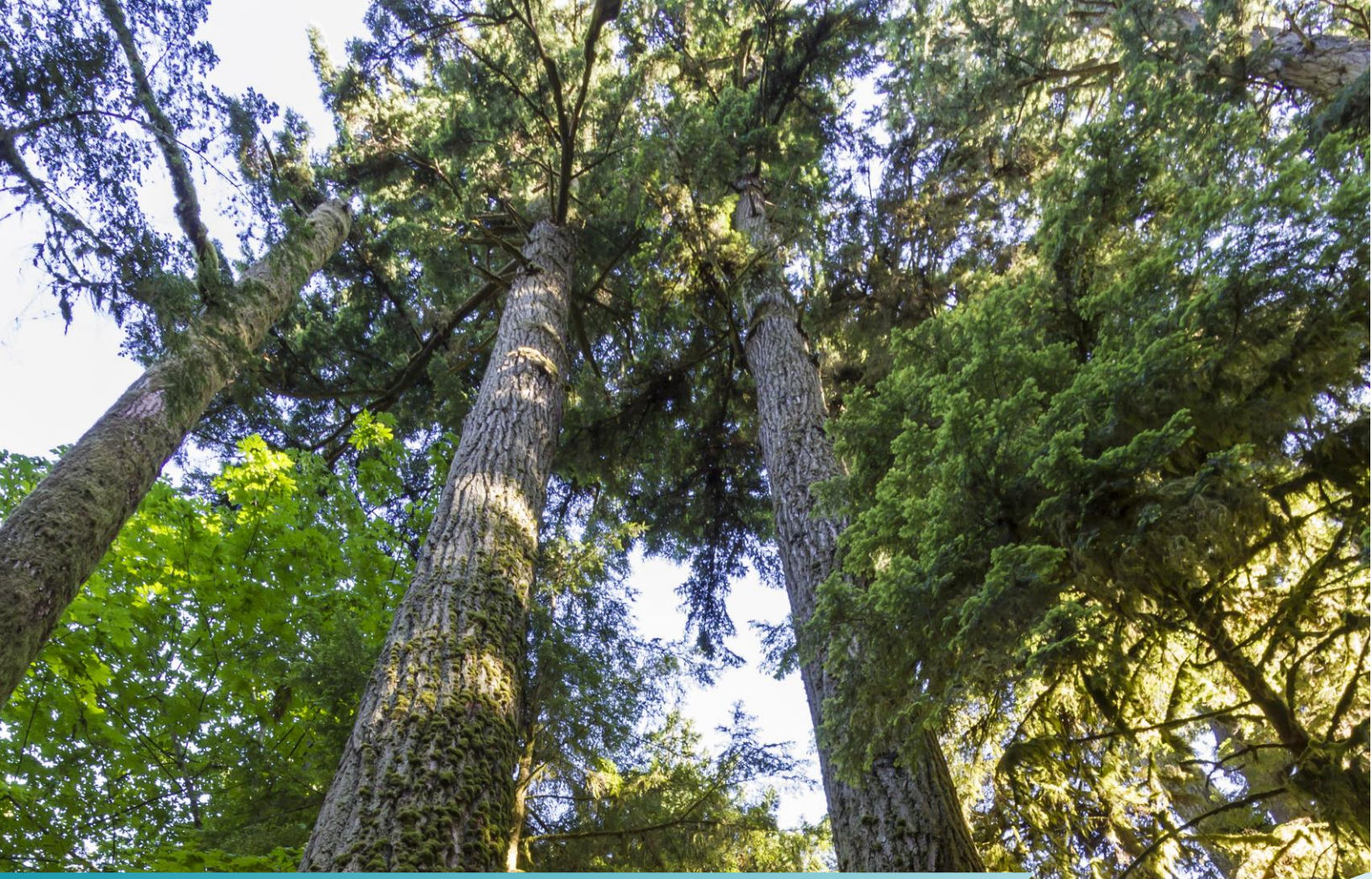

WHATCOM COUNTY **GREENHOUSE GAS INVENTORY 2017**

2020 REPORT

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ACKNOWLEDGMENTS

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More information is available on the web: whatcomcounty.us/2744/Climate-Impact-Advisory-Committee

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1. Introduction

Whatcom County Planning and Development Services Department contracted with Cascadia Consulting Group to complete an updated greenhouse gas (GHG) emissions inventory to address Ordinance 2017-080. The inventory is intended to help inform the work of the County's Climate Impact Advisory Committee, including the development of a County- and Committee-led Climate Action Plan for Whatcom County.

Cascadia used the ClearPath online software platform to complete and document inventory calculations and data sources in accordance with the following protocols, developed by ICLEI – Local Governments for Sustainability:

- U.S. Community Protocol (USCP) for Accounting and Reporting of Greenhouse Gas Emissions, 2019
- Local Government Operations Protocol (LGOP), 2010

INVENTORY SCOPE

Cascadia used 2017 as the analysis year for both the community and government operations inventories.

- **Community**: The community inventory includes emissions that originate from sources physically located within the County's geopolitical boundaries, including incorporated cities. USCP (page 57) notes that "Community GHG inventories are not intended to be exclusive of reporting at other scales." USCP-compliant inventories must include a minimum set of five basic emissions-generating activities in their GHG emission inventories: use of electricity by the community; use of fuel in residential and commercial stationary combustion equipment; on-road passenger and freight motor vehicle travel; use of energy in potable water and wastewater treatment and distribution; and generation of solid waste by the community.
- **Local Government Operations**: The local government operations inventory is a subset of Whatcom County's total community emissions and includes emissions from the operations over which the County government has direct control.

COMPARISON TO PRIOR GHG INVENTORIES

Whatcom County completed community and local government operations GHG emissions inventories for baseline years 2001 and 2000, respectively. Baseline emissions were calculated and documented using the Clean Air and Climate Protection (CACP) software package, a predecessor to the current ClearPath program. Details on changes in methodologies between the 2017 and 2000/2001 baseline inventories are provided in the "Notes" column of **Table 1** and **Table 2** below.

Interim community and government operations inventories were also previously estimated for the year 2005. Whatcom County's 2007 Climate Protection and Energy Conservation Action Plan summarizes the following key changes from the 2000/2001 inventory to the 2005 inventory:

- **Community:** From 2001 to 2005, most emissions sources were similar to those in the base year. However, electricity showed an increase, over 70% of which was in the industrial sector. The 2007 Plan noted that this increase was likely due to changes in the power supply of large users such as Georgia-Pacific, Bellingham Cold Storage, and BP/ARCO after the 2001 western energy crisis.
- **Local Government Operations:** From 2000 to 2005, there was an overall decrease in emissions. Efficiency efforts in County facilities decreased emissions from electricity and natural gas. According to the 2007 Plan, the only significant increases during this period were gasoline use and electricity used by streetlights due to the addition of new lighting in three districts in 2001.

Table 1. Community Inventory Summary for Whatcom County, 2001 and 2017 (in metric tons of carbon dioxide equivalent, MT CO_2e)

COMMUNITY INVENTORY FOR WHATCOM COUNTY	2001	2017	% change	Notes
Population	170,980	216,300	+27%	*Washington State Office of Financial Management population data*
Residential households	75,740	96,271	+27%	
TOTAL emissions	**2,750,728**	**7,583,578**	+176%	*A summary of the categories below; see explanations by topic in the following rows.*
TOTAL emissions *(with exclusions)*	**2,750,728**	**3,721,230**	+35%	*This total excludes industrial point source emissions, process & fugitive emissions, emissions from upstream impacts of activities, and water & wastewater emissions.*
Residential energy	593,652	607,242	+2%	*Including grid electricity and fuel combustion. Emissions from propane use in 2001 were estimated based on data provided by vendors; 2017 uses scaled Census data.*
Commercial energy	416,157	483,107	+16%	*Same methodology used (including grid electricity and natural gas combustion).*
Industrial energy	678,549	878,371	+29%	*Same methodology used (including grid electricity and natural gas combustion).*
Transportation	921,775	1,036,819	+12%	*2001 inventory used Highway Performance Monitoring System data, and 2017 inventory used data from WCOG's Travel Demand Model. The 2001 inventory did not include emissions from aviation, rail, vessels, ferry, and public transit.*
Waste	(20,319)	88,631	N/A *(increased)*	*The 2001 inventory reported negative emissions from solid waste, noting more CO_2e was buried and trapped in the landfill than was added to the atmosphere. The previous methodology was not documented in 2007 Climate Protection and Energy Conservation Action Plan. In addition to emissions from waste generation and transportation, the 2017 inventory includes emissions from closed landfills within Whatcom County and emissions from the processing of waste outside the county.*
Agriculture	160,915	424,380	+164%	*2001 inventory included agricultural emissions only from cattle.*
Industrial point source emissions	N/A	3,862,348	N/A	*Industrial point source emissions were not included in 2001 inventory (reporting was not required until 2010).*
Process & fugitive emissions	N/A	134,737	N/A	*Process and fugitive emissions were not included in 2001 inventory.*
Upstream impacts of activities	N/A	58,883	N/A	*Upstream impacts of activities were not included in 2001 inventory.*
Water & wastewater	N/A	9,060	N/A	*Wastewater emissions were not included in 2001 inventory.*
Emissions and removals from trees	(3,964,569) baseline for 2000–2011		N/A	*Emissions and removals from trees were summarized in the 2017 inventory for the period 2000–2011. Net removal is not included in total above.*

Table 2. Whatcom County Local Government Operations Inventory Summary, 2000 and 2017 (in metric tons of carbon dioxide equivalent MT CO_2e)

LOCAL GOVERNMENT OPERATIONS INVENTORY	2000	2017	% change	Notes
Total Whatcom County Government emissions	**10,318**	**9,950**	-4%	*A summary of the categories below; see explanations by topic in the following rows.*
Buildings & facilities *(County government)*	4,510	3,919	-13%	*Electricity and natural gas consumption data provided by County staff for the 2017 inventory; the data were provided directly by utilities for the 2000 inventory.*
Vehicle fleet *(County government)*	3,943	3,187	-19%	*Fuel consumption (gallons of diesel and gasoline) data were provided by County staff for 2017; the 2000 inventory used fuel prices and total spent to estimate fuel consumption. Contractor fuel consumption was not included due to lack of data.*
Streetlights *(County government)*	59	66	+12%	*Electricity consumption data provided by County staff for the 2017 inventory; the data were provided directly by utilities for the 2000 inventory.*
Employee commuting *(County government)*	1,849	870	-53%	*Commute Trip Reduction survey results were used to estimate commutes for Courthouse and Northwest Annex employees for the 2000 inventory. In the absence of similar data for 2017, employee counts and estimated total mileage from office to home collected in 2013 were used to estimate total mileage for the 2017 inventory, adjusted for the higher employee count.*
Waste *(County government)*	-42	1,874	N/A *(increased)*	*The 2000 inventory reported negative emissions from solid waste, noting more CO_2e was buried and trapped in the landfill than was added to the atmosphere. The previous methodology was not documented in 2007 Climate Protection and Energy Conservation Action Plan. In addition to emissions from waste generation, the 2017 inventory includes emissions from closed Whatcom County landfills.*
Process & fugitive emissions *(County government)*	N/A	34	N/A	*Process and fugitive emissions were not included in 2000 inventory.*

2. Emissions Factors

Emissions factors are numerical values for determining an amount of a greenhouse gas emitted on a per-unit activity basis (e.g., metric tons of carbon dioxide emitted per million BTUs of natural gas combusted).

Cascadia entered the emissions factors below as "Factor Sets" in ClearPath and used them to complete the communitywide and local government operations inventories. In addition to these emissions factors, some calculations relied on emissions factors built into ClearPath or other calculation tools, as indicated in this report where applicable.

