calculator* is used to enter emissions previously calculated by COG's Department of Environmental Programs.

### Rail Transportation

#### DESCRIPTION

Rail Transportation calculates emissions resulting from MARC and Virginia Railway Express (VRE) trains carrying commuters from Maryland and Virginia. Combined average weekday ridership is approximately 60,000 passengers. These commuter rail services serve an important role in providing for a balanced intermodal transit for metropolitan Washington. Local jurisdictions may have influence on service levels in its community via supportive land use policies, infrastructure investments, and connecting transit services.

#### METHODOLOGY

The Commuter Rail Transportation emission calculations generally follow the UUSCP recommended methodology as outlined in Appendix D, TR.4 from Version 1.1 of the Protocol. In this approach, emissions are calculated from annual diesel consumption of commuter rail operators.

Maryland Transit Administration (MTA) and VRE reports diesel consumption for their full commuter rail operations, some of which occurs outside of metropolitan Washington. MTA and VRE annual diesel consumption are attributed to the region by the percent of stations located in the region – 59% of MTA's MARC stations and 75% of VRE stations are located in the region. Emissions for local jurisdictions in Maryland and Virginia are further downscaled by population. No commuter rail emissions are attributed to the District of Columbia.

#### DATA COLLECTION

Diesel consumption of commuter rail systems (code CR) is readily available via the Federal Transit Administration's (FTA) National Transit Database. Data is downscaled by station locations and population because there is no readily available, consistent data for both MTA and VRE commuter rail passenger travel activity.

#### Data Needs:

- Population: Population data for all COG jurisdictions and regions, as well as U.S. totals, are collected from the American Community Survey.
- Diesel Consumption: Annual diesel consumption in gallons for the MTA and VRE as reported to the FTA National Transit Database.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

#### STEPS

1. Enter the annual Diesel Consumption for the inventory year from the FTA National Transit Database for the MTA and VRE in the Master Excel File's Commuter Rail tab in the lower table.

2. In the Master Excel File's Commuter Rail tab in the lower table enter local attribution as 59% for MTA and 75% for VRE.
3. Input the regional inventory record into ClearPath first (before local jurisdictions).
  - a. Under the Metropolitan Washington ClearPath account, go to the main tab titled: *Transportation & Mobile Sources*
  - b. Click on the Calculator titled: *Rail Transportation*
  - c. Create two Inventory Records titled: *MARC Rail Transportation [Year]* and *VRE Rail Transportation [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. Select the "In-Boundary" option for the *Location* drop-down list.
  - f. Select the "Passenger" option for the *Rail Type* drop-down list.
  - g. For *Local Attribution*, enter 75% for VRE and 59% for MARC.
  - h. For *Fuel Type*, select the "Diesel" option from the drop-down list.
  - i. From the Master Excel File's Rail Transportation tab, enter *2015 Diesel Consumption* by Commuter Rail Operator in ClearPath's *Fuel Quantity* cell. Select gallons from the drop-down list.
  - j. Click Save.
  - k. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results by Commuter Rail Operator under the Master Excel File's Rail Transportation tab, Data Inputs and Factors table, MTCO<sub>2</sub>e column.
4. Input the inventory records into ClearPath for each local jurisdiction.
  - a. Under the Metropolitan Washington ClearPath account, go to the main tab titled: *Transportation & Mobile Sources*
  - b. Click on the Calculator titled: *Rail Transportation*
  - c. Create Inventory Record titled: *Rail Transportation [Year]*
  - d. Select "Yes" for the question *Is this a Direct Entry Record?*
  - e. Select the "Out-of-Boundary" option for the *Location* drop-down list.
  - f. Select the "Passenger" option for the *Rail Type* drop-down list.
  - g. From the Master Excel File's Rail Transportation tab, enter *2015 MTCO<sub>2</sub>e* by jurisdiction (from the top table) in ClearPath's *Previously Calculated CO<sub>2</sub>* cell.
  - h. Click Save.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- $VA \text{ Local Jurisdiction Percent of Population} = VA \text{ Local Jurisdiction Population} / \text{Northern VA Population}$
- $MD \text{ Local Jurisdiction Population} = MD \text{ Local Jurisdiction Population} / \text{Suburban MD Population}$
- $\text{Local Jurisdiction Commuter Rail Emissions in MTCO}_2\text{e} = \text{Local Jurisdiction Percent of Population} * \text{Commuter Rail Operator Emissions}$
- $\text{Suburban MD Subtotal} = \text{Charles County} + \text{Frederick County} + \text{Montgomery County} + \text{Prince George's County}$
- $\text{Northern Virginia Subtotal} = \text{Alexandria} + \text{Arlington} + \text{Fairfax County} + \text{Fairfax City} + \text{Falls Church} + \text{Loudoun County} + \text{Prince William County} + \text{Manassas} + \text{Manassas Park}$
- $\text{Metropolitan Washington Total} = \text{DC} + \text{Suburban MD} + \text{Northern VA}$
- Totals Checks are in place for quality control:

Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

Also, total Metropolitan Washington MTCO<sub>2e</sub> in the main local jurisdiction table needs to match the total in the lower table that adds MTA and VRE emissions to get a regional total.

## SOURCES

<sup>28</sup> Federal Transit Administration. National Transit Database

2015 Annual Energy Consumption; rows for MTA and VRE, CR (Commuter Rail)

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Transportation and Mobile Emissions/Rail](https://www.transit.dot.gov/CLIMATE ENERGY/Projects/Inventory/2015/Data/Transportation and Mobile Emissions/Rail)

<https://www.transit.dot.gov/ntd/data-product/2015-annual-database-energy-consumption>

Website Last Accessed: March 2018

## STAFF CONTACTS

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## EMISSIONS FROM OFF ROAD VEHICLES

Under the ClearPath Transportation and Mobile Emissions tab, the *Emissions from Off Road Vehicles Calculator* is used to enter emissions previously calculated by COG's Department of Environmental Programs.

### Off Road Mobile Emissions

#### DESCRIPTION

Off Road Mobile Emissions account for nonroad equipment using gasoline, diesel, compressed natural gas and liquified petroleum gas. Nonroad mobile sources are broken up into the following categories:

- Lawn and garden equipment
- Airport service and ground equipment
- Logging equipment
- Recreational marine equipment
- Light commercial equipment
- Industrial equipment
- Construction and mining equipment
- Agricultural or farm equipment
- Recreational land vehicles or equipment
- Railroad maintenance equipment

While off road emissions account for a small percent of the overall GHG emissions, emissions are increasing across metropolitan Washington due to a lack of control measures.

#### METHODOLOGY

The Off Road Transportation emission calculations generally follow the U.S. Communities Protocol recommended methodology as outlined in Appendix D, TR.1.8 from Version 1.1 of the Protocol.

EPA's Motor Vehicle Emissions Simulator (MOVES2014a), incorporates the NONROAD2008 model. The MOVES2014a/NONROAD2008 model calculates past, present, and future emission inventories (i.e., tons of pollutant) for nonroad equipment. Off Road emissions data for Atmospheric Carbon Dioxide (CO<sub>2</sub>) and Methane (CH<sub>4</sub>) are pulled from the model for the inventory year. MOVES outputs are in short tons and use Global Warming Potential (GWP) Factors from the Intergovernmental Panel on Climate Change Second Assessment Report (IPCC AR2). Therefore, the MOVES outputs need to be converted to metric tons and the CO<sub>2</sub> equivalents need to be updated using GWP Factors from IPCC's Fourth Assessment Report (AR4). Data is downscaled by population for cities in Maryland and Town of Purcellville.

Off Road categories excluded from the MOVES2014a/NONROAD2008 model include large commercial marine, passenger and freight locomotives, and aircraft. Metropolitan Washington does not have a large marine port, so excluding large commercial marine vessels is not a concern for the purposes of COG's GHG inventory work. Emissions from locomotives and aircraft are however included in separate calculations above.

#### **DATA COLLECTION**

The MOVES 2014a/NONROAD2008 model data outputs are available for the District of Columbia, Maryland counties, and Virginia counties and independent cities.

#### Data Needs:

- Population: Population data for all COG jurisdictions and regions, as well as U.S. totals, are collected from COG Cooperative Forecasts and the American Community Survey.
- Emissions: Emissions in short tons of Atmospheric Carbon Dioxide (CO<sub>2</sub>) and Methane (CH<sub>4</sub>) from the EPA MOVES 2014a/NONROAD2008 Model is obtained from COG Department of Environment's Air Quality Program.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

#### **STEPS**

1. Request Off Road emission data from COG's Air Quality Forecaster. Request annual Atmospheric CO<sub>2</sub> and Methane (CH<sub>4</sub>) emissions summarized by jurisdiction. Include both weekday and weekend totals. Data will be provided in short tons by FIP code. The request should include the following FIPs:

- 11001 – District of Columbia
- 24017 – Charles County
- 24021 – Frederick County
- 24031 – Montgomery County
- 24033 – Prince George's County
- 51510 – Alexandria
- 51013 – Arlington County
- 51059 – Fairfax County
- 51600 – Fairfax City
- 51610 – Falls Church
- 51107 – Loudoun County

51153 – Prince William County  
51683 – Manassas  
51685 – Manassas Park

2. Enter Short Tons of CO<sub>2</sub> and CH<sub>4</sub> in the Master Excel File's Off Road Mobile Emissions tab.
3. Input emissions into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Transportation & Mobile Sources*
  - b. Click on the Calculator titled: *Emissions from Off Road Vehicles*
  - c. Create an Inventory Record titled: *Off Road Mobile Emissions [Year]*
  - d. Select "Yes" for the question *Is this a Direct Entry Record?*
  - e. From the Master Excel File's On Road Mobile Emissions tab, enter Total MTCO<sub>2</sub> in ClearPath's *Previously Calculated CO<sub>2</sub>e* cell for each jurisdiction and region.
  - f. Click Save.

### **CALCULATIONS**

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Metric Tons = Short Tons \*0.90718474  
Note: Used to convert short tons to metric tons for both Atmospheric CO<sub>2</sub> and Methane (CH<sub>4</sub>)
- Total Off Road Emissions in MTCO<sub>2</sub>e = (Metric Tons of Methane \*25) + Metric Tons of Atmospheric CO<sub>2</sub>  
Note: CO<sub>2</sub>e for CH<sub>4</sub> = 25
- For Maryland Cities and Town of Purcellville, VA MT of CH<sub>4</sub> and CO<sub>2</sub> are downscaled from the county by population:  
City Off Road Emissions in MTCO<sub>2</sub>e = County Off Road Emissions in MTCO<sub>2</sub>e \* City % of County Population
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

### **SOURCES**

<sup>29</sup> MOVES2014a mobile emissions model/NONROAD2008

<sup>30</sup> Energy Information Administration (EIA). FAQs. How do I convert between short tons and metric tons?  
<https://www.eia.gov/tools/faqs/faq.php?id=7&t=2>  
Website last access: November 2017

### **STAFF CONTACTS**

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# WASTEWATER TREATMENT

## Water and Wastewater

### FUGITIVE EMISSIONS FROM SEPTIC SYSTEMS

Under the ClearPath Water and Wastewater tab, the *Fugitive Emissions from Septic Systems Calculator* is used to calculate emissions from the population served by septic.

#### Septic System Emissions

##### DESCRIPTION

Septic Systems Emissions account for the fugitive emissions resulting from the physical settling and biologic activity during the treatment process in septic tanks. In 2015, approximately 6.5% of the population in the region was served by septic. According to the U.S. Communities Protocol (USCP), local governments can influence community septic through local building codes, providing and promoting incentives, etc.

##### METHODOLOGY

The Fugitive Emissions from Septic Systems calculations follow the U.S. Communities Protocol recommended methodology as outlined in Appendix F.WW.11 from Version 1.1 of the Protocol. The methodology estimates GHG emissions based on the population served by septic.

To estimate population served by septic, first the Regional Wastewater Flow Forecast Model (RWFFM) is run to estimate population served by sewer by wastewater treatment plant (WWTP) and by jurisdiction. COG's Wastewater Team works closely with utilities and annually collects plant-level data to feed the RCFFM. Total population subtracted from the population served by sewer provides a population served by septic estimate.

For the purposes of the inventory (and via guidance by the cities), all cities except Bowie are assumed to have no population on septic.

##### DATA COLLECTION

The RWFFM is processed by COG staff and provides data that is available to use for the purposes of the GHG inventories. COG Cooperative Forecasts are used for population estimates. The model may need to be re-run to align with the Cooperative Forecast version used for the GHG inventory. For the cities where there is not population data available, ACS population data should be used.

