Washington County

Community Greenhouse Gas Inventory

For Calendar Year 2022

December 2023

Acknowledgments

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Consulting Team

Good Company, a sustainability consulting firm based in Eugene, Oregon, conducted the analysis for Washington County. Beth Miller, Claudia Denton, and Suzy Godber of Good Company provided data-gathering assistance to Washington County staff and facilitated the use of Good Company's Carbon Calculator for Communities (G3C – Community), a proprietary greenhouse gas inventory tool, to conduct the analysis. They are the primary authors of this report.

Cover Image

Washington County, Vineyards Along Tour Route
Photo Credit: Joel Zak courtesy of Washington County Visitors Association

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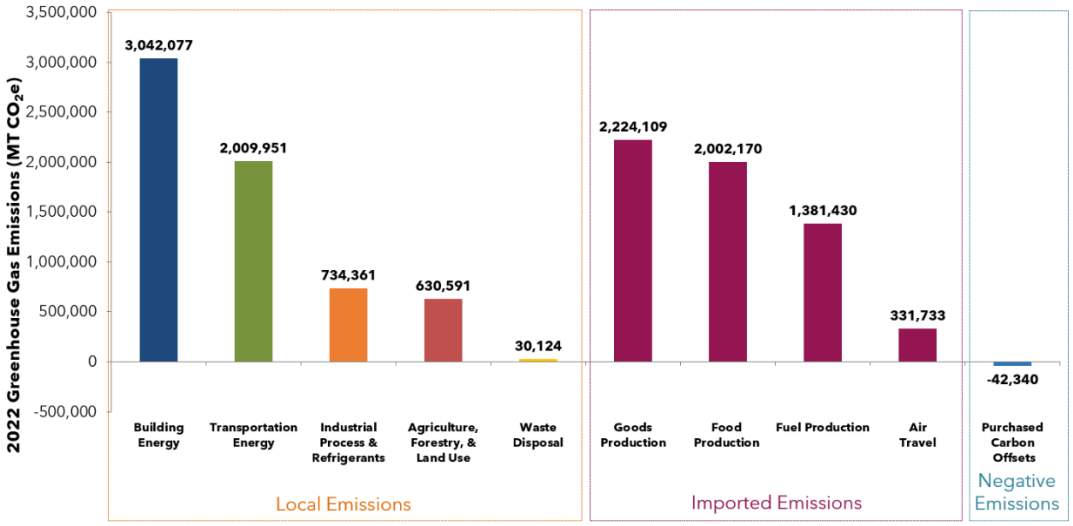
Executive Summary

Washington County completed a community greenhouse gas (GHG) inventory to inform future climate and sustainability work led by county departments, regional community partners, and community-based organizations. The inventory follows internationally recognized community GHG inventory protocols and accounts for all significant sources of GHG emissions driven by activities taking place within Washington County's geographic boundary. Beyond protocol requirements, the inventory also measures consumption-based emissions from imported goods and food, air travel, and the purchase of carbon offsets.

Summary of Findings

- During 2022, with a population of nearly **610,000**, all emissions combined (local and imported emissions) totaled over **12.3 million metric tons of carbon dioxide equivalent (MT CO_2e)**, or an average of about **20.3 MT CO_2e** per resident.
- Of this, local emissions totaled nearly **6.5 million MT CO_2e**, or an average of nearly **10.6 MT CO_2e** per resident.
    - The largest sectors were energy use by buildings (primarily electricity and natural gas use, 47%) and transportation energy (primarily gasoline combustion, 31%). agriculture, forestry, and land use (23%). Industrial processes and refrigerants accounted for 11% of local emissions, agriculture, forestry and land use accounted for 10% and waste disposal accounted for less than 1%.
- Imported emissions from household consumption and production of fuel and energy sold in Washington County totaled over **5.9 million MT CO_2e** and include upstream emissions from production of goods (37%), food (34%), fuel production (23%), and air travel (6%).
- Negative emissions total approximately **42,000 MT CO_2e** carbon offsets purchased through NW Natural.