TRANSPORTATION

2017 Factor Set (Multiple Sources)

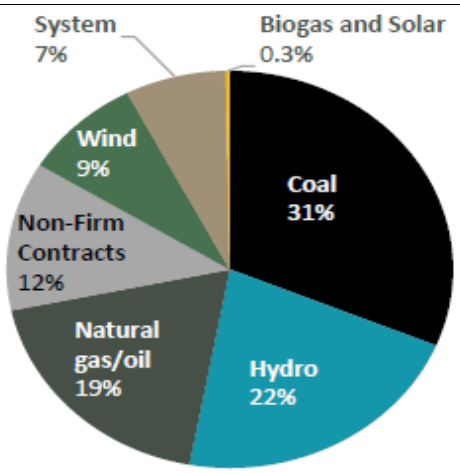
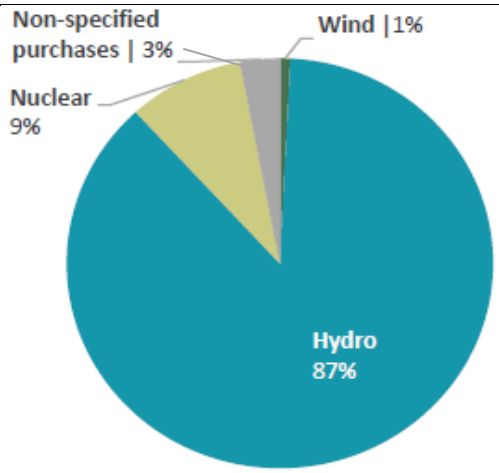
Fuel Type	Mobile Combustion
Gasoline	8.78 kg CO2 per gallon
Diesel	10.21 kg CO2 per gallon
Data source:	▸ USEPA Emission Factors for Greenhouse Gas Inventories (March 26, 2020)

GASOLINE	Passenger Vehicle	Light Truck	Heavy Truck	Transit Bus	Paratransit Bus	Motorcycle
MPG	24.215	17.524	5.3600	N/A	8.3828	43.953
g CH_4/mile	0.0054	0.0084	0.0329	N/A	0.0333	0.0672
g N_2O/mile	0.0018	0.0018	0.0084	N/A	0.0134	0.0069
DIESEL	**Passenger Vehicle**	**Light Truck**	**Heavy Truck**	**Transit Bus**	**Paratransit Bus**	**Motorcycle**
MPG	24.215	13.810	6.0600	4.8435	N/A	N/A
g CH_4/mile	0.0302	0.0290	0.0095	0.0051	N/A	N/A
g N_2O/mile	0.0192	0.0214	0.0431	0.0048	N/A	N/A
Data Sources	▸ 2017 Climate Registry – Default Emission Factors ▸ USEPA Table 4-23: Average Fuel Efficiency of U.S. Light Duty Vehicles ▸ USEPA Table 4-22: Energy Intensity of Light Duty Vehicles and Motorcycles ▸ USEPA Emission Factors for Greenhouse Gas Inventories (Mar 26, 2020) ▸ U.S. Community Protocol (USCP) ▸ Whatcom Transit Authority – 2017 Annual Performance Report ▸ Whatcom Transit Authority – 2017-2022 Transit Development Plan					

WASTE CHARACTERIZATION

Material Types	2015-2016 Overall	2015-2016 Commercial
Mixed Municipal Solid Waste	66.6 %	61.9 %
Newspaper	0.6 %	0.8 %
Office Paper	0.4 %	0.3 %
Corrugated Cardboard	3.4 %	4.5 %
Magazines/Third-Class Mail	0.1 %	0.1 %
Food Scraps	20.6 %	26.3 %
Grass	0.0 %	0.0 %
Leaves	3.9 %	3.7 %
Branches	1.5 %	0.1 %
Dimensional Lumber	2.9 %	2.3 %
Data Source	▸ Washington State Department of Ecology, *2015-2016 Washington Statewide Waste Characterization Study*	

GRID ELECTRICITY

	Puget Sound Energy 2017	Bonneville Power Administration 2017
Emissions Factors	1,073.57 CO_2 lbs/MWh	42.55 CO_2e lbs/MWh
	60.24 CH_4 lbs/GWh	*N/A*
	14.66 N_2O lbs/GWh	*N/A*
2017 Fuel Mix		
Data Sources	▸ Puget Sound Energy 2017 Greenhouse Gas Inventory (PSE-Generated and Purchased Electricity).[1]	▸ California Air Resources Board – Asset Controlling Supplier – System Emission Factors – BPA 2017

[1] Puget Sound Energy, *2017 Greenhouse Gas Inventory*, June 2018, Fig. 7-2. The fuel mix charts are provided for illustrative purposes only; the GHG emission calculations are based on the **emissions factors** shown above (market-based). Data are for 2017, to align with the inventory year, and they reflect both PSE-generated and contract-purchased electricity. The Non-Firm Contracts and System figures include additional fossil fuels. System refers to energy purchased under firm contracts from BC Hydro Point Roberts, BPA, BPA Firm–WNP #3 Exchange, and TransAlta Centralia Generation LLC systems. PSE reports that its fossil fuel share has declined since 2017, including reducing its stake in the coal-fired Colstrip Power Project. Even with these reductions, PSE's

3. Community Inventory

OVERVIEW

As shown in **Figure 1**, Whatcom County's total emissions (7,583,578 MT CO_2e) consist of the components described below, including direct emissions (Scope 1), emissions from electricity consumption (Scope 2), and selected other indirect sources (Scope 3). Note that this total does not include net flux in emissions from trees and forests (see *Emissions & Removals from Trees* section on page 27).

- **Industrial point source emissions.** Industrial operations that contribute 25,000 or more MT CO_2e per year as byproduct of production and other processes are required to disclose and report emissions to the U.S. Environmental Protection Agency (USEPA) annually. These emissions contribute just over half of Whatcom County's total communitywide greenhouse gas emissions. **Figure 2** shows the remaining portions of the communitywide inventory with industrial point sources excluded (3,721,230 MT CO_2e). Emissions from electricity generation facilities in Whatcom County are not included in the total to avoid double-counting with emissions from grid-supplied electricity to industrial, commercial, and residential users. (The emissions are reflected in the Scope 1 direct emissions of Puget Sound Energy and are reported in this inventory as Scope 2 emissions from purchased electricity.)
- **Industrial energy.** Electricity and natural gas consumption by Whatcom County's industrial sector.
- **Residential energy.** Electricity, natural gas, propane, wood, and kerosene consumption by Whatcom County's residential sector.
- **Commercial energy.** Electricity and natural gas consumption by Whatcom County's commercial sector.
- **Electric power transmission & distribution losses.** Estimated amount of electricity lost to heat when electricity is transmitted through power lines.
- **Natural gas distribution (fugitive emissions).** Upstream emissions associated with natural gas combusted directly in Whatcom County as well as emissions associated with secondary fuels used in the natural gas supply chain.
- **Other fugitive emissions.** Emissions from fugitive sources such as refrigerants, fire suppressants, and insulators, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
- **Transportation.** Emissions from on-road and off-road vehicles, vessels, aviation, rail, public transit, and ferry.
- **Agriculture.** Emissions from manure treatment and handling as well as enteric fermentation. Whatcom County developed initial estimates for fertilizer use and agricultural carbon sequestration, which are described in Appendix A and provided separately from the current inventory total to avoid potential double-counting.
- **Solid waste.** Emissions from the generation, transportation, and processing of Whatcom County's solid waste as well as emissions from closed landfills within Whatcom County.

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emissions remain above the statewide average and the regional grid emission factor of 643.4 CO_2e lbs/MWh (eGRID NWPP 2018). Washington law requires the elimination of coal-fired power plants from electric utility portfolios by the end of 2025.

- **Water & wastewater.** Fugitive emissions from septic systems, as well as emissions from wastewater treatment, wastewater treatment lagoons, process nitrous oxide from effluent discharge to rivers and estuaries, and combustion of biosolids and sludges.

Figure 1. Whatcom County Communitywide GHG Emissions (metric tons CO_2e)

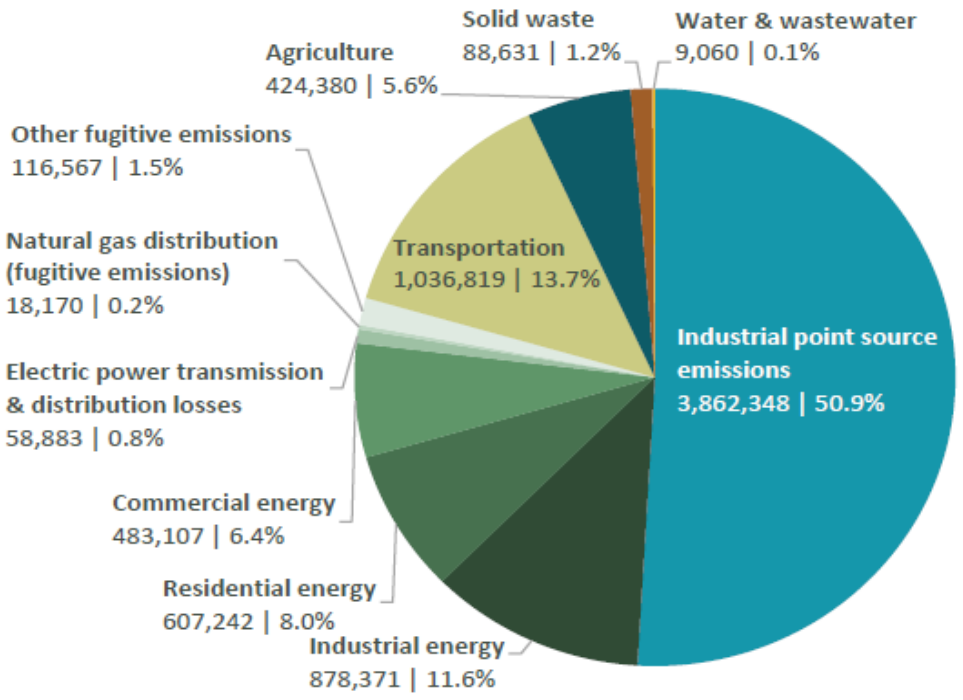
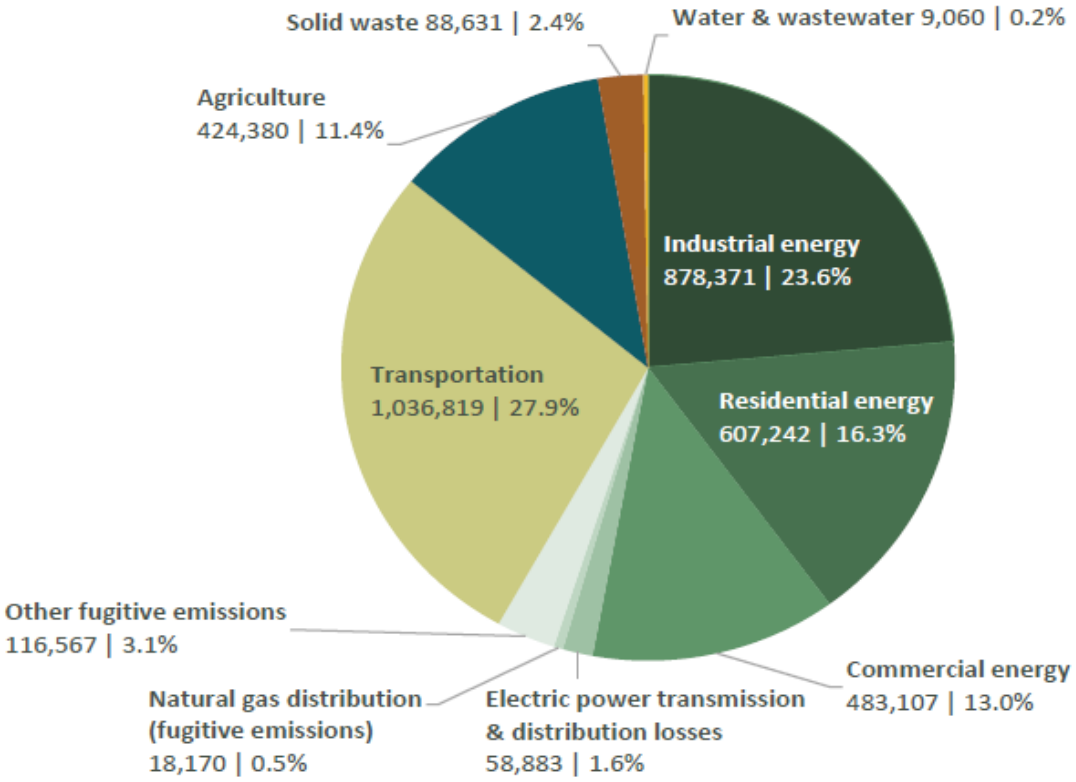


Figure 2. Communitywide GHG Emissions Excluding Industrial Point Source Emissions (metric tons CO_2e)



INDUSTRIAL POINT SOURCE EMISSIONS

Industrial operations that produce emissions of 25,000 MT CO_2e or more per year (as a byproduct of production and other processes) are required to disclose and report emissions data to the U.S. Environmental Protection Agency (USEPA) under its Greenhouse Gas Reporting Program.[2] USEPA reports these emissions publicly on its Facility Level Information on Greenhouse Gases Tool (FLIGHT). Industrial operations producing emissions below this threshold are not included in FLIGHT or this inventory due to data limitations.