##### Data Needs:

- Population served by septic: All cities have zero septic except for a small portion in Bowie. Data retrieved from RWFFM developed by COG Department of Environmental Programs Wastewater Modeler.

##### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

- Although data is readily available on number of septic systems by county, population served by those systems are not readily available. Although this methodology is using data that aligns with the robust RWFFM, population served by septic could be estimated based on the average number of people living per household. COG staff has spot checked the septic results using this approach.

## STEPS

1. In the GHG Inventory Master Excel file's Septic System Emissions tab Population Served by Septic column, mark all cities (except Bowie) as having zero population on septic and zero septic emissions.
2. Request RWFFM data from COG's Wastewater Modeler. It should be a single request to the Wastewater team for septic, sewer, and process N2O data. The request should include:
  - a. Population derived from the same version of the COG Cooperative Forecasts that's being used for the On Road Transportation modeling.
  - b. Provide population served by wastewater treatment plant and by county.
  - c. Daily Nitrogen Load in kg N/day by wastewater treatment plant and by county.  
Note: This data will be used in the calculations for process N2O from effluent discharge;
  - d. Work closely with wastewater data team to translate population served and nitrogen load data from treatment plant to county.

Jurisdiction *	WWTPs Serving Jurisdiction
District of Columbia	Blue Plains
<b>Suburban Maryland</b>	
Charles County	Indian Head, La Plata, Mattawoman, Naval Surface Warfare Center, Swan Point
Frederick County	Brunswick, Emmitsburg, Fort Detrick, Mount Airy, Thurmont, Winebrenner
Frederick City	Ballenger, Frederick City
Montgomery County	Blue Plains, Damascus, Parkway, Poolesville, Seneca
Gaithersburg	Blue Plains
Rockville	Blue Plains
Takoma Park	Blue Plains
Prince George's County	Blue Plains, Marlboro Meadows, Mattawoman, Parkway, Piscataway, USDA, Western Branch
Bowie	Bowie, Western Branch
College Park	Blue Plains
Greenbelt	Blue Plains
Hyattsville	Blue Plains
Laurel	Blue Plains
Bladensburg	Blue Plains
<b>Northern Virginia</b>	
Alexandria	Arlington, Alexandria Renew Enterprises (ASA)
Arlington	Arlington, Blue Plains via Fairfax Water
Fairfax County	Arlington, ASA, Blue Plains, Harbor View, Mooney, Norman Cole, Upper Occoquan
Fairfax City	Norman Cole

Falls Church	Arlington, ASA
Loudoun County	Blue Plains, Broad Run, Leesburg, Upper Occoquan, Purcellville, Round Hill
Prince William County	Dale Services Corporation #1 and #8, Mooney, Nokesville, Occoquan Forest, PWC School Board, Quantico, Upper Occoquan
Manassas	Upper Occoquan
Manassas Park	Upper Occoquan

\* Cities in Maryland are subsets of counties.

3. Estimate population served by septic. For the counties and Bowie, take the total population from COG's Cooperative Forecast and subtract population served by sewer. Enter this into the Population Served by Septic column in the Master Excel File's Septic System Emissions tab.
4. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Water & Wastewater*
  - b. Click on the Calculator titled: *Fugitive Emissions from Septic Systems*
  - c. Create an Inventory Record titled: *Septic System Emissions [Year]*
  - d. Select "Population" for *Calculation Type*.
  - e. Enter Population Served by Septic from the Master Excel File into the *Population Served* cell.
  - f. Click Save.
5. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Septic System Emissions tab's Septic Emissions (MTCO<sub>2</sub>e) column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in MTCO<sub>2</sub>e = MMTCO<sub>2</sub>e \* 1,000,000
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>31</sup> MWCOG Cooperative Forecasts 8.4

Round 8.4 Cooperative Forecasting Summary Tables - Adopted October 14, 2015 (Excel Spreadsheet)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://www.mwcog.org/documents/2016/11/16/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/>

Webpage last accessed: July 2017

<sup>32</sup> U.S. Census Bureau. 2011-2015 American Community Survey 5-Year Population Estimates

Demographic and Housing Estimates (2015 ACS, Table DP05)

[i:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics](https://factfinder.census.gov)

<https://factfinder.census.gov>

Webpage last accessed: July 2017

<sup>33</sup> MWCOG Regional Wastewater Flow Forecast Model

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## **NITRIFICATION/DENITRIFICATION PROCESS N<sub>2</sub>O EMISSIONS FROM WASTEWATER**

Under the ClearPath Water and Wastewater tab, the *Nitrification/Denitrification Process N<sub>2</sub>O Emissions from Wastewater Calculator* is used to calculate emissions from the population served by sewer.

### **Sewer System Emissions**

#### **DESCRIPTION**

This calculation of Sewer System Emissions accounts for N<sub>2</sub>O emissions during the treatment process at wastewater treatment plants (WWTPs). All WWTPs in the region operate with nitrification (converting ammonia to nitrate) and denitrification (converting nitrate into nitrogen gas) processes to remove nutrients from wastewater. This process protects the water quality of local waterways. In 2015, more than 90% of the population in the region was being served by a WWTP.

According to the U.S. Community Protocol (USCP), wastewater utilities can potentially offset GHG emissions through renewable energy generation from biogas and/or biosolids, using reclaimed water to displace imported water, or producing biosolids as fertilizer for use.

#### **METHODOLOGY**

The Nitrification/Denitrification Process N<sub>2</sub>O Emissions from Wastewater Treatment calculations follow the U.S. Communities Protocol recommended methodology as outlined in Appendix F.WW.7 from Version 1.1 of the Protocol. The methodology estimates GHG emissions based on the population served by sewer.

Population served by sewer is estimated via a robust Regional Wastewater Flow Forecast Model (RWFFM). Outputs include population served by sewer by wastewater treatment plant (WWTP) and by jurisdiction. COG's Wastewater Team works closely with utilities and annually collects plant-level data to feed the RWFFM.

For the purposes of the inventory (and via guidance by the cities), all cities except Bowie are assumed to have 100% of the population on sewer.

### DATA COLLECTION

The RWFFM is processed annual by COG staff and outputs data that is available to use for the purposes of the GHG inventories. COG Cooperative Forecasts are used for population estimates. The model may need to be re-run to align with the Cooperative Forecast version used for the GHG inventory. For the cities where there is not population data available, ACS population data should be used.

#### Data Needs:

- Population served by sewer: All cities have 100% of population on sewer except for a small portion in Bowie on septic. Data retrieved from RWFFM developed by COG Department of Environmental Programs Wastewater Team.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

### STEPS

- Request RWFFM data from COG’s Wastewater Modeler. It should be a single request to the wastewater team for septic, sewer, and process N<sub>2</sub>O data. The request should include:
  - Population derived from the same version of the COG Cooperative Forecasts that’s being used for the On Road Transportation modeling.
  - Provide population served by wastewater treatment plant and by county.
  - Daily Nitrogen Load in kg N/day by wastewater treatment plant and by county.  
Note: This data will be used in the calculations for process N<sub>2</sub>O from effluent discharge; however, all data needed from the RWFFM needs to be requested at the same time.
  - Work closely with wastewater data team to translate population served and nitrogen load data from treatment plant to county. See the Summary Table below for guidance.

Jurisdiction *	WWTPs Serving Jurisdiction
District of Columbia	Blue Plains
<b>Suburban Maryland</b>	
Charles County	Indian Head, La Plata, Mattawoman, Naval Surface Warfare Center, Swan Point
Frederick County	Brunswick, Emmitsburg, Fort Detrick, Mount Airy, Thurmont, Winebrenner
Frederick City	Ballenger, Frederick City
Montgomery County	Blue Plains, Damascus, Parkway, Poolesville, Seneca
Gaithersburg	Blue Plains
Rockville	Blue Plains
Takoma Park	Blue Plains
Prince George’s County	Blue Plains, Marlboro Meadows, Mattawoman, Parkway, Piscataway, USDA, Western Branch

Bowie	Bowie, Western Branch
College Park	Blue Plains
Greenbelt	Blue Plains
Hyattsville	Blue Plains
Laurel	Blue Plains
Bladensburg	Blue Plains
<b>Northern Virginia</b>	
Alexandria	Arlington, Alexandria Renew Enterprises (ASA)
Arlington	Arlington, Blue Plains via Fairfax Water
Fairfax County	Arlington, ASA, Blue Plains, Harbor View, Mooney, Norman Cole, Upper Occoquan
Fairfax City	Norman Cole
Falls Church	Arlington, ASA
Loudoun County	Blue Plains, Broad Run, Leesburg, Upper Occoquan, Purcellville, Round Hill
Prince William County	Dale Services Corporation #1 and #8, Mooney, Nokesville, Occoquan Forest, PWC School Board, Quantico, Upper Occoquan
Manassas	Upper Occoquan
Manassas Park	Upper Occoquan

\* Cities in Maryland are subsets of Counties.

2. Determine population served by sewer. Enter in the Master Excel File's Sewer System Emissions tab Population Served by Sewer column.
  - a. For the counties and Bowie, use final data determined from the RWFFM.
  - a. For cities with no septic, use their total population as the population served by sewer. Use COG Cooperative Forecast data for those cities that this data is available for. For other cities, use the ACS population data. See data in the Master Excel File's Demographics tab.
3. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Water & Wastewater*
  - b. Click on the Calculator titled: *Nitrification/Denitrification Process N2O Emissions from Wastewater Treatment*
  - c. Create an Inventory Record titled: *Sewer System Emissions [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. Select "Yes" for the question *Nitrification/Denitrification as a step in the treatment process?*
  - f. Enter Population Served by Sewer from the Master Excel File into the *Population Served* cell.
  - g. Enter 1.25 as the Industrial Commercial Discharge Multiplier
  - h. Click Save.
4. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Sewer System Emissions tab's Sewer Emissions (MTCO<sub>2</sub>e) column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in  $\text{MTCO}_2\text{e} = \text{MMTCO}_2\text{e} * 1,000,000$
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>34</sup> MWCOG Cooperative Forecasts 8.4

Round 8.4 Cooperative Forecasting Summary Tables - Adopted October 14, 2015 (Excel Spreadsheet)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://www.mwcog.org/documents/2016/11/16/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/>

Webpage last accessed: July 2017

<sup>35</sup> U.S. Census Bureau. 2011-2015 American Community Survey 5-Year Population Estimates

Demographic and Housing Estimates (2015 ACS, Table DP05)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://factfinder.census.gov>

Webpage last accessed: July 2017

<sup>36</sup> MWCOG Regional Wastewater Flow Forecast Model

## STAFF CONTACTS

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## PROCESS N<sub>2</sub>O FROM EFFLUENT DISCHARGE TO RIVERS AND ESTUARIES

Under the ClearPath Water and Wastewater tab, the *Process N<sub>2</sub>O Emissions from Effluent Discharge to Rivers and Estuaries Calculator* is used to calculate emissions from wastewater treatment plant nitrogen load discharges.

### N<sub>2</sub>O Effluent Discharge Emissions

#### DESCRIPTION

N<sub>2</sub>O Effluent Discharge Emissions account for the emissions resulting from treated wastewater that flows out of a treatment facility and discharged into waterways. Most of the nitrogen content is removed in the treatment process; however, when effluent containing nitrogen reaches the natural watershed a reaction occurs that releases N<sub>2</sub>O emissions. This reaction makes up the vast majority of N<sub>2</sub>O generated from a wastewater treatment plan (WWTP).

#### METHODOLOGY

The Process N<sub>2</sub>O from Effluent Discharge to Rivers and Estuaries calculations follow the U.S. Communities Protocol recommended methodology as outlined in Appendix F.WW.12 from Version 1.1 of the Protocol. The methodology estimates GHG emissions based on the population served by sewer and daily Nitrogen loads.

Population served by sewer are estimated via a robust Regional Wastewater Flow Forecast Model (RWFFM). Outputs include population served by sewer by WWTP and by jurisdiction. Data inputs on Nitrogen loads are collected for each WWTP. The modeling helps translate loads to jurisdictions that are served by multiple WWTPs. COG's Wastewater Team annually collects plant-level data from utilities and the Chesapeake Bay Program DataHub to feed the RWFFM.

For the purposes of the inventory (and via guidance by the cities), all cities except Bowie are assumed to have 100% of the population on sewer.

#### DATA COLLECTION

The RWFFM is processed by COG staff and outputs data that is available to use for the purposes of the GHG inventories. COG Cooperative Forecasts are used for population estimates. The model may need to be re-run to align with the Cooperative Forecast version used for the GHG inventory. For the cities where there is not population data available, ACS population data should be used.

