**Technical Appendix: Methodology for GHG and Other Air Pollutant Emissions Reductions Calculations**

This technical appendix explains the assumptions and methodologies used in developing the estimated GHG emissions reductions for each GHG reduction measure so that EPA can understand the basis for the estimated GHG emission reductions for each measure in the application. Here, DOEE provides information such as the methods, models, key assumptions, related outputs, and individual calculations supporting their GHG reduction estimates. Estimates of both annual and cumulative GHG emission reductions are provided for each GHG reduction measure for two time periods: 2025 through 2030, and 2025 through 2050.

## **Organic Waste Diversion**

DOEE estimated the greenhouse gas savings from composting food waste using EPA’s WARM tool (v.16) using the following assumptions and inputs to the tool:

Tonnage of organic waste diverted: Annual diversion is estimated to be 430.23 pounds/household/year from curbside organics collection, based on the average of two data points:

* + 392.5 pounds of food and yard waste per household per year based on medium participation and generation estimated in the [District’s 2017 Compost Feasibility Study](https://dpw.dc.gov/compostfeasibilitystudy);
  + 468 pounds of food and yard waste per household per year based on benefit-cost analysis conducted during the development of the [Zero Waste DC Plan](https://zerowaste.dc.gov/zwdcplan) in 2022

Based on the analysis, 40% of waste is food waste, and 60% is yard waste.

* Food waste is entered into the WARM model as general food waste. Yard waste is estimated to be 50% leaves, based on fiscal year 2022 leaf collection data. The remaining 50% is estimated to be 25% grass, and 25% yard trimmings.

As households are added in each phase of the organics collection roll-out, the annual tonnage increases. At full city-wide roll-out—reaching 105,000 households—the program’s food and yard waste diversion potential is 22,587.25 tons per year. Using these inputs, the estimated total tonnage of organics collected are as follows:

* **2025-2030**: 85,508.88 total tons
  + 34,203.55 tons food waste and 51,305.33 tons yard waste
* **2025-2050**: 537,253.88 total tons
  + 214,901.55 tons food waste and 322,352.33 tons yard waste

Baseline management (current disposition of waste): 56% to landfill; 44% to incineration, based on Total Citywide Solid Waste Disposal by Destination (Table 3) from the District of Columbia Solid Waste Diversion Annual Report (2019-2022)[[1]](#footnote-2)

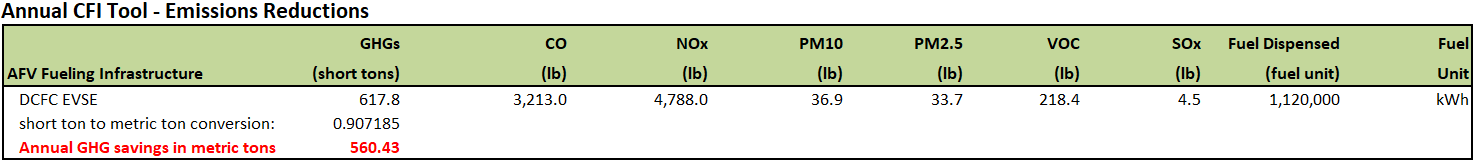
The outputs from the WARM model are captured below, demonstrating a 40,313.89 MTCO2e reduction in total GHG emissions between 2025-2050, with 6,416.33 MTCO2e of savings between 2025-2030.

**2025-2030 cumulative GHG savings:** 6,416.33MTCO2e

**2025-2050 cumulative GHG savings:** 40,313.89MTCO2e

**EV Charging Infrastructure for Medium-to-Heavy Duty Vehicles:**

The District used the AFLEET CFI tool[[2]](#footnote-3) (v1.1) to estimate GHG reductions from installing the proposed 40 Level 3 chargers to support depot charging for medium-to-heavy duty vehicles. Assuming 90% heavy duty charging, and 10% light-to-medium duty fast charging based on the electricity mix for the RFC East eGRID region, the estimated annual savings are 560.4MTCO2e. The outputs of the tool for GHGs and other air pollutants are captured below, with conversion factors to convert outputs from short tons to metric tons for GHG pollutants.