Figure 1: Washington County's 2022 GHG Emissions



Introduction

Greenhouse gas (GHG) emissions are a primary driver of climate change, which has led to hotter and longer extreme heat events, more frequent and severe wildfires, ice storms, and seasonal flooding. After a review of the scientific evidence, the Environmental Protection Agency (EPA) found that GHG emissions threaten the public health and welfare of the American people.[1] Washington County acknowledges that our community is already experiencing the impacts of climate change, which threatens the health and well-being of all, especially historically marginalized communities and frontline communities. For more than a decade, Washington County has actively worked to reduce our operational environmental footprint. While our county departments have demonstrated success in reducing our own facilities' emissions, we know that we are only one part of the county's environmental footprint. An important part of addressing climate change in our county is conducting a community greenhouse gas emissions inventory. This is a fundamental first step to identify sources and opportunities for emission reductions.

Washington County's first community greenhouse gas inventory estimates the GHG emissions associated with the geographic boundaries of Washington County. This report represents Washington County's carbon footprint, and it provides the foundation for GHG emissions tracking in the community. This inventory can be used to better understand how different sectors (see below) impact our emissions. The inventory will also serve as a baseline to evaluate future mitigation strategies and to inform further investment in community-level climate mitigation work and regional efforts with public agencies, utilities, nonprofit partners, and the business community.

Washington County's Community GHG inventory includes the following emissions sources:

Building Energy: Energy usage (primarily electricity and natural gas) by residential, commercial, and industrial buildings and facilities represents a major source of GHG emissions for most communities. These emissions come from combustion of natural gas and from electricity generated from fossil fuels to heat water and power buildings. Small quantities of combusted propane and other fuels are also included. Additionally, a fraction of natural gas is lost during local distribution, releasing methane, a potent greenhouse gas pollutant.

Transportation: Gasoline for passenger vehicles and diesel consumption for freight and bus transit are included in this category. Electricity use by electric vehicles is also included here where possible. Finally, jet fuel and aviation gasoline from the Hillsboro Airport are included here.

[1] The U.S. Environmental Protection Agency. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act. 2009. https://www.epa.gov/climate-change/endangerment-and-cause-or-contribute-findings-greenhouse-gases-under-section-202a.

Waste & Wastewater: Sending organic matter (such as food scraps and paper) to the landfill produces methane, another potent greenhouse gas. Most of this methane is collected and burned for energy production, but some of it leaks. The treatment of wastewater also produces GHG emissions from nitrous oxide and methane.

Industrial Process & Refrigerants: Refrigerant emissions come from transportation and building cooling systems. Refrigerants are powerful global warming gases. Therefore, relatively small losses have a large climate impact. Known significant industrial process emissions are also included here. These emissions are not from the energy used in a factory, for example, but from the other processes involved in manufacturing. In inventory protocol, this is referred to as Industrial Process and Product Use.

Agriculture, Forestry, & Land Use: These emissions come from agricultural activity (e.g., animal waste and agricultural inputs), forestry (any activities that cut down trees), and community land use change (e.g., development of forest or grasslands).

Consumption-Based Emissions: These are generated outside of the community during the production of goods, food, fuels, and service products consumed by residents. Note: *Consumption-based emissions presented in this inventory are estimated (see Appendix D for more information); therefore, the results have a greater level of uncertainty compared with other sources of emissions.*

What's Included? (Boundaries & Methodology)

Protocol and Inventory Boundaries

This community inventory follows Greenhouse Gas Protocol's Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC).[2] The GPC focuses on accounting for sector-based emissions, which can be thought of as local sources of emissions. This inventory also includes an estimate of the emissions embodied in local consumption of consumer goods, construction materials, and food to inform community climate action planning. Consumption of consumer goods is a large emissions source, but it is often excluded from inventories.

The first step in any GHG inventory is setting the inventory boundary. The boundary includes defining the geographic area, time span, emissions sources, and gases covered in the inventory. The greenhouse gas inventory presented in this report is based on data from calendar year 2022 for Washington County's geographic boundary. This inventory considers all seven recognized greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). All gases are reported in terms of carbon dioxide equivalent (CO_2e), or the amount of carbon dioxide it would take to create the same warming effect.

[2] GPC has become the recommended or required standard for international reporting to CDP's Cities Survey and the Global Covenant of Mayors for Climate & Energy. The GPC may be downloaded at https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities.