In Whatcom County, industrial point source emissions contribute more than half of the community's total greenhouse gas emissions. **Table 3** summarizes these emissions for Whatcom County by facility and source of emissions. "Emissions from electricity generation" were excluded from this table to avoid double-counting electricity consumption reported separately within "Industrial Energy" in the *Grid Electricity* section. Emissions from the combustion of natural gas were also excluded from the "Stationary Fuel Combustion" total to avoid double-counting natural gas consumption reported separately within "Industrial Energy" in the *Natural Gas* section.

GHG emissions	3,862,348 MT CO_2e
Activity data	MT CO_2e calculated and reported directly to USEPA
Emissions factors	▸ MT CO_2e calculated and reported directly to USEPA
Data sources	▸ USEPA's FLIGHT Tool (http://ghgdata.epa.gov/ghgp)
Accounting method	▸ USCP BE.8.1

Table 3. Major Industrial Point Source Emissions by Facility (in MT CO_2e), Excluding Electricity Generation[3]

Sources of Emissions	Alcoa Intalco Works[4]	BP Cherry Point Refinery	NW Pipeline GP Sumas C/S	Phillips 66 Ferndale Refinery	Whitehorn Generating Station[5]	Totals (by emission source)
Stationary fuel combustion *(excluding natural gas)*	N/A	1,251,561	N/A	383,963	1,715	**1,637,239**
Aluminum production	1,025,298	N/A	N/A	N/A	N/A	**1,025,298**
Petroleum refineries	N/A	239,213	N/A	305,344	N/A	**544,557**
Petroleum & natural gas systems	N/A	N/A	3,903	N/A	N/A	**3,903**
Industrial waste landfills	9,648	N/A	N/A	N/A	N/A	**9,648**
Hydrogen production	N/A	641,703	N/A	N/A	N/A	**641,703**

[2] Industrial point source emissions are often largely outside of the control of the local government or community. Washington State Department of Ecology reporting includes facilities emitting 10,000 MT CO_2e or more annually, which includes one additional facility not reflected in the USEPA data above (Darigold - Lynden, with 2017 emissions of 17,624 MT CO_2e).
[3] PSE's Encogen, Ferndale, and Sumas generating stations also report to USEPA, but their reported emissions are entirely from Electricity Generation and thus are not shown in this table. Emissions from electricity are reflected in the *Buildings* section.
[4] The Alcoa Intalco Works smelter in Ferndale announced it is curtailing operations by the end of July 2020.
[5] The Whitehorn Generating Station is included here in accordance with the USCP because the facility reports to USEPA as a generator of more than 25,000 MT CO_2e annually. The figures in **Table 3** exclude electricity generation and natural gas combustion to avoid double-counting with the *Grid Electricity* and *Natural Gas* sections.

Totals (by facility)	**1,034,946**	**2,132,477**	**3,903**	**689,307**	**1,715**	**3,862,348**

BUILDINGS

Building-related greenhouse gas emissions produce 2,162,340 metric tons of CO_2e and includes emissions from the sources listed below.[6] As shown in **Figure 3**, electricity consumption makes up over 60% of emissions from buildings, followed by natural gas consumption.

- Grid electricity consumption by sector
- Electric power transmission and distribution (T&D) losses by sector
- Natural gas consumption by sector
- Fugitive emissions from natural gas distribution by sector
- Other stationary fuel consumption (e.g., propane, kerosene, fuel oil) – residential sector only
- Other fugitive emissions (e.g., refrigerants) – not broken out by sector

Figure 3. Whatcom County Building Emissions (in metric tons of CO_2e)

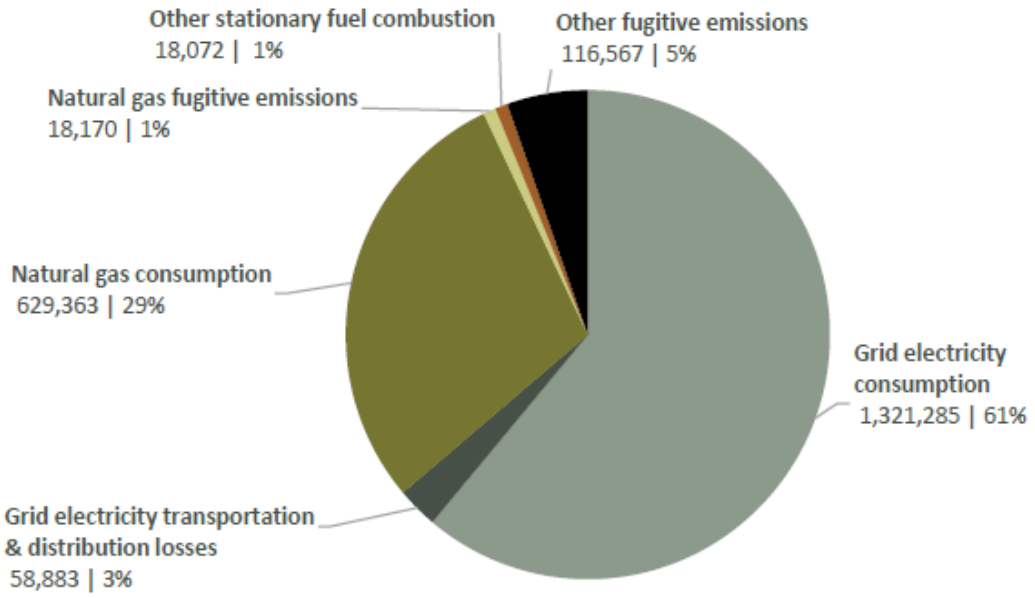


Figure 4 and **Figure 5** detail emissions by sector (excluding "other fugitive emissions"). The industrial sector is the largest consumer of energy—both electricity and natural gas—followed by the residential sector, and then the commercial sector. Industrial electricity and natural gas consumption are divided into "Industrial" for the customers of each utility and "Industrial (transport)," which refers to the following sources:

- **Electricity**: Puget Sound Energy (PSE) uses the category "Industrial – Transportation" to describe three large unidentified users in Whatcom County that purchase power on the open market and use PSE lines for transmission and delivery. Because these users procure power from other sources, the actual emissions profile is unknown. Cascadia estimated these emissions using PSE's emissions factors to be conservative and for comparability with other County electricity emissions. The PSE emissions factors are higher than the regional grid average and much higher than Bonneville Power.

[6] Note that the USCP refers to this category as emissions from the "Built Environment" (BE).

- **Natural gas**: Similarly, Cascade Natural Gas Corporation (CNGC) delivers natural gas to "Noncore – Transport" customers who purchase gas from other sources but pay CNGC for the transportation of their gas. The emissions factors for natural gas remain the same for these other sources.

Figure 4. Whatcom County Building Emissions by Sector, then Process (in thousands of MT CO_2e)

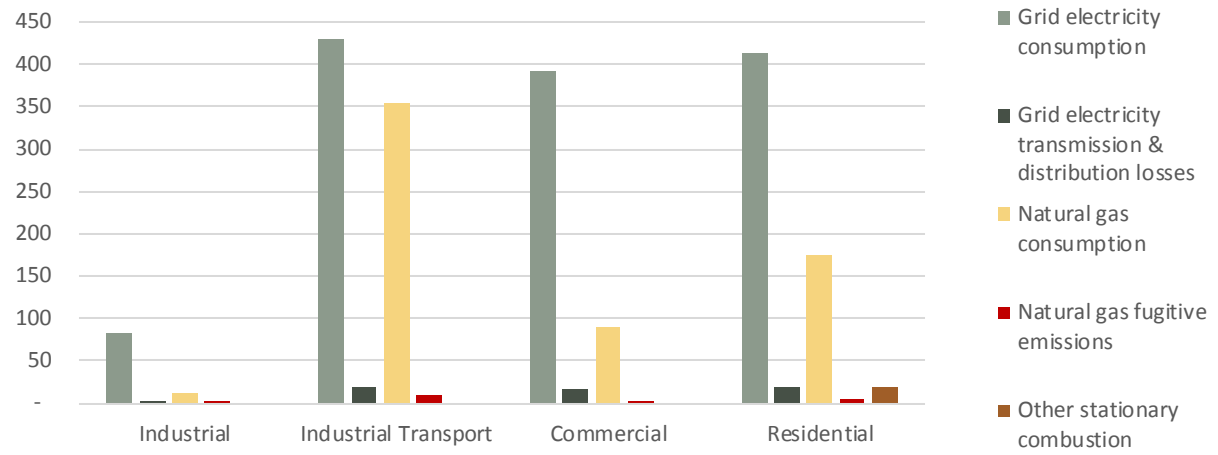
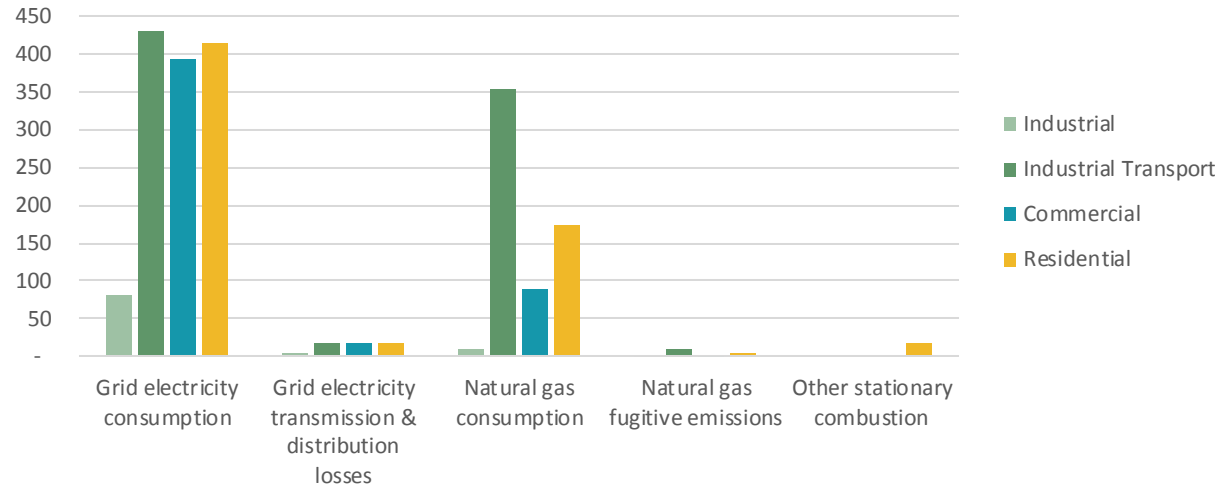


Figure 5. Whatcom County Building Emissions by Process, then Sector (in thousands of MT CO_2e)



Grid Electricity

Puget Sound Energy provides the majority of electricity to Whatcom County. In addition, Whatcom Public Utility District provides electricity to three customers, and the cities of Blaine and Sumas provide electricity within their jurisdictions. Whatcom PUD and the two cities purchase energy from the Bonneville Power Administration (BPA). GHG emissions factors are based on the utility-reported fuel mixes used to generate electricity. Refer to the comparative figures in the *Grid Electricity* section of **Chapter 2, Emissions Factors**.