Based on the planned installation roll-out, cumulative savings are calculated at full-scale starting in 2028, and at 37.5% starting in 2026 (15 chargers installed of 40 total) as follows:

560.43MTCo2e annual savings x 22 years + (560.43 x .375 x 2 years)

**2025-2030 cumulative GHG savings: 420.32 MTCO2e**

**2025-2050 cumulative GHG savings: 12,749.78 MTCO2e**

In addition to the GHG savings, the AFLEET CFI tool estimates reductions in local criteria air pollutants including PM2.5, NOx and VOCs. Using the same methodology for summing cumulative emissions, the estimated air quality benefits from the EV chargers to support MHDV are as follows:

|  |  |  |
| --- | --- | --- |
| **Pollutant** | **Cumulative Savings (lbs)** | |
| **2025 –2030** | **2025 - 2050** |
| NOx | 3,591 | 108,927 |
| PM10 | 28 | 839 |
| PM2.5 | 25 | 767 |
| VOC | 164 | 4,969 |
| SOx | 3 | 102 |

**E-Bike Incentive Program**

**GHG Reduction Estimate Method:** DDOT used an existing publicly available tool, the *Electric Vehicle Incentive Cost and Impact Tool,* hosted by Portland State University’s [Transportation Research and Education Center (TREC)](https://trec.pdx.edu/). Source code can be found [here](https://github.com/PSUTrec/Incentive-Impact-Tool) and is made available using the [GNU GPL v3 license](https://github.com/PSUTrec/Incentive-Impact-Tool/blob/master/LICENSE.txt). The *E-Vehicle Incentive Impact Tool* allows users to better understand the cost, carbon emissions reduction, and carbon emissions reduction cost efficiency given a specific e-vehicle incentive program and local emissions profiles.

**Measure Implementation Assumptions**:

* **Trips**. The trips table shows the weighted average of number of automobile trips per household vehicle per day and the weighted average automobile trip length. Typically, these values are obtained using household travel surveys. Data sourced from the [2017 NHTS](https://nhts.ornl.gov/), was filtered for cars, SUVs, vans, and pickups. Next, the data are filtered for trips where the person was the driver and aggregated by state. The state weighted averages are calculated using the “WTTRDFIN” weight.
  + Average Trips per Day = 5.03, DC preset, data sourced from the NHTS 2017
  + Average Auto Trip Length = 7.11 mi, DC preset, data sourced from the NHTS 2017
* **Electricity**. The electricity table shows the average carbon intensity of electricity generation in the given region.
  + Electricity Carbon Emissions = 438.9 lb CO2 / MWh, DC preset, sourced from the [US EPA eGRID 2018](https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)
* **ICE**. The ICE (internal combustion engine) table shows the average fuel economy of an automobile.
  + Average Fuel Economy = 24.2 mpg
  + Carbon Emissions from Gasoline = 8887.0 g CO2/gal, data [constant](https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references)
* **E-Bike**. The E-Bike table shows the average fuel economy of e-bikes eligible for an e-bike incentive. This value can be obtained from e-bike manufacturers. The ratio of automobile miles that are replaced by e-bike miles is specified by the user. This value can be obtained from local e-bike use studies.
  + Average Economy = 1.91 kWh/100 mi, VT\_mix Low Efficiency preset.
    - An equally weighted average of the e-bikes studied in the Efficiency Vermont report. Fuel economy information from the [Efficiency Vermont report](https://www.efficiencyvermont.com/Media/Default/docs/white-papers/efficiency-vermont-electric-bike-white-paper.pdf).
  + Ratio, portion of car miles replaced by e-bike (maximum 1) = 0.15 (User Defined)

**GHG Reduction Estimate Assumptions**: Voucher at $1500 with a budget of $2M per year.

**Measure-Specific Activity Data:**

* Ratio, portion of car miles replaced be e-bike – measured by NREL’s [OpenPATH](https://www.nrel.gov/transportation/openpath.html) real-time travel data of voucher recipients (estimating 70% participation rate in OpenPATH with additional incentives)
* Vehicle miles traveled by e-bike

**GHG Emissions Reduced**:

|  |  |
| --- | --- |
| 2025–2030 | 2025–2050 |
| 0.6M kg/year = **3,000 mt CO2e total** | 0.6M kg/year = **15,000 mt CO2e total** |

1. 2019 – 2022 Solid Waste Diversion Annual Report, available at: https://dpw.dc.gov/sites/default/files/dc/sites/dpw/page\_content/attachments/Solid%20Waste%20Diversion%20Report%202019-2022.pdf [↑](#footnote-ref-2)
2. |  |
   | --- |
   | This tool was developed with the support of the Joint Office of Energy and Transportation, using the AFLEET Tool available at: <https://greet.es.anl.gov/afleet>. The AFLEET Tool uses emissions data from both the EPA’s MOVES and Argonne’s GREET models. |

   [↑](#footnote-ref-3)