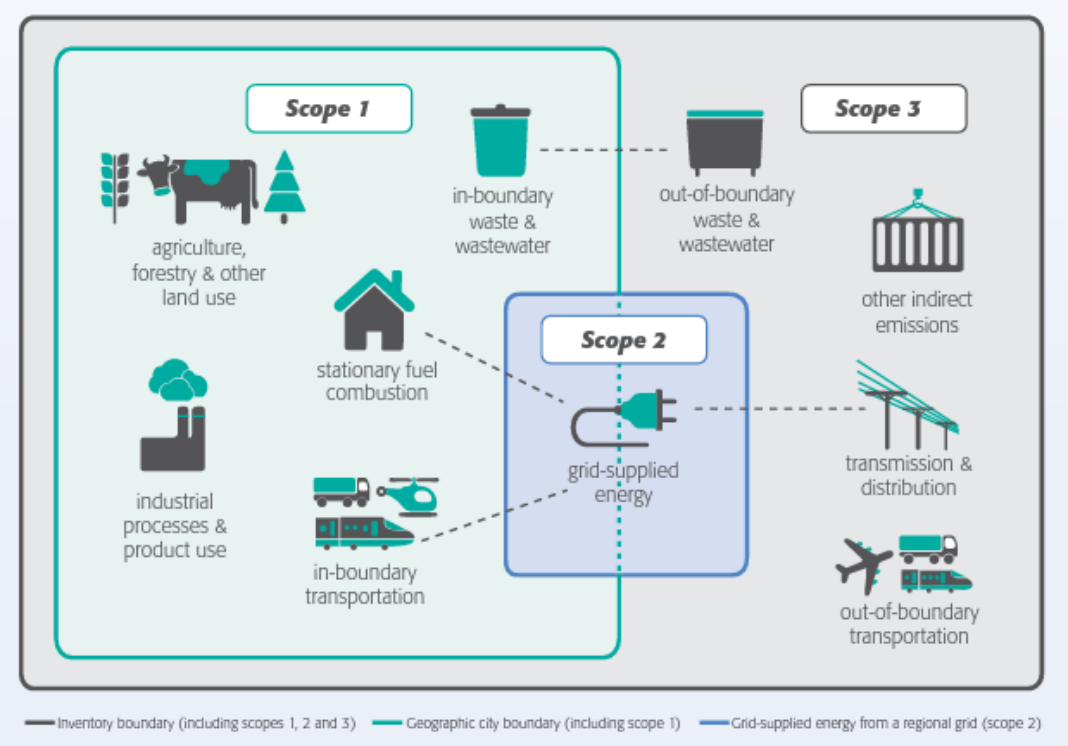
Scopes

As described above, GHG emissions are often organized by sector (buildings, transportation, waste, etc.). Another way to organize them is by their origin location, either within a community or outside; these are referred to as *scopes*. Scope categories, as outlined in Table 1 and Figure 2 (next page) distinguish those emissions that occur within the geographic boundaries (Scope 1) from those that occur outside the boundaries but are driven by activity from within the geographic boundary (Scope 2 and Scope 3). Emissions sectors and sub-sectors included in the GPC are shown in Table 2 (page 4). These are compared with emissions included in the 2022 community inventory by scope category.

Table 1: Scope Descriptions

Scope 1	GHG emissions from sources located within the geographic boundary.	Example: Burning fossil fuels to heat homes or power cars
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity within the geographic boundary.	Example: Emissions from coal and natural gas power plants
Scope 3	All other GHG emissions that occur outside the boundary as a result of activities taking place within the boundary.	Example: Production of fuels, goods, and food

Figure 2: Graphical Illustration of Scopes[3]



[3] Global Protocol for Community-Scale Greenhouse Gas Inventories.