	Residential	Commercial	Industrial
GHG emissions (MT CO_2e)	414,620	393,397	513,268
Activity data (kWh)	939,114,486	784,414,150	1,248,897,090
Emissions factors	▸ PSE Emissions Factor 2017 (1,073.57 CO2 lbs/MWh; see p. 5 for CH_4 & N_2O)		

	▸ BPA Emissions Factor 2017 (42.55 CO2e lbs/MWh)
Data sources	▸ Puget Sound Energy ▸ Washington Fuel Mix Disclosure Report
Accounting method	▸ USCP BE.2.1

Emissions from Electric Power Transmission & Distribution Losses

Some electricity is lost to heat when transmitted through power lines. Cascadia estimated these losses using annual electricity consumption and emissions factors associated with PSE and BPA electricity providers.

GHG emissions	58,883 MT CO_2e
Activity data	2,972,426 MWh
Emissions factors	▸ PSE Emissions Factor 2017 ▸ BPA Emissions Factor 2017
Data sources	▸ Puget Sound Energy ▸ Washington Fuel Mix Disclosure Report
Accounting method	▸ USCP BE.4.1

Natural Gas

Cascade Natural Gas Corporation (CNGC) provides natural gas within Whatcom County. CNGC provided natural gas consumption data (in therms) for all of Whatcom County.

	Residential	Commercial	Industrial
GHG emissions (MT CO_2e)	174,550	89,710	365,103
Activity data (therms)	32,818,412	16,867,000	68,790,641
Emissions factors	▸ ClearPath: 53.02 kg CO_2, 0.005 kg CH_4, 0.0001 kg N_2O per MMBtu		
Data sources	▸ Cascade Natural Gas Corporation		
Accounting method	▸ USCP BE.1.1		

Fugitive Emissions from Natural Gas Distribution

Cascadia calculated fugitive emissions related to leakage in the local natural gas distribution system based on the total quantity of natural gas consumed and assumed leakage rate (default value = 0.3%).

GHG emissions	18,170 MT CO_2e
Activity data	118,476,053 therms
Emissions factors	▸ USCP Table B.1; B.3
Data sources	▸ Cascade Natural Gas Corporation
Accounting method	▸ USCP BE.5.1

Other Fugitive Emissions

Data on other fugitive emissions sources (such as refrigerants)—including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6)—are scarce at county and/or city scales. As such, Cascadia scaled national data from USEPA's 2017 *Inventory of U.S. GHG Sources and Sinks* using Whatcom County's population as a proxy.

GHG emissions	116,567 MT CO_2e
Activity data	216,300 people in Whatcom County
Emissions factors	▸ USCP Table B.19; B.20
Data sources	▸ USEPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*
Accounting method	▸ USCP BE.7.1.A

Other Stationary Fuel Combustion

Due to the nature of the distribution process (which involves multiple private suppliers), local data on other stationary fuel use were not available.

- **Residential** – Emissions from the combustion of propane, wood,[7] and kerosene were estimated using Census home heating fuel data as well as data from the U.S. Energy Information Administration. This estimation method will not reflect changes that may be induced by local climate protection efforts between inventory years. Further, this method does not include households that use a fuel source for back-up heating, cooking, or other end uses, which may underestimate total use.
- **Commercial** – Per the USCP, commercial fuel oil use should only be estimated in communities where commercial fuel oil use is widespread. For many communities in the southern and western portions of the United States, commercial fuel oil use is considered likely insignificant. As such, commercial fuel oil is not included in this inventory.
- **Industrial** – Emissions from stationary fuel combustion for the industrial sector are included in the "Industrial Point Source Emissions" section above.

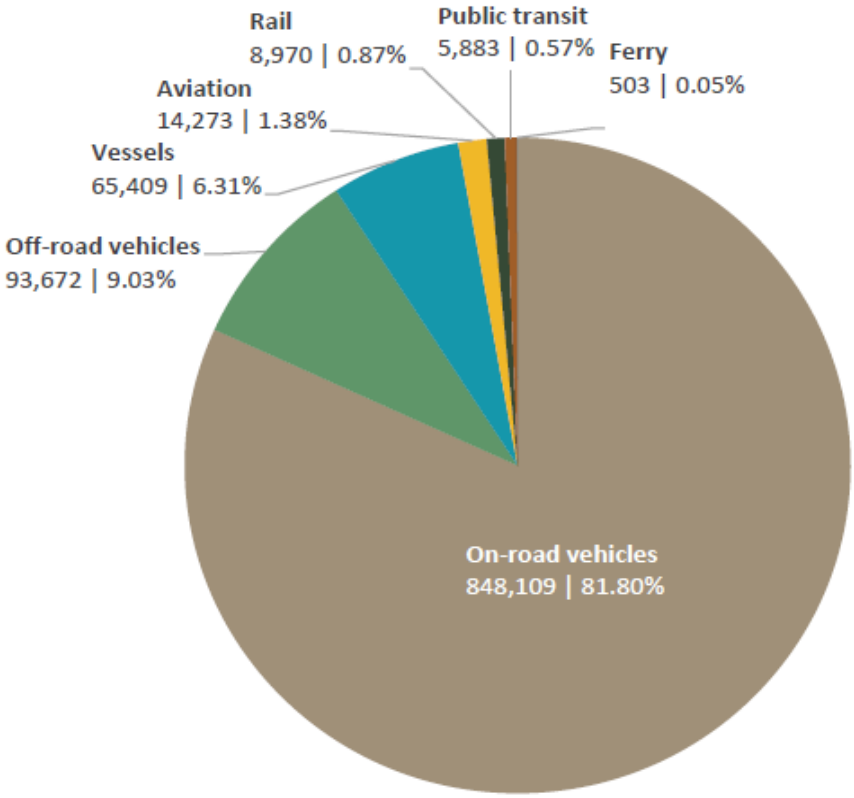
	Residential	Commercial	Industrial
GHG emissions (MT CO_2e)	18,072	N/A	N/A
Activity data (MMBtu)	409,416	N/A	N/A
Emissions factors	▸ **Propane** – ClearPath: 61.46 kg CO_2/MMBtu; 0.010989 kg CH_4/MMBtu; 0.0010989 kg N_2O/MMBtu ▸ **Wood** – ClearPath: 93.8 kg CO_2/MMBtu; 0.316 kg CH_4/MMBtu; 0.0042 kg N_2O/MMBtu ▸ **Kerosene** – ClearPath: 75.2 kg CO_2/MMBtu; 0.011111 kg CH_4/MMBtu; 0.00074074 kg N_2O/MMBtu		
Data sources	▸ American Community Survey data, U.S. Census Bureau ▸ U.S. Energy Information Administration		
Accounting method	▸ USCP BE.1.2		

[7] These biogenic emissions represent the small residential usage of wood burning for home heating, per the USCP. The *Emissions & Removals from Trees* section on page 21 provides additional information on forests, tree removals, and changes in land cover.

TRANSPORTATION

As shown in **Figure 6** below, emissions from on-road vehicles make up over 80% of Whatcom County's total transportation emissions. Emissions from off-road vehicles and vessels compose the next largest portions of the County's transportation emissions.

Figure 6. Whatcom County Transportation Emissions (in metric tons of CO_2e)



On-Road Vehicles

The Whatcom Council of Governments (WCOG) has developed and maintains a Regional Travel Demand Model that simulates automobile and truck flows on regional highways and forecasts future demand. Data from WCOG's model were used to estimate on-road vehicle emissions for passenger and freight vehicles using gasoline or diesel fuel.

GHG emissions	848,109 MT CO_2e
Activity data	1,653,436,860 annual VMT
Emissions factors	▸ 2017 Factor set (multiple sources) ▸ PSE Emissions Factor 2017
Data sources	▸ Whatcom Council of Government's (WCOG) Regional Travel Demand Model
Accounting method	▸ USCP TR.1.B

Off-Road Vehicles

Cascadia used the USEPA's NONROAD model to estimate county-level fuel combustion emissions for agricultural, construction, commercial and industrial, lawn and garden, and recreational vehicles and equipment.

GHG emissions	93,672 MT CO_2e
Activity data	N/A – calculated in USEPA NONROAD Model
Emissions factors	▸ N/A – calculated in USEPA NONROAD Model
Data sources	▸ USEPA NONROAD Model
Accounting method	▸ USCP TR.8

Vessels

In the absence of locally sourced data, the Puget Sound Maritime Air Forum's *2016 Puget Sound Maritime Air Emissions Inventory* provided estimated emissions from ocean-going, harbor, and recreational vessels in Whatcom County.[8] The maritime emissions inventory attributed ocean-going vessel emissions to Whatcom County based on routes within the county. The maritime inventory allocated harbor vessel emissions equally among the four Northwest Clean Air Agency (NWCAA) counties of Island, San Juan, Skagit, and Whatcom. Recreational vessel emissions were attributed to Whatcom County based on data from port-owned marinas, private marinas, and marinas of other non-port, public entities.

GHG emissions	65,409 MT CO_2e
Activity data	N/A – calculated as part of maritime inventory
Emissions factors	▸ N/A – calculated as part of maritime inventory
Data sources	▸ 2016 Puget Sound Maritime Emissions Inventory
Accounting method	▸ N/A – calculated as part of maritime inventory

Rail

In the absence of local data, Cascadia used information from Puget Sound Maritime Air Forum's *2005* and *2016 Puget Sound Maritime Air Emissions Inventories* to estimate emissions from freight rail (BNSF) for Whatcom County.[9] Passenger rail (Amtrak) data were not available at the local level and are not included in this inventory; the Lake Whatcom Railway tourist attraction also is not included.

GHG emissions	8,970 MT CO_2e
Activity data	N/A – used previously calculated CO_2e
Emissions factors	▸ N/A – previously calculated CO_2e
Data sources	▸ 2005 & 2016 *Puget Sound Maritime Air Emissions Inventory*
Accounting method	▸ N/A – previously calculated CO_2e

[8] For future inventories, Whatcom County could obtain locally sourced data by partnering with the Port of Bellingham to track vessel traffic along with fuel use and sales across different facilities and vessel types.

[9] For future inventories, Whatcom County could obtain locally sourced data by working directly with BNSF and Amtrak to obtain local rail fuel use and emissions data.

Aviation

The Port of Bellingham provided fuel usage information for the Bellingham International Airport (BLI); fuel usage data for Whatcom County's smaller general aviation airports were not available. Command Aviation and Bellingham Aviation Services are BLI's two fuel providers. Cascadia then used the BLI Tourism Survey Report (prepared by the Center for Economic and Business Research) to estimate the local attribution percentage of emissions at 31%, based on the proportion of surveyed passengers who live in Whatcom County. Future GHG inventories conducted by BLI or the Port of Bellingham could be used to calculate aviation emissions for Whatcom County more precisely.

GHG emissions	14,273 MT CO_2e
Activity data	135,867 gallons aviation gasoline (avgas) 4,646,012 gallons jet kerosene (Jet A)
Emissions factors	▸ ClearPath: 8.54 kg CO_2e/gallon of aviation gasoline ▸ ClearPath: 9.66 kg CO_2e/gallon of jet kerosene
Data sources	▸ Port of Bellingham
Accounting method	▸ USCP TR.6.B

Public Transit

Whatcom Transportation Authority (WTA) provides public transportation services throughout the county and reports activity data to the National Transit Database (NTD) for the gasoline and diesel vehicles included in WTA's fixed route, paratransit, and vanpool services. While the Lummi Nation offers transit services, Lummi Transit does not report data to NTD due to its small size and is not included in the inventory.