#### Data Needs:

- Population served by sewer: All cities have 100% of population on sewer except for a small portion in Bowie on septic. Data is retrieved from the RWFFM developed by COG Department of Environmental Programs Wastewater Team.
- Daily Nitrogen Load: Values in kg N/day are retrieved from the RWFFM developed by COG Department of Environmental Programs Wastewater Team.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

**STEPS**

1. Complete Sewer System Emissions calculations prior to completing these steps.
  - a. The Population Served by Sewer entered into the Master Excel File’s tab for Sewer System Emissions are automatically loaded into the N2O Effluent Discharge Emission tab.
  - b. Some of these steps below should have been completed during the Septic and Sewer System Emissions steps but are outlined below to show the full scope of what’s needed to complete N2O Effluent Discharge emissions calculations.
  
2. Request RWFFM data from COG’s Wastewater Modeler. It should be a single request to the Wastewater team for septic, sewer, and process N2O data. The request should include:
  - a. Population derived from the same version of the COG Cooperative Forecasts that’s being used for the On Road Transportation modeling.
  - b. Provide population served by wastewater treatment plant and by county.
  - c. Daily Nitrogen Load in kg N/day by wastewater treatment plant and by county.
  - d. Work closely with wastewater data team to translate population served and nitrogen load data from treatment plant to county. See the Summary Table below for guidance.

**Wastewater Treatment Plants (WWTPs) Serving COG Member Jurisdictions Summary Table**

Jurisdiction *	WWTPs Serving Jurisdiction
District of Columbia	Blue Plains
<b>Suburban Maryland</b>	
Charles County	Indian Head, La Plata, Mattawoman, Naval Surface Warfare Center, Swan Point
Frederick County	Brunswick, Emmitsburg, Fort Detrick, Mount Airy, Thurmont, Winebrenner
Frederick City	Ballenger, Frederick City
Montgomery County	Blue Plains, Damascus, Parkway, Poolesville, Seneca
Gaithersburg	Blue Plains
Rockville	Blue Plains
Takoma Park	Blue Plains
Prince George’s County	Blue Plains, Marlboro Meadows, Mattawoman, Parkway, Piscataway, USDA, Western Branch
Bowie	Bowie, Western Branch
College Park	Blue Plains
Greenbelt	Blue Plains
Hyattsville	Blue Plains
Laurel	Blue Plains
Bladensburg	Blue Plains
<b>Northern Virginia</b>	
Alexandria	Arlington, Alexandria Renew Enterprises (ASA)
Arlington	Arlington, Blue Plains via Fairfax Water
Fairfax County	Arlington, ASA, Blue Plains, Harbor View, Mooney, Norman Cole, Upper Occoquan
Fairfax City	Norman Cole

Falls Church	Arlington, ASA
Loudoun County	Blue Plains, Broad Run, Leesburg, Upper Occoquan, Purcellville, Round Hill
Prince William County	Dale Services Corporation #1 and #8, Mooney, Nokesville, Occoquan Forest, PWC School Board, Quantico, Upper Occoquan
Manassas	Upper Occoquan
Manassas Park	Upper Occoquan

\* Cities in Maryland are subsets of Counties.

3. Enter the Daily Nitrogen Load in the Master Excel File's Sewer System Emissions tab Daily Nitrogen Load column.
4. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Water & Wastewater*
  - b. Click on the Calculator titled: *Process N<sub>2</sub>O from Effluent Discharge to Rivers and Estuaries*
  - c. Create an Inventory Record titled: *N<sub>2</sub>O Effluent Discharge Emissions [Year]*
  - d. Select "No" for the question *Is this a Direct Entry Record?*
  - e. Select "Yes" for the question *Do you have daily N load from your effluent discharge?*
  - f. Enter Daily Nitrogen Load from the Master Excel File into the *Daily N Load* cell.
  - g. Enter Population Served by Sewer from the Master Excel File into the *Population Served* cell.
  - h. Click Save.
5. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's N<sub>2</sub>O Effluent Discharge Emission tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in MTCO<sub>2</sub>e = MMTCO<sub>2</sub>e \* 1,000,000
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

<sup>37</sup> MWCOG Cooperative Forecasts 8.4

Round 8.4 Cooperative Forecasting Summary Tables - Adopted October 14, 2015 (Excel Spreadsheet)

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics>

<https://www.mwcog.org/documents/2016/11/16/cooperative-forecasts-employment-population-and-household-forecasts-by-transportation-analysis-zone-cooperative-forecast-demographics-housing-population/>

*Webpage last accessed: July 2017*

<sup>38</sup> U.S. Census Bureau. 2011-2015 American Community Survey 5-Year Population Estimates Demographic and Housing Estimates (2015 ACS, Table DP05)  
[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Demographics](https://factfinder.census.gov)  
<https://factfinder.census.gov>

*Webpage last accessed: July 2017*

<sup>39</sup> MWCOG Regional Wastewater Flow Forecast Model

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# AGRICULTURE

## Agriculture

### EMISSIONS FROM AGRICULTURAL ACTIVITIES

Under the ClearPath Agriculture tab, the *Emissions from Agricultural Activities Calculator* is used to calculate emissions from waste a community sends to landfills for disposal.

#### Enteric Fermentation

##### DESCRIPTION

Enteric Fermentation accounts for the methane produced from animal digestion in cows, sheep, goats, swine, and horses. According to the U.S. Communities Protocol (USCP), enteric fermentation accounts for 25% of nationwide methane emissions from anthropogenic activities. The U.S. EPA report titled 'User's Guide for Estimating Methane and Nitrous Oxide Emissions from Agriculture Using the State Inventory Tool' states that a higher quality of feed produces lower emissions from these animals.

##### METHODOLOGY

The U.S. EPA's Emission Inventory Improvement Program developed a series of Excel-based State GHG Inventory Tools, which include an Agriculture Module. The Ag Module calculates methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions from the agricultural sources. Agricultural sources and activities relevant to metropolitan Washington were calculated using this tool including Enteric Fermentation, Manure Management, and Ag Soils. The module takes your data inputs and applies state-specific data and factors to calculate emissions. The methodologies applied in the tool are generally consistent with EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks.

The USCP does offer similar suggested calculations for enteric fermentation and manure management, where national default factors are applied. While Ag emissions calculated offline can be documented in ClearPath, it does not currently offer a calculator that estimates emissions. At this time, EPA's State Inventory Tool offers the most streamlined calculation process with the most locally relevant default factors for COG's GHG inventory work.

##### DATA COLLECTION

Metropolitan Washington data inputs into EPA's State GHG Inventory Tool are pulled at the county-scale from the EPA Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). CAST is a web-based nitrogen, phosphorus and sediment load estimator tool that streamlines environmental planning.

##### Data Needs:

- Livestock: Livestock population ('000 head) for dairy cows, beef cattle, sheep, goats, swine, horses derived from the Chesapeake Assessment Scenario Tool.

##### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions include all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

- The CAST model output for Livestock is the Animal Count. It will have to be converted to '000 head to enter into the EPA State Inventory Tool, Ag Module.
- Agricultural data is based on the U.S. Department of Agriculture's AG Census. The AG Census is conducted every 5 years and CAST interpolates data to estimate annual data.

## STEPS

1. Research the most up-to date available Ag data. While only some livestock data is needed to calculate Enteric Fermentation, collect all the data needed for all Ag calculations at once. Also see below sections on Manure Management and Ag Soils for full list of data to request.
  - a. From COG Chesapeake Bay staff, request data from the CAST model by jurisdiction for the year the inventory is being completed. Include in the request the following:
    - i. Animal Count: beef, dairy, goats, hogs and pigs for breeding, hogs for slaughter, horses, other cattle, sheep and lambs.
  - b. Download the most recent COG What the Region Grows Report. From COG Ag/Food staff, request the background data spreadsheets from the report – the Ag Production Analysis for COG member counties. This data includes animal counts and crop production from the most recent Ag Census. This data can be used for spot quality control checks against CAST data.
2. Prep data for entry into the EPA State Inventory Tool, AG Module. See animal count calculations in the Calculations sub-section below.
  - a. Determine the dairy-to-beef cow ratio, apply those proportions to “Other Cattle” quantities, and add those quantities to the dairy and beef totals.
  - b. Add the two hog categories from CAST together to get total Swine.
  - c. Convert the animal counts from CAST to '000 head.
3. Calculate emissions in the latest version of the EPA State Inventory Tool Ag Module (Excel). Refer to the Data Field Alignment Summary Table below to support the data entry process.
  - a. Create, save a separate file, and repeat b-d for each jurisdiction.
  - b. On the Control tab select the appropriate state on the drop-down list for the jurisdiction.
  - c. Under the Enteric Fermentation tab, click the plus tab to expand the year for the inventory you are developing. Enter Number of Animals ('000 head) for Dairy Cows, Beef Cows, Sheep, Goats, Swine, and Horses.
  - d. Scroll over to the Summary tab. In the top table titled Emissions (MMTCO<sub>2</sub> Eq.), row: Enteric Fermentation, scroll across to the year you are working with and copy it. Paste the value from this cell into the Master Excel File's Enteric Fermentation tab's GHG Emissions, MMTCO<sub>2e</sub> column for the jurisdiction you are working with.

**Data Field Alignment Summary Table: Enteric Fermentation**

EPA State Ag Inventory Tool Field	CAST Tool Data Field
Number of Animals ('000 head)	Animal Count
Dairy Cows	dairy, portion of other cattle
Beef Cows	beef, portion of other cattle
Sheep or Sheep on Feed	sheep and lambs
Goats	goats
Swine	hogs and pigs for breeding, hogs for slaughter

Horses	horses
--------	--------

4. Input values into ClearPath for the region and each jurisdiction’s account.
  - a. Go to the main ClearPath tab titled: *Agriculture*
  - b. Click on the Calculator titled: *Emissions from Agricultural Activities*
  - c. Create an Inventory Record titled: *Enteric Fermentation [Year]*
  - d. Select “Enteric Fermentation” in the *Agricultural Process* drop-down list.
  - e. Enter the GHG Emissions in MTCO<sub>2e</sub> from the Master Excel File into the CO<sub>2</sub> *Emissions From Agriculture* cell.
  - f. Click Save.

### CALCULATIONS

Calculations necessary prior to entering data into the EPA State Inventory Tool, AG Module and GHG Inventory Master File include:

#### Animal Counts

- % Dairy Cows = Dairy Cow Count / (Dairy Cow Count + Beef Cow Count)
- % Beef Cows = Beef Cow Count / (Beef Cow Count + Dairy Cow Count)
- Dairy Cows = Dairy Cow Count + (Other Cattle Count \* % Dairy Cows)
- Beef Cows = Beef Cow Count + (Other Cattle Count \* % Beef Cows)
- Swine = Hogs and Pigs for Breeding + Hogs for Slaughter
- ‘000 head for each animal type by County = CAST Model’s Animal Count / 1,000

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in MTCO<sub>2e</sub> = MMTCO<sub>2e</sub> \* 1,000,000
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George’s County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George’s County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

### SOURCES

<sup>40</sup> U.S. EPA. (2018). Chesapeake Assessment Scenario Tool (CAST). Annual livestock count, crop acreage, fertilizer applied  
<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG>  
<https://cast.chesapeakebay.net>  
Webpage last accessed: March 2018

<sup>41</sup> U.S. EPA. (2017). EPA State GHG Inventory and Projection Tool. AG Module

[I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG/EPA State Tool  
www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool](http://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool)

Website Last Accessed: January 2018

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## **Manure Management**

### **DESCRIPTION**

Manure Management accounts for emissions from management systems that stabilize or store livestock manure. It accounts for manure from dairy cows, beef cattle, sheep, goats, swine, horses and poultry operations. Methane (CH<sub>4</sub>) is a natural by-product of manure decomposition and nitrous oxide (N<sub>2</sub>O) is also produced during the storage and treatment of animal manure.

The U.S. EPA report titled 'User's Guide for Estimating Methane and Nitrous Oxide Emissions from Agriculture Using the State Inventory Tool' states that the greater energy content of the feed results in an increased capacity to produce CH<sub>4</sub> in manure. In addition, the report states that the amount of N<sub>2</sub>O released depends on the system and duration of waste management.

### **METHODOLOGY**

EPA's Emission Inventory Improvement Program developed a series of Excel-based State GHG Inventory Tools, which include an Agriculture Module. The Ag Module calculates CH<sub>4</sub> and N<sub>2</sub>O emissions from the agricultural sources. Agricultural sources and activities relevant to metropolitan Washington were calculated using this tool including Enteric Fermentation, Manure Management, and Ag Soils. The module takes your data inputs and applies state-specific data and factors to calculate emissions. The methodologies applied in the tool are generally consistent with EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks.

