

Greenhouse Gas Emissions Inventory

Methods

Methods and Data Sources

Calculating Burlington’s GHG inventory involved collecting activity data from various sources, identifying relevant emissions factors, and applying these emissions factors to the activity data.

Table A-1 summarizes the following:

- Activity data, which quantify levels of GHG-generating activities, such as kWh of electricity consumed, vehicle miles traveled, or the amount of waste landfilled.
- Emission factors (e.g., MT CO₂e per kWh) convert activity levels into emissions.

Activity data sources and emission factor sources are fully documented in the City of Burlington 2023 GHG Emissions Inventory spreadsheet.

Table A-1: Activity Data and Emissions Factors for Burlington GHG Emissions Inventory

Category	Activity Data	Emission Factors
Built Environment		
Electricity	Consumption within city limits provided by Puget Sound Energy (PSE)	1) PSE-specific emission factor from PSE 2023 GHG reporting 2) Emissions & Generation Resource Integrated Database (eGRID) emission factors (for informational purposes only)
Natural Gas	Consumption within city limits provided by Cascade Natural Gas (CNG)	U.S. EPA Emission Factors Hub
Propane	WA propane consumption by sector from U.S. Energy Information Administration (EIA)	U.S. EPA Emission Factors Hub
Fuel Oil	WA propane consumption by sector from U.S. EIA	U.S. EPA Emission Factors Hub
Transportation		
City Fleet Vehicles	Vehicle miles traveled (VMT) from City staff estimates	U.S. EPA Emission Factors Hub
Community On-Road Vehicles	VMT data from Washington State Department of Transportation (WSDOT) Highway Performance Monitoring System (HPMS)	U.S. EPA Emission Factors Hub
Wastewater		

Category	Activity Data	Emission Factors
Treatment Processes	Wastewater treatment data from City staff	U.S. Local Government Operations Protocol default emission factors, customized based on data available from wastewater treatment plant
Solid Waste		
Generation and Disposal	City tonnage for municipal solid waste and organics from Waste Management	EPA Waste Reduction Model version 16 (WARM v16) emission factors, customized for landfill characteristics (e.g., landfill gas recovery)

Built Environment

Electricity

Emissions from electricity consumption were calculated using the amount of electricity consumed within Burlington city limits in 2023, multiplied by PSE’s 2023 emission factor. PSE supplied residential, commercial, and industrial electricity consumption data. Burlington city staff provided data for electricity use at city buildings and facilities, which was subtracted from total commercial electricity use to avoid double-counting emissions. To make future GHG inventory data collection more efficient, MFA recommends that the City develop a method to digitally track the amount of electricity used at the locations included in the GHG inventory, such as monthly data entry into a tracking spreadsheet or automated uploads to the City’s ENERGY STAR® Portfolio Manager account.

Natural Gas

Emissions from natural gas consumption were calculated using the amount of natural gas consumed within Burlington city limits in 2023, multiplied by U.S. EPA emission factors. CNG provided residential, commercial, and industrial natural gas consumption data. Burlington city staff provided data for natural gas use at city buildings and facilities, which was subtracted from total commercial natural gas use to avoid double-counting emissions. To make future GHG inventory data collection more efficient, MFA recommends that the City develop a method to digitally track the amount of natural gas used at the locations included in the GHG inventory, such as monthly data entry into a tracking spreadsheet or automated uploads to the City’s ENERGY STAR® Portfolio Manager account.

Propane and Fuel Oil

Residential propane emissions were calculated using 2020 (most recent available data) U.S. EIA average residential propane consumption data for Washington state. Average residential propane consumption was multiplied by U.S. Census American Community Survey (ACS) home heating fuel data for Burlington and then multiplied by U.S. EPA emission factors.

For commercial and industrial propane and fuel oil, U.S. EIA statewide consumption data for 2023 were not available at the time of this analysis, so data from 2022 were used. Commercial and industrial propane and fuel oil emissions were calculated using statewide fuel consumption estimates downscaled by the number of commercial and industrial employees within Skagit County as compared to total state employment. County-level estimates were further downscaled using the ratio of Burlington population to Skagit County population. Employment data were collected from the

Washington Employment Security Department, which provides data on the number of employees across industries. Propane and fuel oil emissions were calculated using U.S. EPA emissions factors.