GHG emissions	5,883 MT CO_2e
Activity data	3,337,250 revenue miles
Emissions factors	▸ 2017 Factor Set (multiple sources)
Data sources	▸ National Transit Database – 2017
Accounting method	▸ USCP TR.4

Ferry

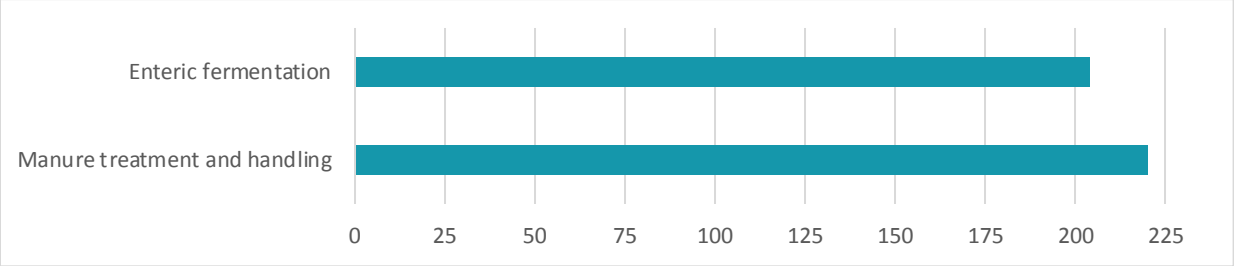
The County operates the Lummi Island Ferry (Whatcom Chief), traveling between Lummi Island and the mainland.

GHG emissions	503 MT CO_2e
Activity data	48,807 gallons of diesel
Emissions factors	▸ PSE Emissions Factor 2017
Data sources	▸ Provided by Whatcom County staff
Accounting method	▸ LGOP 7.2

AGRICULTURAL EMISSIONS

The USCP includes methodologies for estimating emissions from manure management and enteric fermentation, as described below and shown in **Figure 7**. In addition, Whatcom County staff developed an initial estimate of nitrous oxide emissions from fertilizer application of approximately 8,000 metric tons CO_2e; this figure represents less than 2% of agricultural emissions and less than 0.1% of communitywide emissions. The manure portion may include some double-counting with the larger *Manure Treatment & Handling* estimates shown below. The County estimated agricultural carbon sequestration through reduced tillage and no-tillage practices at about 17,000 metric tons CO_2e. *Appendix A. Agricultural Emissions from Fertilizer Application and Tillage Practices* provides more information on the County's estimates.

Figure 7. Whatcom County Emissions from Agricultural Activities (in thousands of MT CO_2e)



Manure Treatment & Handling

Domestic animal production is part of Whatcom County's local economy. Manure from these livestock creates methane and nitrous oxide emissions as it biodegrades. Cascadia calculated emissions based on the type of livestock and manure management system to stabilize or store livestock manure.

GHG emissions	220,318 MT CO_2e
Activity data	140,134,200 kg volatile solids per year
Emissions factors	▸ USCP Tables A.2.1.1; A.2.1.2; A.2.1.3
Data sources	▸ Livestock populations provided by Washington State University Extension
Accounting method	▸ USCP A.2.1.3; A.2.3.3

Enteric Fermentation

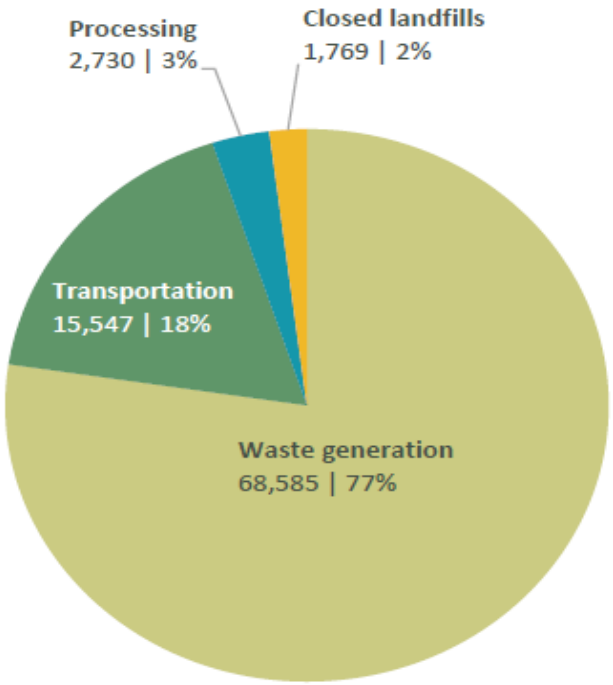
Methane is produced during animal digestion through enteric fermentation. Ruminant livestock such as cattle, sheep, and goats produce higher levels of methane because of the fermentation that occurs in their specialized digestive systems. Cascadia calculated emissions from enteric fermentation based on livestock types and the emissions factor associated with their digestive systems.

GHG emissions	204,062 MT CO_2e
Activity data	52,868 head of livestock
Emissions factors	▸ USCP Tables A.1.1 and A.1.2
Data sources	▸ Livestock populations provided by Washington State University Extension
Accounting method	▸ USCP A.1.3

SOLID WASTE

In accordance with the USCP, Cascadia included Whatcom County's solid waste emissions associated with waste generation, waste transportation, waste processing (active landfills), and closed landfills. As shown in **Figure 8** below, emissions from waste generation make up nearly 80% of Whatcom County's total solid waste-related emissions. Emissions from transporting waste contributes the next largest portion of the county's solid waste emissions.

Figure 8. Whatcom County Solid Waste Emissions (in metric tons of CO_2e)



Waste Generation

Cascadia used 2017 county waste generation data (reported to the Washington State Department of Ecology) to estimate current and future methane emissions attributed to this inventory year. Emissions are calculated based on 1) the type of waste sent to landfill; 2) the mass (tons) of waste sent to landfill; and 3) the individual landfill gas capture rate. Only organic waste types were included in these estimates (municipal/commercial solid waste and wood waste) because they generate methane (CH_4)—a potent greenhouse gas—as they decompose. Inert wastes are not expected to product significant greenhouse gas emissions when landfilled, though emissions could be generated if these wastes were combusted in the future.

GHG emissions	68,585 MT CO_2e
Activity data	166,489 tons of waste
Emissions factors	▸ Washington State Department of Ecology 2015-2016 – Overall
Data sources	▸ Washington State Department of Ecology – Solid Waste Disposal Annual Summary, Recoverable and Non-Recoverable Wastes Generated in Washington State, 1994-2017

Accounting method	USCP SW.4.1

Transportation

Whatcom County's municipal/commercial waste is transported to the Columbia Ridge Landfill (Arlington, Oregon); Cowlitz County Headquarters Landfill (WA); Greater Wenatchee Regional Landfill (WA); Roosevelt Regional Landfill MSW in Klickitat County (WA); and Spokane Regional Waste-to-Energy Facility (WA). Wood waste from Whatcom County is sent to the Columbia Ridge Landfill. Cascadia estimated emissions from the transportation of this waste based on tonnage and distance to receiving landfills and other waste facilities.

GHG emissions	15,547 MT CO_2e
Activity data	166,489 wet short tons; 667 round-trip miles
Emissions factors	▸ ClearPath: 0.00014 MT CO_2e/wet short ton-mile
Data sources	▸ Washington State Department of Ecology, Solid Waste Disposal Annual Summary, Recoverable and Non-Recoverable Wastes Generated in Washington State, 1994-2017
Accounting method	▸ USCP SW.6

Processing

Process emissions come from powering the equipment necessary to manage the waste facility. Since all of Whatcom County's waste is sent to facilities outside of the county, these process emissions are included in the communitywide inventory.

GHG emissions	2,730 MT CO_2e
Activity data	166,489 wet short tons
Emissions factors	▸ ClearPath: 0.0164 MT CO_2e per wet short ton
Data sources	▸ Washington State Department of Ecology – Solid Waste Disposal Annual Summary, Recoverable and Non-Recoverable Wastes Generated in Washington State, 1994-2017
Accounting method	▸ USCP SW.5

Closed Landfills

While Whatcom County does not maintain any active landfills, the Health Department does manage six closed landfills: Cedarville, Birch Bay, Point Roberts PW, Point Roberts Park, Y Road Landfill I, and Y Road Landfill II. These closed landfills continue to emit a small amount of methane, which Cascadia estimated using a USEPA model based on the quantity of waste in place and landfill gas collection systems at each landfill.

GHG emissions	1,769 MT CO_2e
Activity data	310,616 tons of waste in place
Emissions factors	▸ Built into USEPA FOD Model
Data sources	▸ Whatcom County Department of Health
Accounting method	▸ USEPA First Order Decay (FOD) Model

WATER & WASTEWATER

Fugitive emissions from septic systems make up the majority (85%) of Whatcom County's wastewater emissions. Emissions from combustion of biosolids and sludges are the next largest portions of the County's wastewater emissions.

Fugitive Emissions from Septic Systems

Septic tanks collect and process wastewater in underground tanks usually owned by private, residential owners. The sewage in the system is not exposed to air, but some methane is produced and escapes from the septic systems when microorganisms biodegrade the soluble organic material found in waste. Cascadia estimated fugitive methane emissions from septic systems based on the population served (derived from the total number of septic systems in the county multiplied by average Whatcom County household size).

GHG emissions	7,736 MT CO_2e
Activity data	28,340 septic systems
Emissions factors	▸ ClearPath: 0.048213 MT CH_4/daily kg BOD_5
Data sources	▸ Whatcom County Health Department
Accounting method	▸ USCP WW.11(alt)

Emissions from Wastewater Treatment Lagoons

Lagoons treat wastewater through a combination of biological, physical, and chemical processes. Methane is produced during the anaerobic phase of this process. Cascadia calculated emissions from lagoons for the Lynden Wastewater Treatment based on site-specific data for the biochemical oxygen demand (BOD_5) load.

GHG emissions	113 MT CO_2e
Activity data	2,300 kg BOD_5/day
Emissions factors	▸ ClearPath: 1.7532 MT CH_4 per daily kg BOD_5
Data sources	▸ Lynden Wastewater Treatment Plant
Accounting method	▸ USCP WW.6

Process N_2O from Effluent Discharge to Rivers & Estuaries

The Everson, Newhalem, and Lynden Wastewater Treatment Plants discharge treated wastewater into water bodies, such as lakes, rivers, and Puget Sound. Cascadia used the population-based method to calculate associated nitrous oxide (N_2O) emissions.

GHG emissions	175 MT CO_2e
Activity data	18,710 people served
Emissions factors	▸ ClearPath: 0.005 kg N_2O per kg N in effluent
Data sources	▸ Everson Wastewater Treatment Plant ▸ Newhalem Wastewater Treatment Plant ▸ Lynden Wastewater Treatment Plant
Accounting method	▸ USCP WW.12(alt)

Emissions from Combustion of Biosolids & Sludges

Wastewater treatment processes generate sludges, which are concentrated and collected in settling basins. Plants often use anaerobic digesters to stabilize the sludges, producing a final product called biosolids. Anaerobic digestion of sludges and other organic wastes also produces biogas containing methane. Biosolids leaving the digester contain organics that may be combusted, and organics in undigested sludges may also be combusted. The Post Point Wastewater Treatment Facility reported combusting these biosolids and sludges.

GHG emissions	879 MT CO_2e
Activity data	3,678 MT biosolids/sludges incinerated
Emissions factors	▸ ClearPath: 9.7 g/MT CH_4; 900 g/MT N_2O
Data sources	▸ Post Point Wastewater Treatment Plant
Accounting method	▸ USCP WW.4; WW.5

Emissions from Wastewater Treatment

The removal of nitrogen by biological nitrification and denitrification is a two-step treatment process that results in GHG emissions: 1) ammonia is converted aerobically to nitrate (nitrification); and 2) nitrates are converted to N_2O (denitrification). Cascadia used the population-based method to calculate emissions.