The US Communities' Protocol does offer similar suggested calculations for enteric fermentation and manure management, where national default factors are applied. While Ag emissions calculated offline can be documented in ClearPath, it does not currently offer a calculator that estimates emissions. At this time, EPA's State Inventory Tool offers the most streamlined calculation process with the most locally relevant default factors for COG's GHG inventory work.

### **DATA COLLECTION**

Metropolitan Washington data inputs into the EPA's State GHG Inventory Tool are pulled at the county-scale from the EPA Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). CAST is a web-based nitrogen, phosphorus and sediment load estimator tool that streamlines environmental planning.

#### Data Needs:

- Livestock: Livestock population ('000 head) for dairy cows, beef cattle, sheep, goats, swine, horses, pullets, chickens, broilers, and turkeys from the Chesapeake Assessment Scenario Tool.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- The CAST model output for Livestock is the Animal Count. It will have to be converted to '000 head to enter into the EPA State Inventory Tool, Ag Module.
- Agricultural data is based on the U.S. Department of Agriculture's AG Census. The AG Census is conducted every 5 years and CAST interpolates data to estimate annual data.

#### STEPS

1. Complete the Enteric Fermentation calculations prior to completing the Manure Management emissions calculations.
  - a. The total Livestock Populations (Dairy Cows, Beef Cattle, Sheep, Goats, Swine, and Horses) entered into the Master Excel File's tab for Enteric Fermentation are automatically loaded into Manure Management tab.
  - b. Some steps below should have been completed during in the Enteric Fermentation steps but are outlined below to show the full scope of what's needed to complete Manure Management emissions calculations.
2. Research the most up-to date available Ag data. While only livestock data is needed to calculate Manure Management, collect all the data needed for all Ag calculations at once. Also see above section on Enteric Fermentation and Ag Soils below for full list of data to request.
  - a. From COG Chesapeake Bay staff, request data from the CAST model by jurisdiction for the year the inventory is being completed. Include in the request the following:
    - i. Animal Count: beef, broilers, dairy, goats, hogs and pigs for breeding, hogs for slaughter, horses, layers, other cattle, pullets, sheep and lambs, and turkeys.
  - b. Download the most recent COG What the Region Grows Report. From COG Ag/Food staff, request the background data spreadsheets from the report – the Ag Production Analysis for COG member counties. This data includes animal counts and crop production from the most recent Ag Census. This data can be used for spot quality control checks against CAST data.
3. Prep data for entry into the EPA State Inventory Tool, AG Module. See animal count calculations in the Calculations sub-section below.
  - a. Determine the dairy-to-beef cow ratio, apply those proportions to "Other Cattle" quantities, and add those quantities to the dairy and beef totals.
  - b. Add the two hog categories from CAST together to get total Swine.
  - c. Convert the animal counts from CAST to '000 head.
4. Calculate emissions in the latest version of the EPA State Inventory Tool Ag Module (Excel). Refer to the Data Field Alignment Summary Table below to support data entry process.
  - a. In the AG Modules created for each jurisdiction during the Enteric Fermentation calculations, enter Manure Management data.
  - b. Under the CH<sub>4</sub> for Manure Management tab, click the plus tab to expand the year for the inventory you are developing. Enter Number of Animals ('000 head) for Dairy Cows, Beef Cows, Swine, Pullets, Chicken, Broilers, Turkeys, Sheep on Feed, Goats,

and Horses. These entries are automatically loaded into the N<sub>2</sub>O from Manure Management tab.

- c. Scroll over to the Summary tab. In the top table titled Emissions (MMTCO<sub>2</sub> Eq.), row: Manure Management, scroll across to the year you are working with and copy it. Paste the value from this cell into the Master Excel File's Manure Management tab's GHG Emissions, MMTCO<sub>2e</sub> column for the jurisdiction you are working with.

**Data Field Alignment Summary Table: Manure Management**

EPA State Ag Inventory Tool Field	CAST Tool Data Field
Number of Animals ('000 head)	Animal Count
Dairy Cows	dairy, portion of other cattle
Beef Cows	beef, portion of other cattle
Sheep or Sheep on Feed	sheep and lambs
Goats	goats
Swine	hogs and pigs for breeding, hogs for slaughter
Horses	horses
Pullets	pullets
Chickens	layers
Broilers	broilers
Turkeys	turkeys

5. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Agriculture*
  - b. Click on the Calculator titled: *Emissions from Agricultural Activities*
  - c. Create an Inventory Record titled: *Manure Management [Year]*
  - d. Select "Manure Treatment and Handling" in the *Agricultural Process* drop-down list.
  - e. Enter the GHG Emissions in MTCO<sub>2e</sub> from the Master Excel File into the CO<sub>2</sub> *Emissions From Agriculture* cell.
  - f. Click Save.

**CALCULATIONS**

Calculations necessary prior to entering data into the EPA State Inventory Tool, AG Module and GHG Inventory Master File include:

Animal Counts

- % Dairy Cows = Dairy Cow Count / (Dairy Cow Count + Beef Cow Count)
- % Beef Cows = Beef Cow Count / (Beef Cow Count + Dairy Cow Count)
- Dairy Cows = Dairy Cow Count + (Other Cattle Count \* % Dairy Cows)
- Beef Cows = Beef Cow Count + (Other Cattle Count \* % Beef Cows)
- Swine = Hogs and Pigs for Breeding + Hogs for Slaughter
- '000 head for each animal type by County = CAST Model's Animal Count / 1,000

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in MTCO<sub>2e</sub> = MMTCO<sub>2e</sub> \* 1,000,000

- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

## SOURCES

<sup>42</sup> U.S. EPA. (2018). Chesapeake Assessment Scenario Tool (CAST).

Annual livestock count, crop acreage, fertilizer applied

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG>

<https://cast.chesapeakebay.net>

Webpage last accessed: March 2018

<sup>43</sup> U.S. EPA. (2017). EPA State GHG Inventory and Projection Tool.

AG Module

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG/EPA State Tool>

[www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool](http://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool)

Website Last Accessed: January 2018

## STAFF CONTACTS

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## Ag Soils

### DESCRIPTION

Ag Soils account for nitrous oxide (N<sub>2</sub>O) emissions from animals, crop production, and fertilizer application. The U.S. EPA report titled 'User's Guide for Estimating Methane and Nitrous Oxide Emissions from Agriculture Using the State Inventory Tool' states that N<sub>2</sub>O is naturally produced in soils; however, animal and crop management practices and fertilizer application increase the amount of N<sub>2</sub>O emitted. Higher levels of N<sub>2</sub>O are a result of:

- The type of animal waste management systems used;
- Cultivation of certain types of nitrogen-fixing crops;
- Crop residues remaining on agricultural fields; and
- The use of synthetic and organic fertilizer in ag and urban soils.

### METHODOLOGY

The U.S. EPA's Emission Inventory Improvement Program developed a series of Excel-based State GHG Inventory Tools, which include an Agriculture Module. The Ag Module calculates methane (CH<sub>4</sub>) and N<sub>2</sub>O emissions from the agricultural sources. Agricultural sources and activities relevant to metropolitan Washington were calculated using this tool including Enteric Fermentation, Manure

Management, and Ag Soils. The module takes your data inputs and applies state-specific data and factors to calculate emissions. The methodologies applied in the tool is generally consistent with EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks.

The US Communities' Protocol does offer similar suggested calculations for enteric fermentation and manure management, where national default factors are applied. While Ag emissions calculated offline can be documented in ClearPath, it does not currently offer a calculator that estimates emissions. At this time, EPA's State Inventory Tool offers the most streamlined calculation process with the most locally relevant default factors for COG's GHG inventory work.

#### **DATA COLLECTION**

Metropolitan Washington data inputs into EPA's State GHG Inventory Tool are pulled at the county-scale from the EPA Chesapeake Bay Program's Chesapeake Assessment Scenario Tool (CAST). CAST is a web-based nitrogen, phosphorus and sediment load estimator tool that streamlines environmental planning.

#### Data Needs:

- Livestock: Livestock population ('000 head) for dairy cows, beef cattle, sheep, goats, swine, horses, layers (pullets and chickens), broilers, and turkeys from the Chesapeake Assessment Scenario Tool (CAST).
- Crops: Crop production ('000 bushels) for corn for grain, all wheat, and soybeans from CAST.
- Fertilizer: Fertilizer applied (kg N) for synthetic fertilizers, manure, and biosolids.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- City scale data only includes urban fertilizer applied. Data inputs in county-level Ag Soils calculations includes livestock, crop production, and fertilizer application from synthetic (including urban), manure, and biosolid applications, where appropriate.
- The CAST model output for Livestock is the Animal Count. It will have to be converted to '000 head to enter into the EPA State Inventory Tool, Ag Module.
- Agricultural data is based on the U.S. Department of Agriculture's AG Census. The AG Census is conducted every 5 years and CAST interpolates data to estimate annual data.

#### **STEPS**

1. Complete the Enteric Fermentation and Manure Management calculations prior to completing the Ag Soil emissions calculations.
  - a. The total Livestock Populations (Dairy Cows, Beef Cattle, Sheep, Goats, Swine, and Horses) entered into the Master Excel File's tab for Enteric Fermentation are automatically loaded into Manure Management tab.
  - b. The total Poultry Populations entered into the Master Excel File's tab for Manure Management are automatically loaded into Ag Soils tab.
  - c. Some steps below should have been completed during the Enteric Fermentation steps but are outlined below to show the full scope of what's needed to complete Manure Management emissions calculations.

2. Research the most up-to date available Ag data. Ag Soils needs the same data as Enteric Fermentation and Manure Management plus crop production and applied fertilizer data. Also see below the full list of data to request.
  - a. From COG Chesapeake Bay staff, request data from the CAST model by jurisdiction for the year the inventory is being completed. Include in the request the following:
    - i. Animal Count: beef, broilers, dairy, goats, hogs and pigs for breeding, hogs for slaughter, horses, layers, other cattle, pullets, sheep and lambs, and turkeys.
    - ii. Land Use Acres: Sum of PreBMP Acres for Load Sources: Other Agronomic Crops, Grain without Manure, Specialty Crop High, Specialty Crop Low, Full Season Soybeans
    - iii. Nutrients Applied: Sum of FertilizerNLbs Applied, Sum of UrbanFertilizerNLbsApplied, Sum of ManureNLbsApplied, Sum of Direct Deposit ManureNLbsApplied, Sum of BiosolidsNLbsApplied
  - b. Request data from COG's Ag/Food staff, including:
    - i. Request or download the most recent COG What the Region Grows Report. Request the background data spreadsheets from the report.
      1. This data includes animal counts and crop yields from the most recent Ag Census and state resources. This data can be used for spot quality control checks against CAST data.
      2. Specifically request bushels/acre yields for VA and MD for wheat, corn, and soybeans.
3. Prep data for entry into the EPA State Inventory Tool, AG Module. See Calculations subsection below.
  - a. Determine the dairy-to-beef cow ratio, apply those proportions to "Other Cattle" quantities, and add those quantities to the dairy and beef totals.
  - b. Add the two hog categories from CAST together to get total Swine.
  - c. Convert the animal counts from CAST to '000 head.
  - d. Add the grain without manure and high and low specialty crops together to get wheat acreage.
  - e. Convert acres to bushels using a state and crop specific factor of bushels/acre.
    - i. Use CAST acreage by county for wheat, corn, and soybeans.
    - ii. Use AG Census statewide bushels/acre yields for wheat, corn, and soybeans. For each crop, use the MD bushels/acre for MD counties and VA bushels/acre for VA jurisdictions.
  - f. Convert bushels to '000 of bushels
  - g. Add fertilizer (N Lbs) and urban fertilizer (N Lbs) applied to get synthetic fertilizer totals (N Lbs).
  - h. Add manure (N Lbs) and direct deposit manure (N Lbs) to get dried manure totals (N Lbs).
  - i. Convert N Lbs to kg N for synthetic, dried manure and activated sewer sludge.
4. Calculate emissions in the latest version of the EPA State Inventory Tool Ag Module (Excel). Refer to the Data Field Alignment Summary Table below to support data entry process.
  - a. In the AG Modules created for each jurisdiction during the Enteric Fermentation calculations (and in which Manure Management data is entered), enter the additional Ag Soils data.