Table 2: Crosswalk of Emission and Scope Categories

Emissions Sector / Sub-Sector	Included in Inventory	Scope 1	Scope 2	Scope 3
Stationary Energy (Buildings)				
Residential Buildings	•	✓	✓	
Commercial Buildings and Facilities	•	✓	✓	
Industrial Facilities	•	✓	✓	
Irrigation	•	✓	✓	
Water and wastewater treatment	•	✓	✓	
Energy Generation Supplied to the Grid	•	✓	✓	
Fugitive Emissions from Natural Gas Systems	•	✓		
Agriculture, Forestry, and Fishing	IE	✓	✓	
Transportation				
On-Road Passenger and Commercial Vehicles	•	✓	✓	✓
On-Road Freight Vehicles	•	✓	✓	✓
On-Road Transit Vehicles	•	✓	✓	✓
Off-Road Vehicles and Equipment	•	✓		✓
Aviation	•	✓		✓
Waste & Wastewater				
Solid Waste	•			✓
Compost (Biological Treatment of Waste)	•			✓
Wastewater Treatment	•	✓		
Incineration of Waste	•			✓
Industrial Process and Product Use				
Industrial Processes	•	✓		
Refrigerants (Product Use)	•	✓		
Agriculture, Forestry, and Land Use				
Forestry	•	✓		
Land Use	•	✓		
Livestock	•	✓		
Other Agriculture	NE	✓		
Imported Emissions (Other Scope 3)				
Household Consumption of Goods and Food	•			✓
Air Travel	•			✓
Upstream Energy Emissions	•			✓
Negative Emissions (Sequestration & Offsets)				
Purchased carbon offsets	•	✓		
Local carbon storage (annual growth)	•	✓		

IE = Included elsewhere, split not available
NE = Emissions occur but are not reported or estimated - see justification in exclusions

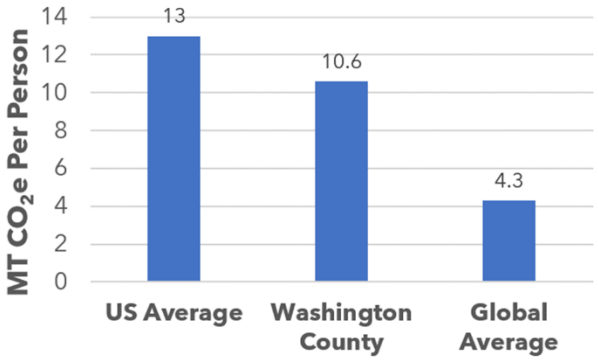
Inventory Results

Local Emissions

The Washington County community generated nearly **6.5 million MT CO_2e** of local emissions, nearly **10.6 MT CO_2e** per resident. This is a little less than the U.S. average of **13 MT CO_2e** per person and considerably greater than global average of **4.3 MT CO_2e** per person (Figure 3).[4] Protocols refer to local emissions as sector-based emissions. Those emissions are generated close to home and are most often under the community's direct control. This quantity of GHGs is equivalent to the carbon sequestered by roughly 7.5 million acres of average U.S. forest land area, about 16 times the size of Washington County.[5]

Definition: MT CO_2e
Metric tons of carbon dioxide equivalent, a unit of measure. Most greenhouse gases are more potent than carbon dioxide in warming the atmosphere. To calculate and compare emissions easily, all gases are calculated and combined into a carbon dioxide equivalent, typically measured in metric tons.

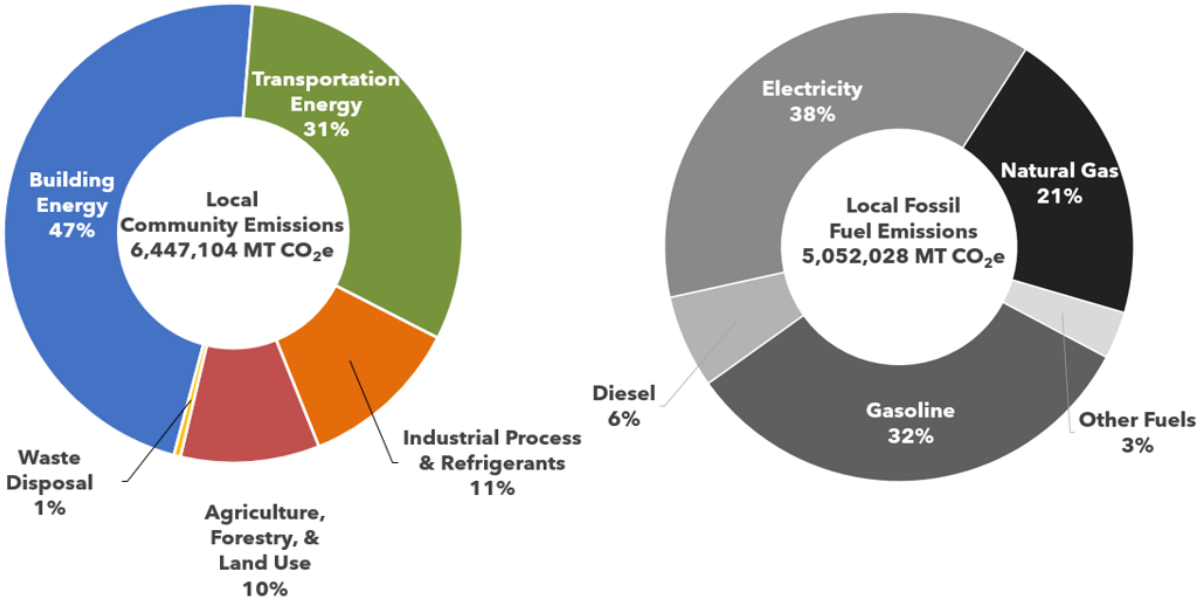
Figure 3. Comparison of per-Person Emissions