GHG emissions	157 MT CO_2e
Activity data	124,536 people served
Emissions factors	▸ ClearPath: 3.2 g N_2O/person
Data sources	▸ Everson Wastewater Treatment Plant ▸ Newhalem Wastewater Treatment Plant ▸ Lynden Wastewater Treatment Plant ▸ Lighthouse Point Wastewater Treatment Plant ▸ Post Point Wastewater Treatment Plant
Accounting method	▸ USCP WW.7; WW.8

EMISSIONS & REMOVALS FROM TREES

Trees and land conversion contribute to net GHG flux—that is, the difference in removals versus emissions of carbon dioxide. GHG inventories for lands are reported in six land use categories: forest land, grassland, cropland, wetland, settlement, and other land coverage such as barren, snow, or ice. More than 60% (approximately 844,000 acres) of Whatcom County is forested, indicating a potentially large sink for CO_2.

In August 2019, ICLEI published new guidance on including forests and trees in GHG emissions accounting, added to the U.S. Community Protocol as *Appendix J: Forest Land and Trees*.[10] This protocol was developed based on a pilot study that included Whatcom County. Two slightly different time periods were used based on available data: 2001-2011 for forest lands; and 2000-2010 for trees outside of forests. This ten-year interval establishes a baseline on the removal and emission of CO_2 by trees and forests. During the baseline period, trees and forests in Whatcom County were found to store over 400 million tons of CO_2. In addition, Whatcom County forests and trees provided a net removal of CO_2 from the atmosphere of approximately 4 million tons of CO_2e per year, as shown in **Table 4**.

This baseline number will be used to show trends with future assessments of GHG removals by forests and trees. These trends are important because they could reveal changes in land use, harvesting, impacts of climate change such as increased frequency of fire and disease, and/or the basic overall health of forests in Whatcom County. Although the GHG emissions and removals from trees have not been calculated as part of the 2017 GHG inventory, it is likely that the value will be on the same order of magnitude as the baseline study. This assumes no large disturbances in the overall number of forested acres in Whatcom County between 2012 and 2017. Given the large amount of forest land in Whatcom County, the Committee recommends that emissions and removal from trees be considered in the 2022 GHG analysis, if not sooner.

Table 4. Summary of Whatcom County Greenhouse Gases from Forests and Trees

IPCC Reporting Categories	MT CO_2e
Forests Remaining Forests	-3,955,881
Forest sequestration	-5,122,273
Forest harvest	1,393,897
Harvested Wood Products	-599,387
Other forest disturbance	371,882
Non-forest Converted to Forests	-7,214
Non-forest → Forest	-7,214
Forests Converted to Non-Forest	162,676
Forest → Grassland	122,188
Forest → Other lands	27,096
Forest → Settlement	13,392
Non-Forest Land Use Categories/Transitions	-164,150
Trees outside forest (emission)	301,981
Trees outside forest (removals)	-466,131

[10] ICLEI – Local Governments for Sustainability, https://icleiusa.org/communities-now-better-equipped-to-include-trees-in-climate-action-planning/ and http://icleiusa.org/publications/us-community-protocol/ (see Appendix J).

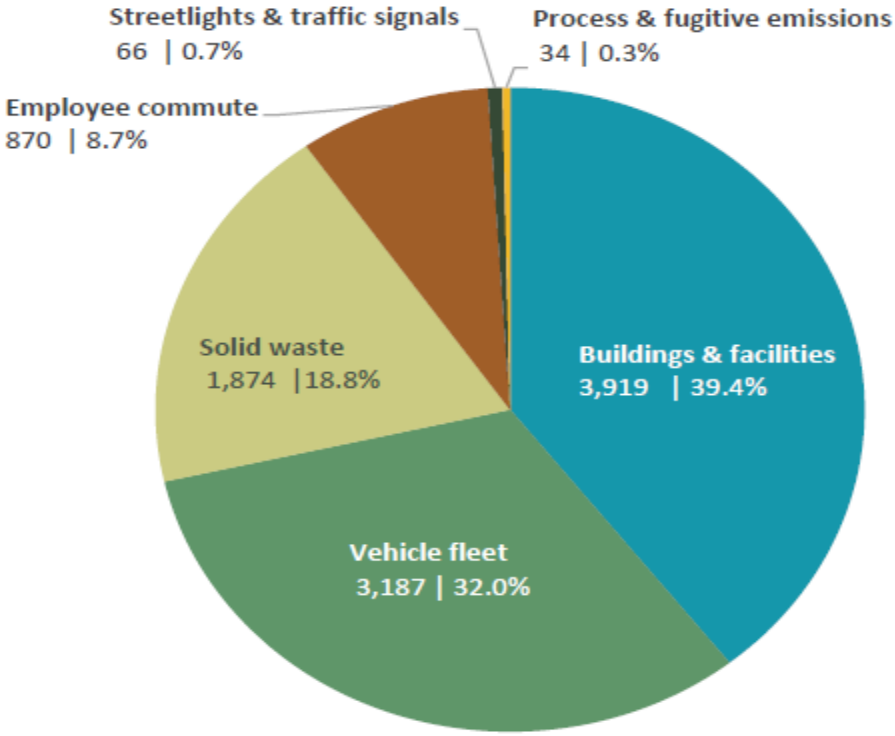
Net Emissions	**-3,964,569**

4. Local Government Operations Inventory

OVERVIEW

The local government operations inventory is a subset of Whatcom County's total community emissions and includes emissions from the operations over which the County government has control. Whatcom County's local government operations were estimated to contribute 9,950 metric tons of carbon dioxide equivalent (CO_2e) emissions in 2017, including direct emissions (Scope 1), emissions from electricity consumption (Scope 2), and selected other indirect sources (Scope 3). As shown in **Figure 9** below, emissions from operating buildings and facilities and the County's vehicle fleet together make up over 70% of greenhouse gas emissions from local government operations. Emissions from Whatcom County's closed landfills and County employee commuting contribute the next largest portions of the County's emissions. As noted in the Local Government Operations Protocol (page 176), the emissions figure "can vary greatly based on what has been included and, consequently, is not comparable to other local governments."

Figure 9. Whatcom County Government Operations GHG Emissions (in metric tons of CO_2e)



Excluded from Government Operations Inventory

The following components were not included in this inventory:

- **Electric power production**: Whatcom County does not own or operate any power generation facilities.
- **Transit fleet**: Public transit in Whatcom County is managed independently by Whatcom Transportation Authority, which is included in the Communitywide inventory.
- **Water & wastewater treatment**: Whatcom County does not own or operate any water/wastewater treatment facilities.

BUILDINGS & FACILITIES

Grid Electricity

Puget Sound Energy provides electricity to Whatcom County facilities. **Table 5** shows the electricity use, natural gas use, and associated CO_2e emissions of County buildings and facilities that generated more than 30 metric tons of CO_2e in 2017. Together, these 16 facilities represented 97% of the County's building electricity use. The top 5 facilities (each with more than 150 MT CO_2e in 2017) represented 80% of building electricity use. The table includes employee counts where available to help illustrate the scale of facilities, since square footage data were not available. Energy use for traffic signals and streetlights, including parking lots and the Lummi Island ferry terminal, is reported separately in the *Streetlights & Traffic Signals* section on page 31.

GHG emissions	2,859 MT CO_2e
Activity data	5,841,174 kWh
Emissions factors	▸ PSE Emissions Factor 2017
Data sources	▸ Average kWh by meter, per 2017 Puget Sound Energy – Voluntary Long-Term Renewable Energy Service Agreement (contract #201705023) ▸ Additional electricity usage data provided by Whatcom County staff
Accounting method	▸ LGOP 6.2.1

Natural Gas

Cascade Natural Gas Corporation (Cascade or CNGC) provides natural gas to Whatcom County. Natural gas usage at government buildings and facilities contributed an estimated 1,060 MT CO_2e emissions. Some facilities reported no natural gas usage, though it is not clear if records are incomplete or if those facilities use electricity for their heating and hot water needs. The 16 facilities that produce 30 or more metric tons of CO_2e represented 98% of the reported natural gas use in County buildings in 2017. The top 4 facilities by CO_2e emissions represented 71% of natural gas use in County buildings (the fifth facility, Public Works' Central Shop, reported no natural gas use). **Table 5** shows reported natural gas use and combined CO_2e emissions from electricity and natural gas usage.

GHG emissions	1,060 MT CO_2e
Activity data	199,209 therms
Emissions factors	▸ 0.053020 MT CO_2/MMBtu (ClearPath) ▸ 0.000005 MT CH_4/MMBtu (ClearPath) ▸ 0.0000001 MT N_2O/MMBtu (ClearPath)
Data sources	▸ Natural gas data provided by Whatcom County staff
Accounting method	▸ LGOP 6.1.1

Table 5. Whatcom County Electricity and Natural Gas Use: Top Buildings and Facilities by CO_2e Emissions

Facility *(# accounts if multiple)*	Department	Employees	2017 kWh	2017 Therms	MT CO_2e
Courthouse *(4 accounts)*	Executive	417	3,310,661	97,833	2,140.9
Interim Work Center	Sheriff	31	506,960	29,065	402.7
Northwest Planning Annex	Planning	61	287,040	7,253	179.1
Community Health Center	Health	48	276,720	6,970	172.5
Central Shop	Public Works	81	308,187	-	150.9
Evidence Storage	Sheriff	*N/A*	25,299	21,512	126.8
Civic Center	Public Works	57	188,520	4,773	117.7
Bellingham Senior Center	Parks	20*	119,154	7,300	97.2
Health Dept. Administration	Health	28	131,880	5,662	94.7
Plantation Rifle Range	Parks	*	123,677	-	60.5
Public Defender Office *(4)*	Public Defender	31	61,975	4,629	55.0
Forest Street Annex *(3)*	Executive	7	72,696	2,947	51.3
Silver Lake Park *(8)*	Parks	*	101,825	-	49.8
Emergency Operations Center	Sheriff	4	57,760	2,772	43.0
Facilities Management Main	Facilities	18	38,662	2,778	33.7
Ferndale Senior Center	Parks	*	36,518	2,300	30.1
Total of Top 16 Facilities		**803**	**5,647,534**	**195,793**	**3,806**
% of estimated total		*98.8%*	*96.7%*	*98.3%*	*97.1%*

**The Parks Department had 20 employees, working across multiple facilities including the Bellingham Senior Center, Plantation Rifle Range, Silver Lake Park, Ferndale Senior Center, and others locations not in the top buildings by CO_2e emissions.*

STREETLIGHTS & TRAFFIC SIGNALS

Puget Sound Energy provides electricity to Whatcom County facilities, including streetlights and traffic signals.

GHG emissions	66 MT CO_2e
Activity data	134,388 kWh
Emissions factors	▸ PSE Emissions Factor 2017
Data sources	▸ Average kWh by meter, per 2017 Puget Sound Energy – Voluntary Long-Term Renewable Energy Service Agreement (contract #201705023) ▸ Additional electricity usage data provided by Whatcom County staff
Accounting method	▸ LGOP 6.2.1

VEHICLE FLEET

On-Road Vehicles

Cascadia used fuel consumption (in gallons of gasoline/diesel) and mileage totals to calculate emissions from the County's vehicle fleet. Note this total does not include emissions from contractor fuel consumption, usage records were not available. The Committee discussed that Whatcom County could add a fuel reporting requirement to new contracts to support more complete vehicle emissions tracking in future inventories.

GHG emissions	2,684 MT CO_2e
Activity data	190,205 gallons gasoline; VMT = 2,296,392. 98,707 gallons diesel; VMT = 114,264
Emissions factors	▶ 2017 Factor Set (multiple sources) ▶ PSE Emissions Factor 2017
Data sources	▶ Whatcom County staff provided fuel usage report and mileage.
Accounting method	▶ LGOP 7.1.1.1

Ferry

The Lummi Island Ferry (Whatcom Chief) operates in Whatcom County, traveling between Lummi Island and the mainland.

GHG emissions	503 MT CO_2e
Activity data	48,807 gallons of diesel
Emissions factors	▶ LGOP Table G.14
Data sources	▶ Whatcom County staff provided fuel usage report
Accounting method	▶ LGOP 7.2

EMPLOYEE COMMUTE

Washington State RCW 70.94.527 specifies that employers with over 100 employees shall develop a commute trip reduction (CTR) plan designed to achieve reductions in the proportion of single-occupant vehicle (SOV) commuting trips. The plans should be reviewed annually and contain goals for commute trip reduction and describe how these goals will be measured.