- b. Under the Ag Soils-Plant-Residues&Legumes tab, click the plus tab to expand the year for the inventory you are developing. Enter Crop Production data in the rows: Corn for Grain, All Wheat, and Soybeans.
- c. Under the Ag Soils-Plant-Fertilizers tab, click the plus tab to expand the year for the inventory you are developing. Enter Total Fertilizer Use (kg N) in the rows: Synthetic, Dried Manure, and Activated Sewer Sludge.
- d. Scroll over to the Summary tab. In the top table titled Emissions (MMTCO<sub>2</sub> Eq.), row: Ag Soils, scroll across to the year you are working with and copy it. Paste the value from this cell into the Master Excel File's Ag Soils tab's GHG Emissions, MMTCO<sub>2e</sub> column for the jurisdiction you are working with.

**Data Field Alignment Summary Table: Ag Soils**

EPA State Ag Inventory Tool Field	CAST Tool Data Field
<b>Number of Animals ('000 head)</b>	<b>Animal Count</b>
Dairy Cows	dairy, portion of other cattle
Beef Cows	beef, portion of other cattle
Sheep or Sheep on Feed	sheep and lambs
Goats	goats
Swine	hogs and pigs for breeding, hogs for slaughter
Horses	horses
Pullets	pullets
Chickens	layers
Broilers	broilers
Turkeys	turkeys
<b>Crop Production ('000 bushels)</b>	<b>Land Use Acres</b>
Corn for Grain	Other Agronomic Crops
All Wheat	Grain without Manure, Specialty Crop High, Specialty Crop Low
Soybeans	Full Season Soybeans
<b>Total Fertilizer Use (kg N)</b>	<b>Nutrients Applied (Lbs)</b>
Synthetic Fertilizer	Sum of FertilizerNLbsApplied, Sum of UrbanFertilizerNLbsApplied
Dried Manure	Sum of ManureNLbsApplied Sum of DirectDeposit ManureNLbsApplied
Activated Sewer Sludge	Sum of BiosolidsNLbsApplied

5. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Agriculture*
  - b. Click on the Calculator titled: *Emissions from Agricultural Activities*
  - c. Create an Inventory Record titled: *Ag Soils [Year]*
  - d. Select "Fertilizer Application" for the *Agricultural Process* drop-down list for the cities only. Leave drop-down list blank for the counties.
  - e. Enter the GHG Emissions in MTCO<sub>2e</sub> from the Master Excel File into the *CO<sub>2</sub> Emissions From Agriculture* cell.
  - f. Click Save.

## CALCULATIONS

Calculations necessary prior to entering data into the EPA State Inventory Tool, AG Module and GHG Inventory Master File include:

### Animal Counts

- % Dairy Cows = Dairy Cow Count / (Dairy Cow Count + Beef Cow Count)
- % Beef Cows = Beef Cow Count / (Beef Cow Count + Dairy Cow Count)
- Dairy Cows = Dairy Cow Count + (Other Cattle Count \* % Dairy Cows)
- Beef Cows = Beef Cow Count + (Other Cattle Count \* % Beef Cows)
- Swine = Hogs and Pigs for Breeding + Hogs for Slaughter
- '000 head for each animal type by County = CAST Model's Animal Count / 1,000

### Crop Production

- Wheat Acres = Grain without Manure + Specialty Crop High + Specialty Crop Low
- Bushels = Acres \* Bushels per Acre factor
- '000 Bushels = Bushels / 1,000

### Fertilizer Use

- Synthetic Fertilizer in kg N = (Sum of FertilizerNLbsApplied + Sum of UrbanFertilizerNLbsApplied) \* 0.453592
- Dried Manure kg N = (Sum of ManureNLbsApplied + Sum of DirectDeposit ManureNLbsApplied) \* 0.453592
- Activated Sewer Sludge in kg N = Sum of BiosolidsNLbsApplied \* 0.453592

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Emissions in MTCO<sub>2e</sub> = MMTCO<sub>2e</sub> \* 1,000,000
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park

## SOURCES

<sup>44</sup> U.S. EPA. (2018). Chesapeake Assessment Scenario Tool (CAST).

Annual livestock count, crop acreage, fertilizer applied

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG](https://climate.energy/projects/inventory/2015/data/ag)

<https://cast.chesapeakebay.net>

Webpage last accessed: March 2018

<sup>45</sup> U.S. EPA. (2017). EPA State GHG Inventory and Projection Tool.

AG Module

<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/AG/EPA State Tool>  
[www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool](http://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool)

*Website Last Accessed: January 2018*

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# SOLID WASTE TREATMENT

## Solid Waste

### WASTE GENERATION

Under the ClearPath Solid Waste tab, the *Waste Generation Calculator* is used to calculate emissions from waste a community sends to landfills for disposal.

#### Landfill Waste Generation

##### DESCRIPTION

Landfill Waste Generation accounts for the emissions resulting from waste generated by the community in a year and disposed of at a landfill. In other words, it accounts for the resultant methane emissions from the decomposition of biologic solid waste produced by the community that year. Methane capture has a significant influence over resulting GHG emissions. If a landfill receiving waste has no methane capture, the resultant GHG emissions are much higher. According to the U.S. Communities Protocol (USCP), local jurisdictions' municipal solid waste (MSW), recycling, and composting programs can influence the amount of waste generated, the methods of disposal, and locations.

##### METHODOLOGY

The Landfill Waste Generation emission calculations follow the USCP recommended methodology as outlined in Appendix E, SW.4 from Version 1.1 of the Protocol. The calculations are based on tons of MSW from each jurisdiction going to a landfill and whether the receiving landfills have methane capture. It is important to make this distinction and identify how many tons are annually disposed of at these landfills.

##### DATA COLLECTION

The best available MWS data from local and regional sources was used to calculate these emissions. Unlike other activities in this inventory, there is not a regional, state, or federal source of MSW data that comprehensively reports data in the way that is needed for GHG inventory calculations.

The Northern Virginia Regional Commission (NVRC) regularly reports on public solid waste services in metropolitan Washington and serves as a good starting point for data collection. Data on total MSW tonnage is reported; however, for GHG inventory calculations there needs to be a distinction between tonnage going to the landfill and tonnage going to waste to energy (WTE). Additionally, the NVRC reports provide data from participating local jurisdictions, which includes all COG members except for Frederick and Charles Counties in Maryland. Therefore, local solid waste reports and additional local data collection is needed. Researching local reports and contacting local jurisdictions is needed to verify the most accurate information on how much is going to landfills vs. WTE and which landfills regularly accept waste from each community.

It is important to identify which landfills accept a community's waste because one of the driving factors of emissions from landfill waste is methane collection. If no, resultant emissions are much higher than if the answer is yes. While most landfills accepting waste from the region have methane collection, there is a small portion that was assumed to be delivered to landfills without methane collection. Local knowledge, local reports, and the EPA FLIGHT tool are used to make these determinations.

#### Data Needs:

- Municipal Solid Waste (MSW): Annual mass in tons of MSW landfilled retrieved from local and regional sources.
- Methane Collection: Identify landfills that regularly receive MSW from each jurisdiction and whether those landfills have methane collection using the EPA FLIGHT Tool.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- It is a complex task for local jurisdictions to collect accurate MSW data. Local jurisdictions do not all collect data using the same methods. For instance, a mix of calendar year and fiscal year data is used in calculating the GHG emissions.
- The Charles County Comprehensive Solid Waste Management Plan states on page 3-3 that the annual flow of landfilled waste is stable between 50K-60K tons annually.
- The Frederick County Solid Waste Management Plan states on pages 3-3, 3-4, and 3-23 that residential, commercial MSW solid waste is hauled to the county landfill. On page 3-21, the report states that 1-5% of waste is exported to out-of-county landfills.
- Specific City of Frederick landfill tonnage data was not available. City tonnage is downscaled from County totals based on the city to county population ratio and 100% landfill disposal is assumed.
- The data reported by Prince George's County for its cities only represents what was delivered/disposed of at the County landfill. If there is any waste disposed of by the cities out-of-county, it is not accounted for.
- Alexandria's Solid Waste Management Plan states on pages 18, 22, 31 and 41 that waste is disposed of at the Covanta WTE facility located in Alexandria.
- Page 33 of the Arlington County Solid Waste Management Plan states that MSW is disposed of at the Covanta WTE Facility in Alexandria.
- Fairfax County's Solid Waste Management Plan 2015 Update states on page 7 of Attachment A that approximately 75% of MSW generated in the county is delivered to the I-66 Transfer Station (primary disposal option is WTE) and 25% is delivered to the Covanta Resource Recovery Center (i.e. WTE) in the county. 100% of the County's waste is assumed to be combustion.
- The City of Fairfax Solid Waste Management Plan states on pages ES-3 and ES4 that MSW is disposed of as WTE and landfilling is only used as a back-up emergency option.
- The Falls Church Solid Waste Management Plan states on several pages (2-20, 6-2, 6-26, 6-35, 11-4) that MSW is delivered to the I-66 Transfer Station for disposal via WTE and that the plan is to continue this method of disposal.
- Loudoun County operates a landfill and has a landfill policy to provide waste disposal to residents.
- Best available data to report for Prince William County is 2014. The Solid Waste Management Plan states that solid waste is disposed of at the County Landfill and the

Fairfax I-95 Energy Resource Recovery Facility. However, there is no information that suggests how to break out what is landfilled v. WTE; therefore, all waste is assumed to be landfilled.

- The City of Manassas Solid Waste Strategy states on pages 6-3 and 6-5 that the city has no plans to utilize incineration and landfilling is the most economical choice.
- Best available data to report for Manassas Park is 2014 and 100% landfill disposal is assumed.

## STEPS

1. Research solid waste reports/data. Collect and verify all the solid waste data at once (landfill, methane collection, combustion).
  - a. Download the most recent NVRC Solid Waste report. Check with COG and NVRC Solid Waste staff on status of data collection for upcoming reports.
  - b. Research online to see if any local jurisdictions have new or updated solid waste reports or numbers. Save documentation.
    - i. If you find new documentation online, review to see if solid waste landfill vs. combustion assumptions should remain the same or change.
    - ii. Also, review any new data on which landfills the community is regularly delivering solid waste to. Go to the EPA FLIGHT Tool online to confirm whether the landfill has Methane Collection.
      1. Search facilities by State and County. Select Waste facilities.
      2. Double click on the facility to review.
      3. Look under Facility Information, Information on Municipal Landfills, Does the landfill system have an active gas collection system and note whether the answer is Y or N.
  - c. Contact local jurisdictions to confirm solid waste data to use for landfill, methane collection (yes/no), and combustion tonnage at the same time.
2. Document Municipal Solid Waste Landfilled in tons and Yes/No Methane Collection in the GHG Master Excel File's Landfill Waste Generation tab.
3. Input a solid waste Factor Set into ClearPath for the region and each jurisdiction's account.
  - a. In ClearPath, click on *Factor Sets*. Under *Factor Sets*, click on *Waste Characterization*. Click on *+ Add Factor Set*.
  - b. Name your factor sets *Solid Waste [Year]*
  - c. Select the year of the inventory being completed in the drop-down list.
  - d. Enter "100" in *Percentage Mixed MSW* cell.
  - e. Click *Save Factor Sets*.
4. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Solid Waste*
  - b. Click on the Calculator titled: *Waste Generation*
  - c. Create an Inventory Record titled: *Landfill Waste Generation [Year]*  
Note: For the regional and Montgomery County, there will need to be two records, *Landfill Waste Generation [Year] - Methane Capture* and *Landfill Waste Generation [Year] - No Methane Capture*.
  - d. Under *Factor Sets Waste Characterization*, select "Solid Waste [Year]"
  - e. Select "No" for the question *Is this a previously calculated Value?*

- f. From the Master Excel File's Landfill Waste Generation tab, enter Municipal Solid Waste Landfilled (tons) in ClearPath's Total Waste Generated cell for each jurisdiction and sub-region.
  - g. For the question *Does the receiving landfill have Methane Collection?* select "Yes" or "No" based on the Master Excel File's column titled Methane Collection at Receiving Landfill?
  - h. Select Inside the Jurisdiction (or Outside) as appropriate for the *Disposal Location*.
  - i. From the Master Excel File's Demographics tab, enter *Number of Households* (use the ACS numbers) and number of businesses (use CoStar Number of Commercial Buildings).  
Note: These values do not change the calculations. ClearPath estimates benchmarks with this data, such as *CO<sub>2</sub> per person*.
  - j. Click Save.
5. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Landfill Waste Generation tab's MTCO<sub>2</sub>e column.

### CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Total Metropolitan Washington Landfill Tonnage = Regional Landfilled Tons with Methane Capture + Regional Landfilled Tons without Methane Capture  
Total Metropolitan Washington Landfill Emissions = Regional Landfilled Emissions with Methane Capture + Regional Landfilled Emissions without Methane Capture  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

### SOURCES

- <sup>46</sup> US Environmental Protection Agency. (data year 2015). Facility Level Greenhouse Gas Tool (FLIGHT) Sector: Waste. Search by state, county, and or facility name for all facilities jurisdictions send municipal solid waste (MSW). Click on facility and data year 2015. Under Facility Information and the question "Does the landfill have an active gas collection system?" there will be a Y/N answer.  
<https://ghgdata.epa.gov/ghgp>  
*Website Last Accessed: September 2017*
- <sup>47</sup> District Department of Energy and Environment. (2015). Landfill Waste Generation. Data provided by Jenn Hatch via email in March 2018
- <sup>48</sup> District Department of Public Works. (2016). Washington, DC Solid Waste Diversion Progress Report.

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Solid Waste Treatment  
https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page\\_content/attachments/FY15WasteDiversionReport\\_f.pdf](https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page_content/attachments/FY15WasteDiversionReport_f.pdf)

*Website Last Accessed: September 2017*

- <sup>49</sup> Charles County Comprehensive Solid Waste Management Plan 2011 - 2021  
Table 3-4: Estimated Waste Generation in Charles County 2009 - 2021, sum of Residential and Commercial rows, 2015 column page 3-12

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Solid Waste Treatment  
https://www.charlescountymd.gov/sites/default/files/pgm/rim/Charles%20County%202011-2021%20SWMP.pdf](https://www.charlescountymd.gov/sites/default/files/pgm/rim/Charles%20County%202011-2021%20SWMP.pdf)

*Website Last Accessed: September 2017*

- <sup>50</sup> Frederick County Division of Utilities and Solid Waste Management. Solid Waste Management Plan 2018 - 2037  
Table 3-1: Annual Waste Generation in Frederick County (Tons) 2018 - 2037, column: 2015 Actual, the sum of rows MSW Residential + MSW Commercial + MSW Mixed, page 3-2

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Solid Waste Treatment  
https://frederickcountymd.gov/3563/Solid-Waste-Management-Plan](https://frederickcountymd.gov/3563/Solid-Waste-Management-Plan)

*Website Last Accessed: September 2017*

- <sup>51</sup> Montgomery County Department of Environment. (2015). Landfill Waste Generation  
Data provided by Stan Edwards via email in March 2018

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Data provided by Mark Charles via phone in September 2017. All landfill, no WTE.

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6957 tons of municipal waste reported, 46% disposed (landfill disposal assumed)

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Table 3-1: Annual Waste Generation in Prince George's County 2017-2026 Plan Period, column 2015 Estimates, sum of rows: MSW Residential + MSW Commercial + MSW Mixed, page III-1

Table 3-2: Municipal Waste Deliveries Calendar Year 2015, page III-4

[:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Solid Waste Treatment  
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Table 14: Refuse/Garbage Tonnage, Tip Fees 2008-2014, Column: Refuse Tonnage 2014, Row: Prince William County, Manassas Park, page 49

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<sup>64</sup> Prince William County Solid Waste Management Plan

Page 3

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Website Last Accessed: September 2017

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## **COMBUSTION OF SOLID WASTE GENERATED BY THE COMMUNITY**

Under the ClearPath Solid Waste tab, *Combustion of Solid Waste Generated By The Community Calculator* is used to calculate emissions from waste a community sends to waste-to-energy plants for disposal via combustion.

### **Combustion of Solid Waste**

#### **DESCRIPTION**

The Combustion of Solid Waste accounts for the emissions resulting from municipal solid waste (MSW) generated by the community in a year and disposed of at a waste-to-energy (WTE) facility. WTE facilities burn garbage and typically generate steam and/or electricity from the combustion of MSW. According to the U.S. Communities Protocol (USCP), local jurisdictions' MSW, recycling, and composting programs can influence the amount of waste generated, the methods of disposal, and locations.

#### **METHODOLOGY**

The Combustion of Solid Waste Generated by the Community emission calculations follow the USCP recommended methodology as outlined in Appendix E, SW.2.2 from Version 1.1 of the Protocol. The calculation used is SW.2.2a. The calculations are based on tons of MSW from each jurisdiction going to a WTE.

## DATA COLLECTION

The best available municipal MWS data from local and regional sources was used to calculate these emissions. Unlike other activities in this inventory, there is not a regional, state, or federal source of MSW data that comprehensively reports data in the way that is needed for GHG inventory calculations.

The Northern Virginia Regional Commission (NVRC) regularly reports on public solid waste services in metropolitan Washington and serves as a good starting point for data collection. Data on total MSW tonnage is reported; however, for GHG inventory calculations there needs to be a distinction between tonnage going to the landfill and tonnage going to WTE. Additionally, the NVRC reports provide data from participating local jurisdictions, which includes all COG members except for Frederick and Charles Counties in Maryland. Therefore, local solid waste reports and additional local data collection is needed. Researching local reports and contacting local jurisdictions is needed to verify the most accurate information on how much is going to landfills vs. WTE and which landfills regularly accept waste from each community.

It is important to identify which landfills accept a community's waste because one of the driving factors of emissions from landfill waste is methane collection. If no, resultant emissions are much higher than if the answer is yes. While most landfills accepting waste from the region have methane collection, there is a small portion that was assumed to be delivered to landfills without methane collection. Local knowledge, local reports, and the EPA FLIGHT tool are used to make these determinations.

### Data Needs:

- Municipal Solid Waste (MSW): Annual mass in tons of MSW combusted retrieved from local and regional sources.

### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- It is a complex task for local jurisdictions to collect accurate MSW data. Local jurisdictions do not all collect data using the same methods. For instance, a mix of calendar year and fiscal year data is used in calculating the GHG emissions.
- The Charles County Comprehensive Solid Waste Management Plan states on page 3-3 that the annual flow of landfilled waste is stable between 50K-60K tons annually.
- The Frederick County Solid Waste Management Plan states on pages 3-3, 3-4, and 3-23 that residential, commercial MSW solid waste is hauled to the county landfill. On page 3-21, the reports states that 1-5% of waste is exported to out-of-county landfills.
- Specific City of Frederick landfill tonnage data was not available. City tonnage is downscaled from County totals based on the city to county population ratio and 100% landfill disposal is assumed.
- The data reported by Prince George's County for its cities only represents what was delivered/disposed of at the County landfill. If there is any waste disposed of by the cities out-of-county, it is not accounted for.
- Alexandria's Solid Waste Management Plan states on pages 18, 22, 31 and 41 that waste is disposed of at the Covanta WTE facility located in Alexandria.

- Page 33 of the Arlington County Solid Waste Management Plan states that MSW is disposed of at the Covanta WTE Facility in Alexandria.
- Fairfax County's Solid Waste Management Plan 2015 Update states on page 7 of Attachment A that approximately 75% of MSW generated in the county is delivered to the I-66 Transfer Station (primary disposal option is WTE) and 25% is delivered to the Covanta Resource Recovery Center (i.e. WTE) in the county. 100% of the County's waste is assumed to be combustion.
- The City of Fairfax Solid Waste Management Plan states on pages ES-3 and ES4 that MSW is disposed of as WTE and landfilling is only used as a back-up emergency option.
- The Falls Church Solid Waste Management Plan states on several pages (2-20, 6-2, 6-26, 6-35, 11-4) that MSW is delivered to the I-66 Transfer Station for disposal via WTE and that the plan is to continue this method of disposal.
- Loudoun County operates a landfill and has a landfill policy to provide waste disposal to residents.
- Best available data to report for Prince William County is 2014. The Solid Waste Management Plan states that solid waste is disposed of at the County Landfill and the Fairfax I-95 Energy Resource Recovery Facility. However, there is no information that suggests how to break out what is landfilled vs. WTE; therefore, all waste is assumed to be landfilled.
- The City of Manassas Solid Waste Strategy states on pages 6-3 and 6-5 that the city has no plans to utilize incineration and landfilling is the most economical choice.
- Best available data to report for Manassas Park is 2014 and 100% landfill disposal is assumed.

## STEPS

1. Research solid waste reports/data. Complete simultaneously with data collection for landfills.
  - a. Download the most recent NVRC Solid Waste report. Check with COG and NVRC Solid Waste staff on status of data collection for upcoming reports.
  - b. Research online to see if any local jurisdictions have new or updated solid waste reports or numbers. Save documentation.
    - i. If you find new documentation online, review to see if solid waste landfill v. combustion assumptions should remain the same or change.
  - c. Contact local jurisdictions to confirm solid waste data to use for landfill and combustion tonnage at the same time.
2. Document Annual Mass of Municipal Solid Waste Combusted in tons in the GHG Master Excel File's Combustion of Solid Waste tab.
3. Input values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Solid Waste*
  - b. Click on the Calculator titled: *Combustion of Solid Waste Generated by the Community*
  - c. Create an Inventory Record titled: *Combustion of Solid Waste [Year]*
  - d. Under *Input Method*, select "Calculation Using SW.2.2a."

- e. From the Master Excel File's Combustion of Solid Waste tab, enter Annual Mass of Municipal Solid Waste Combusted (tons) in ClearPath's Annual Mass of Municipal Solid Waste cell for each jurisdiction and sub-region.
  - Enter "100" in *Percent of Total Combusted MWS Generated In-Boundary* cell.
  - f. For the question *Does the receiving landfill have Methane Collection?* select "Yes" or "No" based on the Master Excel File's column titled Methane Collection at Receiving Landfill?
  - g. Select "Yes" for the question *Is Electricity Generated from Waste?*
  - h. Select "Generated and Disposed in Boundary" for the *Waste Generation and Disposal Location* drop-down list for the region and for most counties. Select "Exported" for cities.
  - i. Click Save.
4. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Combustion of Solid Waste tab's MTCO<sub>2</sub>e column.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Checks are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park  
Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

## SOURCES

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<sup>67</sup> District Department of Public Works. (2016). Washington, DC Solid Waste Diversion Progress Report. [https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page\\_content/attachments/FY15WasteDiversionReport\\_f.pdf](https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page_content/attachments/FY15WasteDiversionReport_f.pdf)  
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<sup>68</sup> Charles County Comprehensive Solid Waste Management Plan 2011 - 2021  
Page 3-3  
Table 3-6: Active Solid Waste Acceptance Facilities. Page 3-36  
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- <sup>67</sup> Frederick County Division of Utilities and Solid Waste Management. Solid Waste Management Plan 2018 - 2037  
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Data provided by Mark Charles via phone in September 2017. All landfill, no WTE.
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6957 tons of municipal waste reported, 46% disposed (landfill disposal assumed)  
<https://takomaparkmd.gov/newsletter/waste-management-101-a-review-of-takoma-parks-2016-efforts/>  
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- <sup>72</sup> Prince George's County, Maryland. (2017). Comprehensive Ten-Year Solid Waste Management Plan: 2017-2026  
Table 3-1: Annual Waste Generation in Prince George's County 2017-2026 Plan Period, column 2015  
Estimates, sum of rows: MSW Residential + MSW Commercial + MSW Mixed, page III-1  
Table 3-2: Municipal Waste Deliveries Calendar Year 2015, page III-4  
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- <sup>73</sup> Northern Virginia Regional Commission (NVRC). (2017). DRAFT Master Table Waste Report  
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- <sup>75</sup> Arlington County Department of Environmental Services. (2004). Solid Waste Management Plan  
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Generation, page 3-15  
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- <sup>78</sup> City of Falls Church, Virginia. (2004). Solid Waste Management Plan  
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<sup>82</sup> City of Manassas, Virginia. (2010). Solid Waste Management Plan 2010-2030

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*Website Last Accessed: September 2017*

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## OTHER

### Process and Fugitive Emissions

#### SUBSTITUTES FOR OZONE DEPLETING SUBSTANCES

Under the ClearPath Process and Fugitive Emissions tab, the *Other Process and Fugitive Calculator* is used to enter previously calculated emissions from substitutes for Ozone depleting substances.

#### Hydrofluorocarbon Emissions (HFC)

##### DESCRIPTION

Hydrofluorocarbons (HFC's) are a type of GHG and are comprised of several organic compounds composed of hydrogen, fluorine, and carbon. HFC's are produced synthetically and are commonly used in air conditioning and refrigerants in place of older halons and chlorofluorocarbons (CFC's), which were attributed to the depletion of Earth's Ozone layer. Following the implementation of the Montreal Protocol, HFC's gradually replaced CFC's because of their minimal impact on the Ozone layer, having an Ozone depletion potential of zero. However, HFC's are potent greenhouse gases (HFC's are 3,830 times more potent than CO<sub>2</sub>) with high global warming potentials.