Transportation

City Fleet Vehicles

City staff provided estimates of 2023 mileage for each vehicle in the city fleet, along with each vehicle's year, make, model and Vehicle Identification Number. These data were entered into the Dashboard for Rapid Vehicle Electrification (DRVE) Tool. The DRVE Tool generated an assumed fuel type, city road fuel economy, and highway fuel economy for each vehicle. Based on the uses of city fleet vehicles, it was assumed that vehicles traveled 75% of the estimated annual mileage on city roads and 25% on highways, which was used to create an average fuel economy and estimated fuel consumption for 2023 based on mileage estimates. Vehicles were also categorized as passenger cars, light trucks (includes vans, pickup trucks, SUVs), or heavy-duty vehicles based on vehicle weight class. Estimated fuel consumption and mileage data were multiplied by fuel- and vehicle-type-specific U.S. EPA emission factors to estimate city fleet vehicle emissions.

Community On-road Vehicles

On-road emissions were developed using 2023 VMT activity data from WSDOT's HPMS, which provides estimated annual VMT for all public roadways by county and city. The data used for calculations only includes estimated VMT on city-owned roads in Burlington and does not include VMT within Burlington city limits on roads that are not city-owned (e.g., Interstate 5, State Route 20). VMT was split into freight/service vehicles and passenger vehicles VMT based on WSDOT HPMS statewide freight percentages. For freight/service vehicle emissions, VMT was multiplied by U.S. EPA vehicle-specific emissions factors. For passenger vehicles, 2023 vehicle registration data from Skagit County was used to estimate VMT by vehicle type, which was then multiplied by U.S. EPA vehicle-specific emissions factors.

Wastewater

Wastewater treatment process emissions produced in the Burlington service area were estimated based on 2023 data provided by city staff. Emissions were estimated based on the type of processes occurring at the plant (e.g., combustion of anaerobic digester biogas, wastewater treatment in aerated basins) as well as the population served. Based on the data provided by city staff, emissions were calculated using U.S. Local Government Operations Protocol default equations.

Solid Waste

Emissions from the generation and disposal of landfilled and composted solid waste were estimated by multiplying the tons of waste generated in 2023 by material type-specific emissions factors using the US EPA Waste Reduction Model (WARM) v16. Waste Management provided waste and compost generation data for customers within Burlington city limits. The WARM v16 calculations were customized to estimate methane emissions based on the landfill's characteristics and methane capture technology. Emissions from transportation of waste to landfills were estimated using default travel distances from EPA WARM v16.

Data Limitations

For some categories, data availability was limited and/or it was necessary to scale regional or state data to estimate emissions. Data limitations and the local relevance of data sources for each category are summarized below.

Built Environment

Electricity

- No notable limitations of data sources or approach.
- Electricity data reflect local conditions.

Natural Gas

- No notable limitations of data sources or approach.
- Natural gas data reflect local conditions.

Propane and Fuel Oil

- At the time of analysis, 2023 EIA data for statewide commercial and industrial propane and fuel oil use were not available, so 2022 data were used in calculations.
- At the time of analysis, 2023 EIA data for statewide average household residential propane consumption were not available, so 2020 data (most recent available data) were used in calculations.
- Data for average residential fuel oil use in Washington state were withheld because either the relative standard error was greater than 50% or there were fewer than 10 households in the reporting sample.
- Residential, commercial, and industrial propane and fuel oil data are based on scaled regional and state data.

Transportation

City Fleet Vehicles

- City staff provided estimates of 2023 fleet vehicle mileage by vehicle.
- City fleet vehicle data reflect local conditions.

Community On-road Vehicles

- City staff requested that emissions from City fleet vehicles and community on-road VMT be included in the scope of this inventory to produce a high-level estimate of the percentage of Burlington's total GHG emissions that are attributable to vehicle travel. Detailed assessment of community-wide vehicle-related GHG emissions and development of monitoring tools for community-wide vehicle-related GHG will be handled through a separate transportation project and are not included in the scope of work for this GHG emissions inventory.
- The VMT data used for calculations only include estimated VMT on city-owned roads in Burlington and does not include VMT within Burlington city limits on roads that are not city-owned (e.g.,

Interstate 5, State Route 20). Information about VMT within city limits on non-city-owned roads is not available from WSDOT HPMS. Community on-road vehicle emissions quantified in this inventory are likely underestimated due to limited data availability.

- WSDOT HPMS data reflect local conditions, with some exceptions.

Wastewater

- No notable limitations of data sources or approach.
- Wastewater data reflects local conditions.

Solid Waste

- No notable limitations of data sources or approach.
- Waste characterization data reflect local conditions, with some exceptions.