To fulfill this law, Whatcom County has used Smart Trips, a voluntary program that encourages alternative commuting. Annual Smart Trips summaries show a decline in the use of this program with only 83 employees using the system in 2019; recent commute behavior of the other 90% of the county employees is unknown. In the future, the County could conduct a simple, brief annual or biennial survey of County employees to provide the information needed to estimate commuting emissions and understand the effectiveness of the CTR program. The state's CTR program can provide a standard survey.

In the absence of 2017 employee commute survey data, Cascadia estimated employee commute emissions using the data listed in **Table 6**.

Table 6. Summary of Employee Commute Calculation Inputs

Commuting Data	2013	2017	Data sources
Employee count	789	813 FTEs 824 total	Provided by Whatcom County staff.
Round-trip distances between employee homes and offices (in miles)	9,193	N/A	Provided by Whatcom County staff from 2013 survey.
Average employee commute in miles per year (per employee)	3,030	N/A	Round-trip miles divided by employee count, multiplied by approximate number of working days per year (52 weeks x 5 days per week)
Commute methods: ▸ Drove alone ▸ Carpooled ▸ Public transit	N/A	75.25% 9.13% 2.48%	2017 U.S. Census Bureau American Community Survey (ACS) data. This information is for Whatcom County as a whole, not just county employees.
Total vehicle miles traveled: ▸ Drove alone ▸ Carpooled ▸ Public transit	N/A	1,876,199 113,819 61,834	Multiplied 2017 employee counts by average employee commute (miles per year, per employee) for a total of 2,493,287 miles per year. Used ACS data to estimate total miles by commute method. Cascadia assumed two employees per carpool so total VMT for this method was halved.

Passenger Vehicles

GHG emissions	866 MT CO_2e
Activity data	1,850,716 employee VMT
Emissions factors	▸ 2017 Factor Set (multiple sources) ▸ PSE Emissions Factor 2017
Data sources	▸ Employee counts and commute data provided by Whatcom County staff
Accounting method	▸ LGOP 12.2.1

Transit

GHG emissions	4 MT CO_2e
Activity data	61,834 employee passenger miles
Emissions factors	▸ 3.5991 kg/passenger mile
Data sources	▸ Employee counts and commute data provided by Whatcom County staff
Accounting method	▸ LGOP 12.2.1

SOLID WASTE FACILITIES

Closed Landfills

While Whatcom County does not maintain any active landfills, the Health Department does manage six closed landfills: Cedarville, Birch Bay, Point Roberts PW, Point Roberts Park, Y Road Landfill I, and Y Road Landfill II. These closed landfills continue to emit a small amount of methane, which was estimated based on the waste in place and landfill gas collection systems at each landfill using a USEPA model.

GHG emissions	1,769 MT CO_2e
Activity data	310,616 tons of waste in place
Emissions factors	▸ Built into USEPA FOD Model
Data sources	▸ Whatcom County Department of Health
Accounting method	▸ USEPA First Order Decay (FOD) Model

Waste Generation

In the absence of waste tonnage data, Whatcom County staff provided monthly waste hauler invoices containing volumes of waste disposed by Whatcom County government facilities. Cascadia used waste volumes to estimate tonnage using the EPA's volume-to-weight conversion (138 pounds per cubic yard). Composition of waste is assumed to resemble the "commercial" waste stream.

GHG emissions	103 MT CO_2e
Activity data	244.54 tons
Emissions factors	▸ Washington State Department of Ecology 2015-2016 – Commercial
Data sources	▸ Waste information provided by Whatcom County staff
Accounting method	▸ LGOP 12.2.2

PROCESS & FUGITIVE EMISSIONS

Refrigerant Use

Installation, use, and disposal of refrigeration systems (e.g., air conditioners, chillers, refrigerators) can leak refrigerants that contain or consist of hydrofluorocarbons (HFC) compounds with high global warming potentials. Cascadia used the mass-balance method to calculate emissions related to Whatcom County's use of R-22 (Freon) and R-410a (Puron).

GHG emissions	34 MT CO_2e
Activity data	42 lbs fugitive gas released
Emissions factors	▸ Global Warming Potential; IPCC 5th Assessment Report, 2014 (AR5)
Data sources	▸ Refrigerant data provided by Whatcom County staff
Accounting method	▸ LGOP 6.6.1

5. Projected & Targeted Emissions

As a planning tool to help guide the County's work in reducing greenhouse gas emissions over time, the Climate Impact Advisory Committee established the following targets:

- Whatcom County communitywide targets will follow state-mandated targets:
  - 45% reduction below 1990 levels by 2030.
  - 95% reduction below 1990 levels by 2050 and net-zero emissions.
- Whatcom County government operations targets:
  - 85% reduction below 2000 levels by 2030.
  - 100% reduction below 2000 levels by 2050.

Cascadia used these targets and timelines, combined with inventory data, to prepare the figures below.

COMMUNITY EMISSIONS

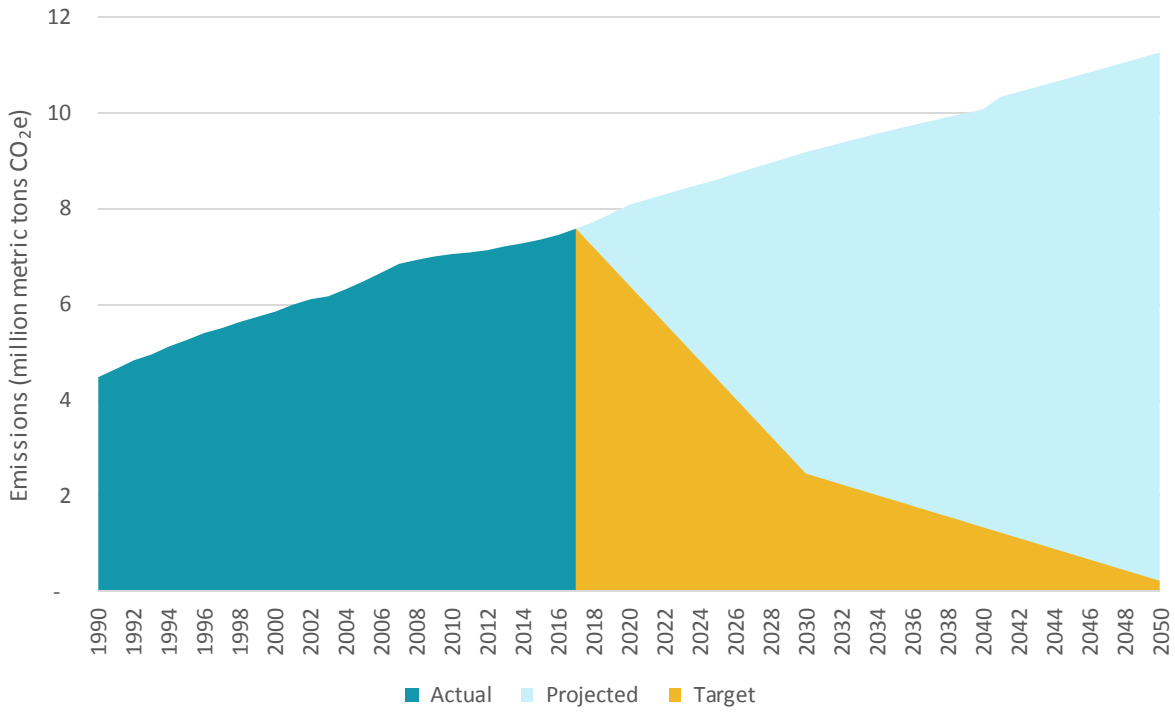
Cascadia used Whatcom County population figures as a proxy to estimate community emissions back to 1990 based on 2017 emissions. Note that this figure does not include the 2000/2001 baseline or 2005 inventory totals due to significant variances in methodology, including data sources and coverage. This simple estimation is based on population changes alone and does not incorporate other changes in the local economy or intensity of emissions per unit of activity. The resulting estimate for 1990 emissions in Whatcom County is 4,480,000 MT CO_2e, about 59% of 2017 levels. For reference purposes, Washington State estimated 97.5 million MT CO_2e in 2017 and 88.4 million MT CO_2e in 1990.[11]

- The light blue "**Projected**" wedge in **Figure 10** indicates the amount of emissions currently projected based on a Business-as-Usual (BAU) scenario of continued population growth at 2017 emissions rates. These figures do not reflect the 2020 curtailment of the Intalco smelter in Ferndale. Mitigation efforts will be needed to achieve the county's targets, as described below.
- The annual "**Target"** numbers shown in yellow are based on the assumption that the targets will be achieved gradually over time rather than having all emissions reductions occur in the target year. Actual emissions reductions could happen on a different schedule, such as a step pattern in which larger reductions occur when certain policies or programs are implemented.
  - Based on the 1990 estimate of 4,480,000 MT CO_2e, the target for annual emissions in 2030 would be 2,464,000 MT CO_2e (45% below 1990 levels).
  - The target for 2050 would be 224,000 MT CO_2e (95% below 1990) with net-zero emissions.
  - Relative to the BAU scenario, projected emissions will need to be reduced by approximately 6,722,000 MT CO_2e in 2030 to reach the 2030 target.

[11] Washington State Department of Ecology, "2017 Greenhouse Gas Data," https://ecology.wa.gov/Air-Climate/Climate-change/Greenhouse-gases/2017-Data; *Washington State Greenhouse Gas Emissions Inventory: 1990-2015: Report to the Legislature*, Publication 18-02-043, December 2018, https://apps.ecology.wa.gov/publications/documents/1802043.pdf. Whatcom County accounted for 3.0% of the state's population in 2017 and 2.6% in 1990 (www.ofm.wa.gov/washington-data-research/population-demographics/population-estimates). For emissions reported by major sources (25,000 MT CO_2e or more), Whatcom County represented 7.438% of emissions in 2017 (https://data.wa.gov/Natural-Resources-Environment/GHG-Reporting-Program-Map/gtyb-56w7). Applying this percent share to Washington's 1990 estimate would yield a higher 1990 estimate for Whatcom County of 6,575,000 MT CO_2e.

- The darker blue "**Actual**" wedge shows inventoried emissions in 2017 and estimates back to 1990.

Figure 10. Projected vs. Target Levels of Community GHG Emissions (millions of MT CO_2e), 1990-2050



LOCAL GOVERNMENT OPERATIONS EMISSIONS

Cascadia applied Whatcom County's local government emissions as calculated for the 2000 baseline and 2017 inventories to estimate greenhouse gas emissions for government operations through 2050.

- The light blue "**Projected**" wedge in **Figure 11** indicates the amount of emissions currently estimated in a Business-as-Usual scenario based on the slight decline observed from 2000 to 2017. These figures do not reflect the County's participation in PSE's Green Direct wind energy program starting in mid-2019.[12]
- The annual "**Target"** numbers shown in yellow are based on the assumption that the targets will be achieved gradually over time rather than having all emissions reductions occur in the target year. Actual emissions reductions could happen on different schedule, such as a step pattern in which larger reductions occur when certain policies or programs are implemented.
  - Based on the 2000 baseline estimate of 10,300 MT CO_2e, the target for annual government emissions in 2030 would be approximately 1,500 MT CO_2e. The target for 2050 is zero emissions.
  - Relative to the BAU scenario, projected government emissions will need to be reduced by approximately 8,100 MT CO_2e in 2030 to reach the 2030 target.
- The darker blue "**Actual**" wedge shows inventoried emissions from 2000 and 2017, with a linear regression to estimate emissions between that period.

[12] When the PSE Green Direct program or other renewable energy purchases appear in future inventories, the County should include a parallel "location-based" emissions calculation using regional grid emissions factors, such as from EPA's eGRID.