##### METHODOLOGY

HFC emissions in this inventory represent GHG emissions from substitutions for Ozone depleting substances. Total U.S emissions from substitutes for Ozone depleting substances are scaled locally by population to estimate jurisdictional and regional values. Substitutions for Ozone depleting substances primarily result in HFC emissions; however, small amounts of perfluorocarbon (PFC) emissions also result from this source.

##### DATA INPUTS

Local data on substitutes for Ozone depleting substances is not available. It would take extensive research and local surveys to develop this data. Although emissions from these substances continues to expand, it only accounts for a small portion of emissions. The U.S. Environmental Protection Agency's annual inventory reports on GHG emissions calculates nationwide emissions for substitutes for Ozone depleting substances.

##### Data Needs:

- Population: Population data for all COG jurisdictions and regions, as well as U.S. totals, are collected from the American Community Survey.
- U.S. Emission of Ozone Depleting Substances: National data for HFC emissions is recorded in Million Metric Tons of Carbon Dioxide Equivalent (MMTCO<sub>2e</sub>) from the U.S. EPA, Inventory of U.S. GHG Emissions and Sinks – 1990-2015.

##### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.

## STEPS

1. Input American Community Survey population data for each jurisdiction and U.S. total into the GHG Inventory Master Excel File's Demographic Summary tab. This data will automatically be populated into the HFCs tab.
2. Input EPA GHG Inventory U.S. HFC totals in MMTCO<sub>2e</sub> for the inventory year into the lower table in the Master Excel File's HFCs tab.
3. Input MTCO<sub>2e</sub> values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Process and Fugitive Emissions*
  - b. Click on the Calculator titled: *Other Process and Fugitive*
  - c. Create an Inventory Record titled: *Hydrofluorocarbon Emissions (HFCs) [Year]*
  - d. Enter Emissions number from the Master Excel file into the *Gas in CO<sub>2</sub> Equivalent* cell. Click Save.

## CALCULATIONS

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- U.S. HFCs in MTCO<sub>2e</sub> = U.S. HFCs in MMTCO<sub>2e</sub> \* 1,000,000
  - Local Jurisdiction HFCs = U.S. HFC Total in MTCO<sub>2e</sub> \* (Local Population/ U.S. Population)
  - Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
  - Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
  - Metropolitan Washington Total = DC + Suburban MD + Northern VA
- A Totals Check is calculated for quality control:  
Metropolitan Washington Total = U.S. HFC Total in MTCO<sub>2e</sub> \* (Regional Population/ U.S. Population)

## SOURCES

<sup>83</sup> U.S. Census Bureau. 2011-2015 American Community Survey 5-Year Population Estimates Demographic and Housing Estimates (2015 ACS, Table DP05)

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<sup>84</sup> U.S. Environmental Protection Agency. (2017). Inventory of U.S. GHG Emissions and Sinks - 1990-2015 Executive Summary, Page ES-7, Table ES-2: Recent Trends in U.S. Greenhouse Gas Emissions and Sinks (MMT CO<sub>2</sub> Eq.), row titled "Substitution of Ozone Depleting Substances" under HFCs sub-header, 2015 column

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Webpage last accessed: July 2017

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## FUGITIVE EMISSIONS FROM NATURAL GAS DISTRIBUTION

Under the ClearPath Process and Fugitive Emissions tab, the *Fugitive Emissions from Natural Gas Distribution Calculator* is used to calculate the emissions from leakage in the natural gas distribution system.

### Natural Gas Fugitive Emissions

#### DESCRIPTION

Natural Gas Fugitive Emissions accounts for emissions resulting from local natural gas system losses within the community.

#### METHODOLOGY

The Fugitive Emissions from Natural Gas emission calculations uses the ClearPath calculator developed after the latest version of the U.S. Communities Protocol was published (Version 1.1). ICLEI, author of the Protocol, intends to outline the method in the next edition of the Protocol under development in the winter 2018. The fugitive emissions are calculated based on a leakage rate for total annual natural gas consumption. The ClearPath calculator uses a leakage rate of 0.3%.

#### DATA COLLECTION

Data from the Metropolitan Washington Annual Utility survey needs to first be collected and analyzed for the inventory year prior to completing these steps. See the residential and natural gas under the Built Environment section of this report and COG's Utility Data Summary Template.

#### Data Needs:

- Natural Gas Consumption: Total Annual Therms for each jurisdiction from the analyzed results of the Metropolitan Washington Annual Utility Survey.

#### Notes on Data:

- Maryland cities and the Town of Purcellville are subtotals of the county data. Maryland county emissions includes all city emissions. In Virginia, COG member local jurisdictions are independent of counties, therefore, city and county emissions are reported independent of each other.
- The total residential and commercial consumption entered into the Master Excel File's tabs for Residential Natural Gas and Commercial Natural Gas are automatically loaded into the Natural Gas Fugitive tab.

#### STEPS

1. Complete the residential and commercial natural gas calculations under the Built Environment Section prior to completing the natural gas fugitive emissions calculations.
2. Input MTCO<sub>2</sub>e values into ClearPath for the region and each jurisdiction's account.
  - a. Go to the main ClearPath tab titled: *Process and Fugitive Emissions*
  - b. Click on the Calculator titled: *Fugitive Emissions from Natural Gas Distribution*
  - c. Create an Inventory Record titled: *Natural Gas Fugitive [Year]*

- d. Enter Total Annual Natural Gas from the Master Excel file into the *Quantity of Natural Gas Used* cell. Select *Therms* from the drop-down list. Do not change the ICLEI default factors.
  - e. Click Save.
3. Enter ClearPath's calculated emissions from the CO<sub>2</sub>e (MT) results into the Master Excel File's Natural Gas Fugitive tab's MTCO<sub>2</sub>e column.

### **CALCULATIONS**

The following calculations are embedded into the GHG Inventory Master File Template to facilitate calculations of GHG emissions.

- Local Jurisdiction Residential Annual Natural Gas + Local Jurisdiction Commercial Natural Gas = Total Annual Natural Gas in Therms.
- Suburban MD Subtotal = Charles County + Frederick County + Montgomery County + Prince George's County
- Northern Virginia Subtotal = Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park
- Metropolitan Washington Total = DC + Suburban MD + Northern VA
- Totals Check are in place for quality control:  
Metropolitan Washington Total = DC + Charles County + Frederick County + Montgomery County + Prince George's County + Alexandria + Arlington + Fairfax County + Fairfax City + Falls Church + Loudoun County + Prince William County + Manassas + Manassas Park + Unassigned

Also, when entering regional totals into ClearPath, double check to make sure it matches to the total emissions in the template. A rounding error of 1 or less is acceptable. If difference is above 1, additional quality control checks are needed.

### **SOURCES**

<sup>85</sup> 2015 Metropolitan Washington Energy Utility Data Survey Analysis  
<I:/CLIMATE ENERGY/Projects/Utility Data/2005-2015 Data Re-Scrub Files/FINAL>

<sup>86</sup> Environmental Defense Fund (EDF). User Guide For Natural Gas Leakage Rate Modeling Tool  
<I:/CLIMATE ENERGY/Projects/Inventory/2015/Data/Built Environment/Electric and Natural Gas Utility>  
<https://www.edf.org/sites/default/files/US-Natural-Gas-Leakage-Model-User-Guide.pdf>

*Website Last Accessed: January 2018*

### **STAFF CONTACTS**

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## APPENDIX A: 2015 METHODOLOGY SUMMARY TABLE

Emissions Type	Emissions Activity or Source	GHG Types (CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, HFCs, PFCs, SF <sub>6</sub> )	Methodology (From US Communities Protocol, v 1.1)	Data Quality Confidence Levels (High, Medium, Low)
<b>BUILT ENVIRONMENT</b>				
<b>Residential Energy</b>	Emissions from Grid Electricity *	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Appendix C, BE.2.1	High
	Emissions from Stationary Fuel (Natural Gas) *		Appendix C, BE.1.1	High
	Emissions from Stationary Fuel (Fuel Oil, LPG) *		Appendix C, BE.1.2	Medium
<b>Commercial and Industrial Energy</b>	Emissions from Grid Electricity *	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Appendix C, BE.2.1	High
	Emissions from Stationary Fuel (Natural Gas) *		Appendix C, BE.1.1	High
	Emissions from Stationary Fuel (Fuel Oil, LPG) *		Appendix C, BE.1.3	Medium
	Industrial Point Source Emissions from Stationary Fuel Combustion	Any GHG	IE in commercial and industrial stationary fuel and solid waste	N/A
	Consumption of District Energy	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	IE in commercial and industrial grid electricity and stationary fuel	N/A
<b>TRANSPORTATION AND MOBILE EMISSIONS</b>				
<b>Transportation and Mobile Emissions</b>	On Road Transportation *	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	Appendix D, TR.1.A	High
	Emissions from Public Transit *		IE in On Road	N/A
	Aviation Travel		Appendix D, TR.6.D	Medium
	Rail Transportation *		Appendix D, TR.4	Medium
	Emissions from Off Road Vehicles *		Appendix D, TR.8	High
	Water Transportation *		IE in Non-Road	N/A
<b>WASTEWATER TREATMENT</b>				
<b>Water and Wastewater</b>	Emissions from Wastewater Treatment Energy Use *	CO <sub>2</sub> , CH <sub>4</sub> , and N <sub>2</sub> O from electricity and fuels	IE in commercial and industrial energy	N/A
	Emissions from the Supply of Potable Water *	CO <sub>2</sub> , CH <sub>4</sub> , and N <sub>2</sub> O from electricity and fuels	IE in commercial and industrial energy	N/A
	Fugitive Emissions from Septic Systems*	Fugitive CH <sub>4</sub>	Appendix F, WW.11	High
	Nitrification/Denitrification Process N <sub>2</sub> O Emissions from Wastewater Treatment *	Process N <sub>2</sub> O	Appendix F, WW.7	High
	Process N <sub>2</sub> O from Effluent Discharge to Rivers and Estuaries *	Fugitive N <sub>2</sub> O	Appendix F, WW.12	High
<b>AGRICULTURE</b>				
<b>Agriculture</b>	Emissions from Agricultural Activities	CH <sub>4</sub> , N <sub>2</sub> O	Alternate Method - EPA State Inventory Tool, AG Module	High
	Emissions from Stationary Fuel Combustion	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	IE in commercial and industrial grid electricity and stationary fuel	N/A
	Emissions from Grid Electricity			

Emissions Type	Emissions Activity or Source	GHG Types (CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, HFCs, PFCs, SF <sub>6</sub> )	Methodology (From US Communities Protocol, v 1.1)	Data Quality Confidence Levels (High, Medium, Low)
<b>SOLID WASTE TREATMENT</b>				
<b>Solid Waste</b>	Waste Generation (Landfill) *	Fugitive CH <sub>4</sub>	Appendix E, SW.4	Medium
	Process Emissions Associated with Landfilling	CO <sub>2</sub> e	NE	N/A
	Combustion of Solid Waste Generated by the Community *	Fossil CO <sub>2</sub> , N <sub>2</sub> O, CH <sub>4</sub> (biologic CO <sub>2</sub> optional)	Appendix E, SW.2.2	Medium
	Biologic Treatment of Solid Waste (Composting)	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	NE	N/A
<b>OTHER</b>				
<b>Process and Fugitive Emissions</b>	Other Process and Fugitive	HFCs, PFCs, Refrigerant Blends	Alternate Method - Downscale from national inventory	High
	Fugitive Emissions from Oil Systems, Mining, Processing, Storage, and Transportation of Coal	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	NE	N/A
	Fugitive Emissions from Natural Gas Distribution	CO <sub>2</sub> , CH <sub>4</sub>	ClearPath calculator	High
<b>Upstream Impacts of Activities</b>	Upstream Impacts of Electricity Used by the Community	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O	NE	N/A
	Upstream Impacts of Fuels Used in Stationary Combustion by the Community			
	Emissions from Electric Power Transmission and Distribution Losses			
<b>Consumption Based</b>	Consumption Based Emissions, Previously Calculated	Any GHG	NE	N/A

Column Header	Description
Emissions Type	This column lists the main tabs in the online ClearPath tool's GHG inventory entry pages in the same order listed in ClearPath.
Emissions Activity/Source	This column lists the ClearPath calculators that are used to calculate or record emissions from activities/sources. * Indicates that reporting for this activity or source is required by the U.S. Community Protocol or Global Protocol for Community-Scale GHG Inventories (BASIC). Those without a * are not requirements of the protocols.
GHG Types	Summarizes the leading GHG emission types that result from each activity or source, including carbon dioxide (CO <sub>2</sub> ), Methane (CH <sub>4</sub> ), Nitrous oxide (N <sub>2</sub> O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF <sub>6</sub> ).
Methodology	The methodologies and calculations generally follow ICLEI's US Community Protocol for Accounting and Reporting GHG Emissions Version 1.1. Modified approaches to the ICLEI methodology are used based on data availability. In addition, notations are made in accordance with the Notation Keys legend below.