Washington County's local emissions are shown on the left side of Figure 4 (below) and come primarily from building energy, such as electricity use and combustion of natural gas by buildings and other facilities (**blue segments**); transportation sources, mainly gasoline and diesel combustion in vehicles (**green segment**); and agriculture, forests, and land use, such as land-use changes that alter soil composition and methane produced from digestive processes of livestock (**red segment**). Emissions from industrial process and refrigerants include federally reported special industrial emissions and refrigerant gas loss from buildings and vehicles (**orange**). Waste emissions include landfill disposal of community solid waste and wastewater treatment (**yellow**). The right side of Figure 4 details fossil fuel use. Note that almost all emissions from **buildings** and **transportation** are from **fossil fuels** (**over 95% of total**). **Agriculture, forestry, and land use**; **industrial process and refrigerants**; and **waste** are non-fossil fuel emissions. Although all building energy emissions are from fossil fuels, that does not mean that all building electricity is from fossil fuel sources. Electricity generated from zero carbon sources, such as hydropower, does not contribute to the county's emissions; biofuels, such as R-99 and biodiesel, contribute minimal emissions.

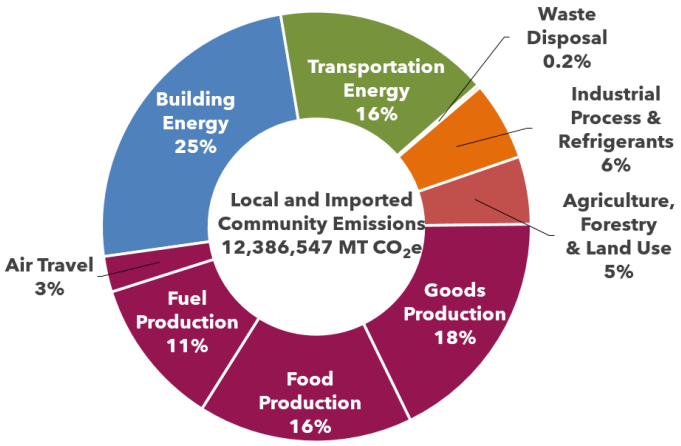
[4] Data from World Bank. For details, visit https://data.worldbank.org/indicator/EN.ATM.CO2E.PC.
[5] U.S. EPA GHG Equivalencies Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Figure 4: 2022 Local Community Emissions and Fossil Fuels Details



Imported Emissions

Figure 5: Imported and Local Emissions



In addition to accounting for local emissions, the inventory also estimates **imported (consumption-based) emissions**, which are generated outside of Washington County to produce and provide the imported **goods, food, services, air travel,** and **production and transport of fuels** consumed by local households. Imported emissions total over **5.9 million MT CO_2e** in addition to sources of local emissions. This quantity of GHGs is equivalent to the carbon sequestered by over 7 million acres of average U.S. forest,[6] an area 37 times the size of the Crater Lake National Park. **Error! Reference source not found.** compares the scale of local, sector-based emissions to imported emissions from household consumption. Within **goods**, the largest purchasing categories include **vehicles & parts, appliances**, and **construction materials.** Within **food**, the largest emissions are from the **production of meats**, particularly **beef** products.

Upstream emissions from **fuel production** (gasoline, diesel, electricity, and natural gas) and **air travel** from flights taken by residents (regardless of airport location) are also significant sources of consumption-based emissions.

