City of Bellevue 2022 Greenhouse Gas Emissions Inventory

Methodology Report

Prepared by Cascadia Consulting Group, Inc. and the City of Bellevue
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Inventory Approach

Scope

The City of Belleuve annually updates greenhouse gas (GHG) inventories for the community and municipal operations. These inventories were completed for calendar year **2022** and included emission sources and sectors intended to align closely with the 2019 Puget Sound Regional Emissions Analysis scope and methodology.

The community-level inventories were completed in compliance with ICLEI's *U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions* and the government operations inventories were completed in compliance with ICLEI's *Local Government Operations Protocol*.

Inventory Platform

Emissions were calculated using a combination of **ICLEI's ClearPath platform** and Microsoft Excel.[1] ClearPath is the leading software platform used by local governments to complete communitywide and government operations GHG inventories in the United States.

Inventory Processes & Data Sources

Conducting these inventories involved identifying and applying activity data and emission factors, summarized in Table 1 and Table 2 and detailed in the following sections:

- **Activity data** quantify levels of activity that generate GHG emissions, such as vehicle miles traveled and kWh of electricity consumed.
- **Emission factors** translate activity levels into emissions (e.g., $MTCO_2e$ per kWh).

[1] *Microsoft Excel was utilized to perform more detailed calculations than what is currently possible in ClearPath.*

Community

Table 1. Key approaches and data sources for 2022 communitywide inventories.

Sector	Activity Data	Emission Factors
Transportation		
On-road vehicles	• Modeled vehicle miles traveled by vehicle type. The BKR model was used for Bellevue, Kirkland, and Redmond.	• Vehicle carbon intensities (MTCO2e/mile) based on PSRC modeling
Non-road vehicles and equipment	• County-level emissions from non-road vehicles (EPA MOVES) by sector (e.g., construction, lawn/garden) and fuel type, downscaled to cities by population	
Aviation	• Fuel consumption data (SeaTac, Boeing Field), downscaled equitably to cities using passenger survey data (SeaTac), population (US Census), and average household income (US Census)	• EPA emission factors, by fuel type (US EPA)
Public transit	• Modeled transit vehicle miles traveled (PSRC; BKR model)	• Average vehicle fuel economies for KC Metro and Sound Transit (NTD Database) • EPA emission factors for fuels (US EPA)
Building Energy		
Electricity	• Electricity consumption from PSE's standard service and through green power programs, by sector (Puget Sound Energy) • Grid loss rates (Puget Sound Energy)	• Utility-specific emission factors (Puget Sound Energy)
Natural gas	• Natural gas consumption, by sector (Puget Sound Energy) • Natural gas leakage rates (Puget Sound Energy)	• Utility-specific emissions factor (Puget Sound Energy)
Fuel oil	• Washington state energy consumption estimates (EIA), downscaled by: ○ Local households heated using fuel oil (US Census) ○ Local employment, by sector (PSRC)	• ClearPath default emission factor (US EPA)
Propane	• Washington state energy consumption estimates (EIA), downscaled by: ○ Local households heated using fuel oil (US Census) • Local employment, by sector (PSRC)	• ClearPath default emission factor (US EPA)
Solid Waste & Wastewater		

Sector	Activity Data	Emission Factors
Solid waste and compost generation & disposal	• Annual tons disposed and composted, as reported by City staff from haulers • Landfill and composted waste characterization (King County Solid Waste Division)	• EPA WARM v15 model
Wastewater process emissions	• Process emissions for South Plant and Brightwater Plant, scaled by population served (King County Wastewater Treatment Division)	
Refrigerants		
Refrigerants	• Nationally reported fugitive gas emissions, scaled by local population (US EPA)	

Government Operations

Table 2. Key approaches and data sources for 2022 government operations inventories.

Sector	Activity Data	Emission Factors
Transportation		
Vehicle fleet	• Gallons of fuel, vehicle type, and miles travelled, as reported by City staff	• ClearPath default emission factors (US EPA)
Employee commute	• Average one-way commute, number of employees, and working days as reported by WSDOT CTR Employer Survey (Bellevue, Redmond, and Issaquah) • Employee Survey (Mercer Island) • City staff estimates (Kirkland)	• WSDOT CTR Employer Survey (Redmond & Issaquah) • ClearPath default emission factors (US EPA)
Business travel	• Air miles traveled, as reported by City staff	• ClearPath default emission factors (US EPA)
Building Energy, Streetlights/Traffic Signals, and Water Conveyance		
Electricity	• Electricity consumption from PSE's standard service and through green power programs (Puget Sound Energy) • Grid loss rates (Puget Sound Energy)	• Utility-specific emission factors (Puget Sound Energy)
Natural gas	• Natural gas consumption (Puget Sound Energy) • Natural gas leakage rates (Puget Sound Energy)	• Utility-specific emission factor (Puget Sound Energy)
Fuel oil/diesel	• Consumption for generators (City staff)	• ClearPath default emission factors (US EPA)
Solid Waste		
Solid waste generation & disposal	• Annual tons disposed and composted (City staff) • Landfill waste characterization studies (King County Solid Waste Division)	• ClearPath default emission factors
Refrigerants		
Refrigerants	• Annual tons of refrigerants used in City facilities and vehicles (City staff)	

Data Limitations and Assumptions

Notable limitations of the approach and data sources are summarized below.