Notation Keys	Description
IE = Included Elsewhere	Emissions for this activity are estimated and presented in another category of the inventory. The category where these emissions are included should be noted in explanation.
NE = Not Estimated	Emissions occur but have not been estimated or reported (e.g., data unavailable, effort required not justifiable).
NA = Not Applicable	The activity occurs but does not cause emissions; explanation should be provided.
NO = Not Occurring	The source or activity does not occur or exist within the community.

Note: These notations were developed by the Global Communities Protocol and are also used by the U.S. Communities Protocol. See Version 1.1, 2012, Appendix B.

# APPENDIX B: DATA NEEDS AND AVAILABILITY SUMMARY TABLE

Emissions Type	Emissions Activity or Source	Data Needs	Data Source	Data Availability
<b>BUILT ENVIRONMENT</b>				
<b>Residential Energy</b>	Emissions from Grid Electricity	Number of Residential Electricity Accounts	COG Annual Utility Data Survey	Annually available for previous year in Sept
		Residential Electricity Consumption		
		eGRID Emission Rates	U.S. Environmental Protection Agency (EPA)	Biennially available with a 2-year lag (2016 data released in Feb. 2018)
	Emissions from Stationary Fuel (Natural Gas, Fuel Oil, LPG)	Number of Residential Natural Gas Accounts	COG Annual Utility Data Survey	Annually available for previous year in Sept
		Residential Natural Gas Consumption		
		Households using Fuel Oil and LPG	American Community Survey (ACS)	Annually available by Dec. for previous year
	Residential Fuel Oil and LPG Statewide Consumption	U.S. Energy Information Administration (EIA) State Energy Data System (SEDS)	Annually available with 2-year lag (2017 data release scheduled for Jan-Apr 2019)	
<b>Commercial and Industrial Energy</b>	Emissions from Grid Electricity	Number of Non-Residential Electricity Accounts	COG Annual Utility Data Survey	Annually available for previous year in Sept
		Non-Residential Electricity Consumption		
		eGRID Emission Rates	U.S. EPA	Biennial (2016 data released in Feb. 2018)
	Emissions from Stationary Fuel (Natural Gas, Fuel Oil, LPG)	Number of Non-Residential Natural Gas Accounts	COG Annual Utility Data Survey	Annually available for previous year in Sept
		Non-Residential Natural Gas Consumption		
		Number of Local Commercial Buildings and Total Square Footage	COG's CoStar Database Account	Annually available for previous year in Apr/May
		South Atlantic Region's Total Commercial Floorspace and Square Footage using Fuel Oil and LPG	EIA Commercial Building Energy Consumption Survey (CBECS)	The next CBECS survey will be completed for 2018 and results will be released starting in mid-2020. CBECS is not completed in standardized cycles (i.e. every x years); it depends on budget and funding.
		Fuel Oil and LPG Energy Intensity	EIA CBECS	
<b>TRANSPORTATION AND MOBILE EMISSIONS</b>				
<b>Transportation and Mobile Emissions</b>	On Road Transportation	Population	COG Cooperative Forecasts and ACS	COG - Every 1-2 years ACS - Annually available by Dec. for previous year
		Emissions	EPA MOVES and travel demand models	Data request to COG DTP, 3-4 weeks to complete
		Vehicle Miles Travelled		
	Aviation Travel	Number of Originating Air Passengers	COG's Washington-Baltimore Regional Air Passenger Survey	Biennial (2017 report released in June 2018)
		Total Enplanements for BWI, DCA, IAD	Geographic Findings Report	
		Total Revenue Passenger Miles	Bureau of Transportation Statistics	Monthly, available 10 weeks after end of the month (2018 data totals available in Mar 2019).
	U.S. Total Commercial Aircraft Emissions		U.S. EPA Inventory of U.S. GHG Emissions and Sinks	Annually available by April 15
	Rail Transportation	Population	ACS	Annually available by Dec. for previous year
		MTA and VRE Diesel Consumption	FTA National Transit Database	Annually available in Oct for previous year
Emissions from Off Road Vehicles	Population	COG Cooperative Forecasts and ACS	COG - Every 1-2 years ACS - Annually available by Dec. for previous year	
	Emissions	EPA MOVES2014/ NONROAD 2008	Only develop new off-road emissions SIP or base year air quality emissions inventory due for EPA submittal. 2016 or 2017 data available July/Aug. 2020	

Emissions Type	Emissions Activity or Source	Methodology (From US Communities Protocol, v 1.1)	Data Source	Data Availability	
<b>WASTEWATER TREATMENT</b>					
<b>Water and Wastewater</b>	Fugitive Emissions from Septic Systems	Population Served by Septic	COG Regional Wastewater Flow Forecast Model (RWFFM);	RWFFM - Dec after COG Cooperative Forecast adoption; ACS - Annually available by Dec. for previous year	
	Nitrification/Denitrification Process N2O Emissions from Wastewater Treatment	Population Served by Sewer	ACS		
	Process N2O from Effluent Discharge to Rivers and Estuaries	Population Served by Sewer			
		Daily Nitrogen Load			
<b>AGRICULTURE</b>					
<b>Agriculture</b>	Emissions from Agricultural Activities	Livestock - dairy cows, beef cattle, sheep, goats, swine, horses, layers (pullets and chickens), broilers, and turkeys	Chesapeake Assessment Scenario Tool (CAST)	Annually, ongoing	
		Fertilizer - synthetic, manure, biosolids			
		Crops acreage - corn for grain, all wheat, soybeans			
		Crop yields - bushels/acre for corn, wheat and soybeans by state (MD and VA)	AG Census		Every 5 years (2017 Census will be available starting in Feb 2019)
<b>SOLID WASTE TREATMENT</b>					
<b>Solid Waste</b>	Waste Generation (Landfill)	Municipal Solid Waste (MSW)	Northern Virginia Regional Commission (NVRC) Solid Waste Reports, local plans and sources	Local MSW data reported to state annually in May (state publishing times vary; collect directly from localities). Biennially NVRC reports (2018 released summer 2020, preliminary data available Spring 2019).	
	Combustion of Solid Waste Generated by the Community	MSW			
<b>OTHER</b>					
<b>Process and Fugitive Emissions</b>	Other Process and Fugitive	Population	ACS	Annually available by Dec. for previous year	
		U.S. Emissions of Ozone Depleting Substances	U.S. EPA Inventory of U.S. GHG Emissions and Sinks	Annually available by April 15	
	Fugitive Emissions from Natural Gas Distribution	Total Natural Gas Consumption	COG Annual Utility Data Survey	Annually available for previous year in Sept	

# APPENDIX C: EMISSIONS FACTOR LIBRARY

# APPENDIX D: INVENTORY CHANGE LOG

## Process

### DEMOGRAPHICS

Check and change, as needed, City of Fairfax employment statistics (particularly for 2015).

### FINAL PRODUCTS

Add additional indicators to final products, such as fact sheets to align with LEED for Cities and Communities requirements, which includes:

- Built environment (energy sector) per capita emissions (COG already provides overall GHG per capita)
- GHG intensity = Total City GHG/Total City GDP.
  - Apportion metro scale GDP data to the city by pop to get city GDP
  - Do for each inventory year so have a trend line
- Carbon intensity calculated the same as GHG intensity?

## Built Environment

### EMISSIONS FROM GRID ELECTRICITY (RESIDENTIAL AND COMMERCIAL)

#### 2005, 2012, 2015 Methodology

2015 inventory uses e-GRID 2014. EPA changed the e-GRID methodology in the 2014 version to be based on geographic location rather than service territory. This changed the sub-region grid of more than 200 plants. EPA agreed reverted as closely as possible for eGRID 2016 to the methodology used in eGRID 2012 and earlier, in which plants are assigned based on the sub-region into which they deliver power. There were some more minor impacts to our local sub-regions (SRVC, RFCE).

#### 2018 Methodology

Change 2015 to use e-GRID 2016. Use e-GRID 2018 for 2018 data.

## Transportation

### ON-ROAD TRANSPORTATION

#### 2005, 2012, 2015 Methodology

2005 and 2012 were MOVES 2010 model runs while 2015 was MOVES 2014 model run. Estimates for Maryland cities are subtotals of county estimates based on population. In Virginia, the cities have been separated out from Fairfax and Prince William County based on population; therefore, the county totals do not include cities. Cities of Falls Church and Fairfax have been separated from Fairfax County and the Cities of Manassas and Manassas Park have been separated out from Prince William County.

#### 2018 Methodology

To ensure modeling consistency and reduce potential error, COG Transportation data team will run all years of the inventories (2005, 2012, 2015, 2018) using MOVES 2014b, Global Warming

Potential Factors using the IPCC AR4 Report, and convert from short tons to metric tons by multiplying short tons by the factor 0.90718474.

We are currently researching potential alternative approaches for downscaling data for small cities/looking for an option that may provide more accurate results than downscaling by population. Thus far we've found that the DTP data team has VIN data for cities in Virginia, but not for Maryland and city-scale VIN data is not available anywhere by zip code. Therefore, VIN data is not an option. Our regional VMT models do not scale down accurately to the smaller-city scale; therefore VMT is also not an option for downscaling.

## AIR PASSENGER TRAVEL 2005, 2012, 2015 Methodology

The Airport Analysis Zones (AAZ) for Greenbelt, Hyattsville, Bladensburg, Manassas and Manassas Park are significantly larger than the COG member city. The originating passengers were downscaled by American Community Survey (ACS) population. The 2015 example is below:

AAZ	2015 Originating Passengers			Community	ACS Pop 2015		Originating Passengers		
	BWI	DCA	IAD		#	% of Total AAZ	BWI	DCA	IAD
69	29,612	34,985	3,911	Bladensburg	9,461	8.64%	2,558	3,022	338
				Hyattsville	18,225	16.64%	4,927	5,821	651
				Langley	21,049	19.22%	5,690	6,723	752
				Chillum	37,150	33.91%	10,043	11,865	1,326
				Mt Rainer	8,329	7.60%	2,252	2,660	297
				Brentwood	3,139	2.87%	849	1,003	112
				Cottage City	1,151	1.05%	311	368	41
				Edmonston	1,445	1.32%	391	462	52
				Berwyn Heights	3,223	2.94%	871	1,029	115
				Cheverly	6,368	5.81%	1,721	2,034	227
			TOTAL	109,540	100%	29,612	34,985	3,911	
74	27,019	30,975	8,155	Greenbelt	23,827	65.51%	17,701	20,293	5,343
				New Carrollton	12,542	34.49%	9,318	10,682	2,812
				TOTAL	36,369	100%	27,019	30,975	8,155
87	3,109	11,878	56,338	Manassas	40,743	72.28%	2,247	8,585	40,721
				Manassas Park	15,625	27.72%	862	3,293	15,617
				TOTAL	56,368	100%	3,109	11,878	56,338

Purcellville had many small surrounding communities in the AAZ where there was not readily available population statistics and thus originating air passengers were downscaled from the county statistics. Falls Church was not downscaled. After inventory completion, the City pointed out that the City was much smaller than the AAZ.

## 2018 Methodology

A one-time analysis was completed by DTP's air traffic data team to determine the appropriate downscale factors using Transportation Analysis Zones (TAZ) population data. TAZs are small area planning zones with demographic data assigned in line with the COG Cooperative Forecasts. When grouped together, TAZ zones generally geographically align with cities and AAZs. Therefore, TAZ

demographic data were analyzed to determine the percent to downscale the AAZ number of originating air passengers to city-scale.

This is a more unified approach to downscaling that will be used moving forward. It is slightly different than the approach applied for 2005, 2012, and 2015. If the new approach results in a significant difference in emissions, this approach will be revised in the past inventories as COG works on the 2018 round of inventories.

For cities with a significantly smaller footprint than the AAZ, the number of originating passenger input data will be downscaled based on city-to-AAZ demographic data. Data will be pulled from the AAZ table and downscale AAZ number of originating passengers to the city as follows:

<b>City</b>	<b>AAZ #</b>	<b>Downscale Percentage</b>
Bladensburg, MD	69	8%
College Park, MD	70	80%
Greenbelt, MD	74	36%
Hyattsville, MD	69	11%
Laurel, MD	73	49%
Falls Church, VA	34	10%
Manassas, VA	87	39%
Manassas Park, VA	87	14%
Purcellville, VA	94	17%