In addition, the Committee requested a trendline based on 100% reduction (net zero) below 2001 by 2035, as shown in **Figure 12**. The light blue "Projected" wedge indicates the amount of emissions estimated based on a BAU scenario that will need to be avoided in order to achieve the net-zero emissions target, shown in dark green, by 2035. **Figure 12** shows a more rapid decrease in emissions after 2030 than seen in **Figure 11**.

Figure 11. Projected vs. Target Levels of Government Operations GHG Emissions (MT CO_2e), 2000-2050

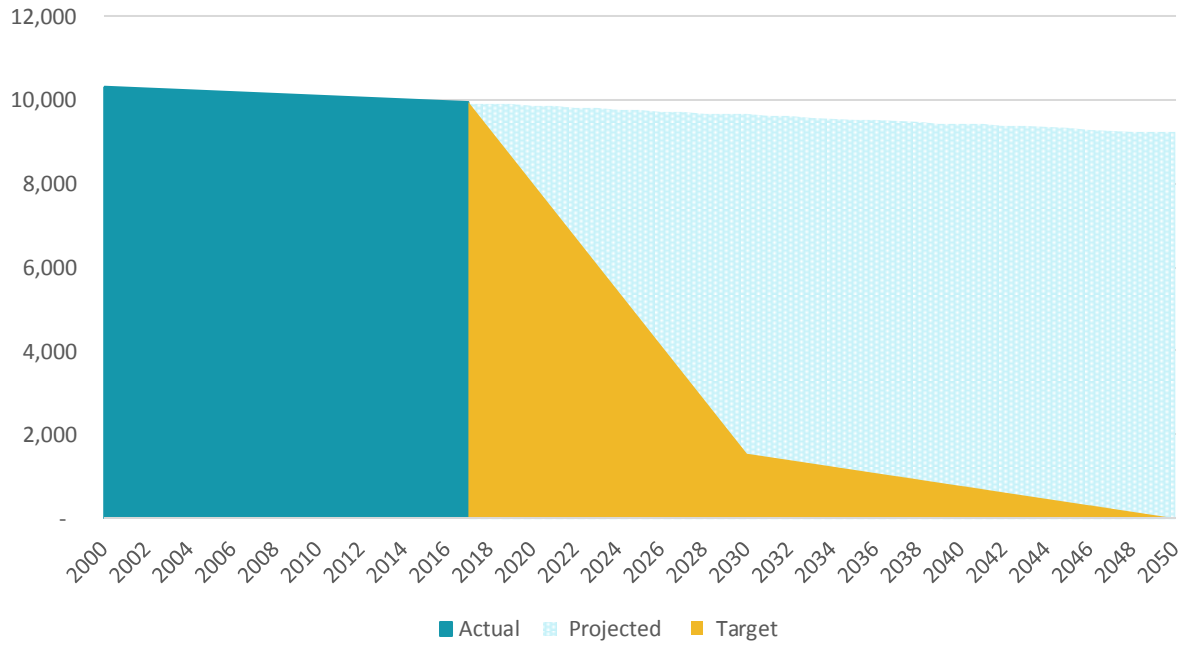
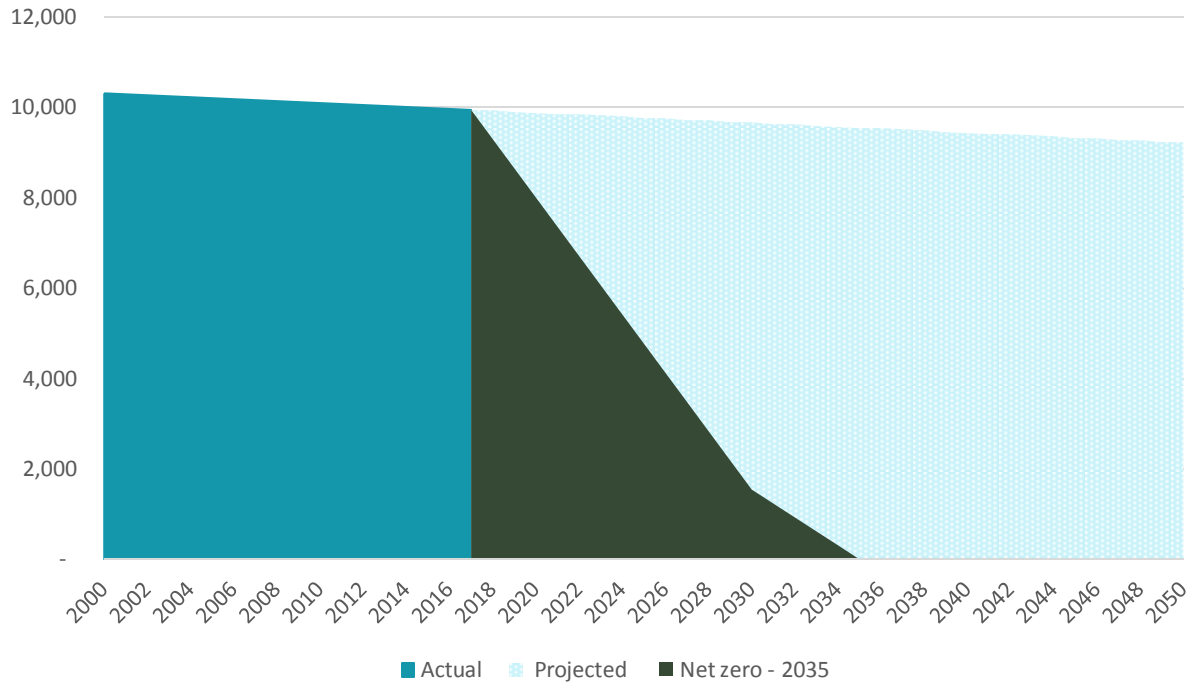


Figure 12. Projected vs. Net-Zero 2035 Government Operations GHG Emissions (MT CO_2e), 2000-2050



COMMUNITY GHG INVENTORY REPORT SUMMARY TABLE

6. Community GHG Inventory Report Summary Table

Notation Keys for Excluded Emission Sources and Activities:

- **IE – Included Elsewhere**: Emissions for this activity are estimated and presented in another category of the inventory.
- **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.

Legend for Reporting Frameworks Used:

- **SI** – Local Government Significant Influence
- **CA** – Community-wide Activities

Emissions Type	Source or Activity?	Required Activity?	Included under reporting frameworks:		Excluded	Explanatory notes (OPTIONAL)	Emissions (MT CO_2e)
			SI	CA			
Built Environment							
Stationary fuel combustion	Activity	●	●	●			647,435
Electricity use	Activity	●					1,321,285
District heating and cooling energy use	Source				IE	Included in stationary fuel combustion and electricity use totals.	-
Emissions from electric power production	Source				IE	Included in stationary fuel combustion and electricity use totals.	-
Refrigerant leakage and fire suppression	Source			●			116,567
Industrial process emissions	Source			●			3,862,348
Upstream impacts of fuels used in stationary applications by the community	Activity		●	●			18,170
Upstream and transmission and distribution (T&D) impacts of purchased electricity used by the community	Activity			●			58,883

COMMUNITY GHG INVENTORY REPORT SUMMARY TABLE

Emissions Type	Source or Activity?	Required Activity?	Included under reporting frameworks:		Excluded	Explanatory notes (OPTIONAL)	Emissions (MT CO_2e)
Transportation and Mobile Emissions							
On-road passenger vehicles	Activity	●					848,109
Freight and service trucks	Activity				IE	Included with passenger vehicles	-
Transit	Source		●	●		Includes ferry	6,386
Freight rail	Source			●		BNSF only	8,970
Inter-city passenger rail	Source				NO	Amtrak data unavailable.	-
Air travel	Source			●		Bellingham International Airport	14,273
Marine vessels	Source			●			65,409
Off-road equipment	Source			●			93,672
Solid Waste							
Solid waste facilities located in community	Source		●			Whatcom County closed landfills	1,769
Community-generated waste	Activity	●		●		Includes processing and transportation emissions	86,862
Water & Wastewater							
Stationary emissions	Source	●		●		Combustion of biosolids and sludges	879
Process emissions	Source	●		●		Wastewater treatment nitrification/ denitrification and lagoons	270
Fugitive emissions	Source	●		●		Septic systems and effluent discharge to rivers and estuaries	7,911
Agriculture							
Manure treatment & handling	Source			●			220,318
Enteric fermentation	Source			●			204,062
TOTAL EMISSIONS							**7,583,578**

7. Abbreviations Used in This Report

ACS	American Community Survey, from the U.S. Census Bureau
BLI	Bellingham International Airport
BOD_5	Biochemical oxygen demand load (over 5 days)
BPA	Bonneville Power Administration
CACP	Clean Air and Climate Protection Software (predecessor to ICLEI's ClearPath)
CH_4	Methane, a potent greenhouse gas
CNGC	Cascade Natural Gas Corporation
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CTR	Commute Trip Reduction
FLIGHT	Facility Level Information on Greenhouse Gases Tool, from USEPA
FOD	First Order of Decay, a model from USEPA for estimating landfill emissions
g	Gram
GHG	Greenhouse gas
GWh	Gigawatt-hour
GWP	Global warming potential
HFC	Hydrofluorocarbon, a class of greenhouse gases
ICLEI	ICLEI – Local Governments for Sustainability (formerly, International Council for Local Environmental Initiatives)
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
kWh	Kilowatt-hour
lbs	Pounds
LGOP	Local Government Operations Protocol
MMBtu	Million British Thermal Units
mpg	Miles per gallon
MSW	Municipal solid waste
MT	Metric tons
MWh	Megawatt-hour
N	Average total nitrogen discharged per day (total N-load)
N_2O	Nitrous oxide, a potent greenhouse gas
NTD	National Transit Database
NWCAA	Northwest Clean Air Agency
PFC	Perfluorocarbons, a class of greenhouse gases
PSE	Puget Sound Energy
PUD	Public Utility District
R-22	Freon refrigerant
R-410a	Puron refrigerant
SF_6	Sulfur hexafluoride
T&D	Transmission and distribution
USCP	United States Community Protocol
USEPA	United States Environmental Protection Agency
VMT	Vehicle miles traveled
WA	Washington State
WCOG	Whatcom Council of Governments
WTA	Whatcom Transportation Authority

Appendix A. Agricultural Emissions from Fertilizer Application & Tillage Practices

Chris Elder of Whatcom County provided this additional information and calculations regarding estimated agricultural emissions from fertilizer application and carbon sequestration from improved tillage practices.

Data on emissions from agricultural activities are not well tracked and often vary significantly by crop type, producer, soil type, and farm location. Estimates for this inventory were derived from the 2017 Agricultural Census and in consultation with Washington State University and Whatcom Conservation District based on their published application guidance and local knowledge of standard fertilizer and manure application rates and acreages cover cropped and in perennial groundcover. Carbon sequestration rates were determined from the 4th Assessment Report of the Intergovernmental Panel on Climate Change. Nitrogen emissions factors were determined from the IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 Agriculture, Forestry, and Other Land Use. Estimates for agricultural emissions and removals provided in this inventory are by no means comprehensive and should be considered as an initial assessment of emissions and removals related to agricultural production.

The County developed a spreadsheet with information on crops, acreage, and fertilizer use to estimate nitrous oxide emissions of 31 metric tons N_2O, or about 8,200 metric tons CO_2e, and carbon sequestration of 17,400 metric tons CO_2 throughout reduced tillage and no-tillage farming practices for the following crops:

- Corn silage (reduced tillage)
- Wheat (reduced tillage)
- Orchards (no tillage)
- Raspberries (reduced tillage)
- Blueberries (no tillage)
- Forage (hay, haylage, grass silage, and greenchop)
- Drybeans (reduced tillage)
- Oats (reduced tillage)
- Potatoes (tillage)
- Other vegetables (tillage)
- Cherries (sweet) (no tillage)
- Cherries (tart) (no tillage)
- Grapes (no tillage)
- Peaches (no tillage)
- Pears (no tillage)
- Plums (no tillage)
- Nuts (no tillage)