Community

Transportation

- **Non-Road Vehicles and Equipment:** The EPA MOVES model estimates emissions at the County level, so emissions were scaled from County to City level by population for this analysis.
- **Aviation:** Aviation emissions were estimated by equitably attributing emissions from fuel consumption at Seattle-Tacoma International Airport and Boeing Field, using population and average household income data. The 2022 household income data from the US Census was unavailable for all cities at the time of this analysis, so 2021 data was used as a proxy. Bellevue included aviation emissions as part of the communities' total emissions.

Building Energy

- **Electricity:** Electricity provided through Puget Sound Energy's green power programs, such as Green Direct and Community Solar, was assumed to be carbon neutral. This assumption is based on information provided by Puget Sound Energy and guidance provided by ICLEI and standard protocols.
- **Electricity:** These inventories use utility-specific emission factors to estimate emissions from electricity use, rather than regional eGRID emission factors that were used in previous inventories. Puget Sound Energy's fuel mix has varied over time as the utility uses different amounts of individual fuels to generate electricity. Since 2011, PSE's annual emission factor has been reported as reaching up to 35% higher than the utility's 2011 emission factor – one metric which may account for fluctuation in emissions from electricity over time.
- **Propane and fuel oil:** In the PSREA project, propane and fuel oil emissions were estimated using EIA sales data. With this update, these emissions were estimated using EIA consumption data for WA state to improve the accuracy of estimations.

Solid Waste & Wastewater

- **Compost:** Emissions from composted waste were estimated using King County's most recent residential and commercial organics studies, completed in 2018 and 2019.
- **Wastewater:** In previous years, emissions were estimated using wastewater treatment process data provided by King County's Wastewater Treatment District (KC WTD). In 2022, KC WTD provided each plant's calculated emissions. To estimate emissions by jurisdiction, a per-capita emission factor was determined based on the approximate population served by each plant, and this factor was applied to Bellevue's population.

Refrigerants

- Emissions from refrigerants were scaled from national data based on population.
- The EPA has not released the 2022 *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, so 2021 refrigerant emissions were scaled to 2022 for this analysis.

Government Operations

City of Bellevue collects activity data for municipal operations. Methodologies for each emission sources (e.g., employee commute, refrigerants), are noted in Table 2.

Appendix A. Changes from Past Inventories

Several methodological differences between the current inventory and previous inventories led to changes in GHG emissions reported (see table below). The values reflected in this inventory report for current and previous inventory years have been calculated using the current methodology.

Brief methodological outline of previous inventories and the 2022 inventory.

Sector	Methodology for Previous Inventories[2]	Methodology for 2022 Inventory Update	Rationale
Transportation			
On-road vehicles	Model-derived VMT and vehicle carbon intensities	No change	Reflects best available information
Non-road vehicles and equipment	MOVES model, downscaled by population/jobs	No change	Reflects best available information
Aviation	Not included	SeaTac & Boeing field fuel usage downscaled to jurisdiction through passenger survey data	Important to acknowledge this important emissions source, but also highly modeled and with limited local control
Public transit	Same as on-road vehicles	Model-derived VMT with agency-specific vehicle carbon intensities	More reflective of local transit agency emission reduction initiatives; consistent with PSREA

[2] *Methodologies may have varied by jurisdiction. This column presents a general methodology that was used by most cities in previous inventories.*

Sector	Methodology for Previous Inventories[2]	Methodology for 2022 Inventory Update	Rationale
Building Energy			
Electricity - General	kWh consumed and either 1) utility-specific or 2) grid average emissions factors	kWh consumed and utility-specific emissions factors	Consistent with PSREA and protocols
Electricity – Green Programs	No separate accounting for green program participation	Consider green direct program kWh consumption to be zero emissions	New, more detailed information from Puget Sound Energy related to utility-specific emissions factors for general and green program consumption
Electricity – Transmission & Distribution Losses	Not included	Included using utility-specific grid loss factor	Consistent with protocols and PSREA
Natural Gas	Therms consumed and EPA natural gas emissions factor	No change	Consistent with protocols
Natural Gas – Distribution	Not included	Included using utility-specific leakage rate	Consistent with protocols and PSREA
Fuel oil	Not included	Downscaled state-level consumption data based on local households/jobs	Consistent with protocols and PSREA
Propane	Not included	Downscaled state-level consumption data based on local households/jobs	Consistent with protocols and PSREA

Sector	Methodology for Previous Inventories[2]	Methodology for 2022 Inventory Update	Rationale
Solid Waste & Wastewater			
Solid waste generation & disposal	Applied ClearPath-provided EPA WARM emissions factors to tonnage estimates	Applied detailed EPA WARM emission factors to tonnage estimates	More accurate results
Wastewater process emissions	Assumed an average facility-specific per-capita emissions rate, scaled to local population	Downscaled facility-level emissions to local population	Based on information available from facility
Refrigerants			
Substitution of ozone-depleting substances (ODS)		National EPA value downscaled by population	Consistent with protocols and PSREA