[6] U.S. EPA GHG Equivalencies Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

Total Emissions

Local and imported emissions combine for a total of nearly **12.5 million MT CO_2e**, or **20.3 MT CO_2e per resident.** This quantity of GHGs is roughly equivalent to the carbon sequestered by about 16 million acres of average U.S. forest, an area roughly 23% of the size of Oregon.[7] There are net **negative emissions** sources as well, from local carbon storage and voluntary purchase of **carbon offsets** from Northwest Natural Gas customers (**over 40,000 MT CO_2e**). Note that the net benefit from Portland General Electric (PGE) customers' purchase of Renewable Energy Certificates (RECs) is already accounted for in the building energy sector (market-based accounting) and reduced emissions by approximately **1 million MT CO_2e.**

Figure 6: Washington County's 2022 Emissions Sources and Offsets

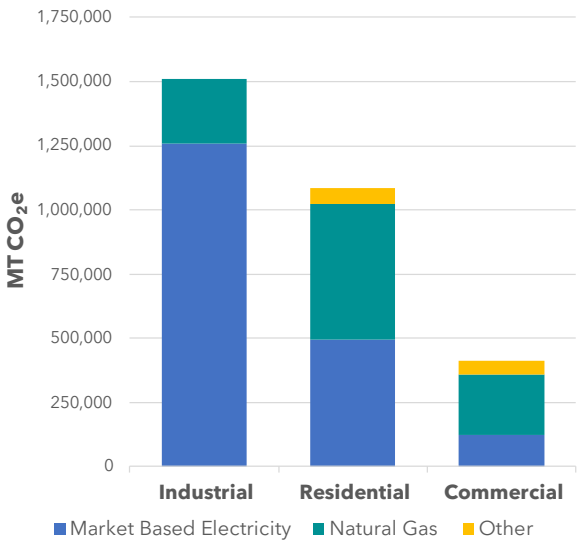
[7] National Park Foundation: https://www.nationalparks.org/connect/explore-parks/crater-lake-national-park.

Inventory Highlights

Building Energy

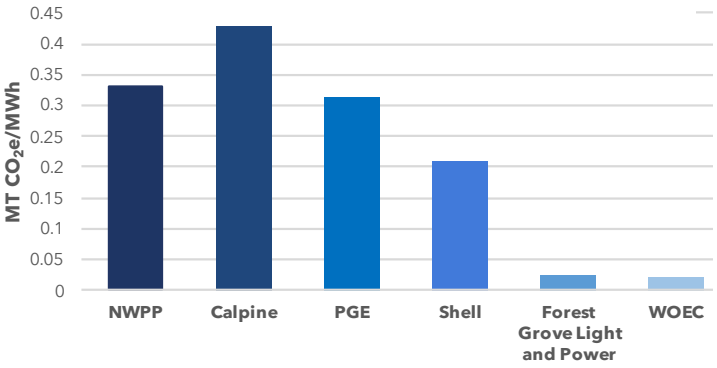
Energy used in buildings is Washington County's largest source of local GHG emissions, accounting for **47%** of local emissions. These emissions come from a mix of electricity, natural gas use, and other stationary combusted fuels, and they result in over **3 million MT CO_2e**.[8] (See Appendix D: Summary of Data and Emissions Factors for more detailed methodology.) By energy type, electricity had the largest impact (62% of total building emissions); followed by natural gas (34%); and other fuels (4%). Figure 7 shows emissions by sub-sector and energy type. Fugitive natural gas escaping from local distribution systems was reported by Northwest Natural Gas and accounts for 0.5% of total building emissions. Emissions from electricity usage for wastewater processing, irrigation, and drinking water were included in the inventory but excluded from Figure 7, as they account for less than 1% of total building energy emissions.

Figure 7: Building Energy Emissions



Portland General Electric, West Oregon Electric Co-op (WOEC), Forest Grove Light & Power, Calpine, and Shell all supply electricity to the Washington County community and industries. Each electric utility has its own specific emissions factor (MT CO_2e emitted per kilowatt-hour [kWh] of electricity) which is dependent on the utility's power generation supply contracts. Figure 8 contrasts the average emissions factor for the region (Northwest Power Pool [NWPP]) with utility-specific emissions factors for Calpine, PGE, Shell, Forest Grove Light and Power, and WOEC. The emissions factors for WOEC and Forest Grove Light and Power are considerably lower than the other providers because they are consumer-owned utilities, which gives them privileged access to

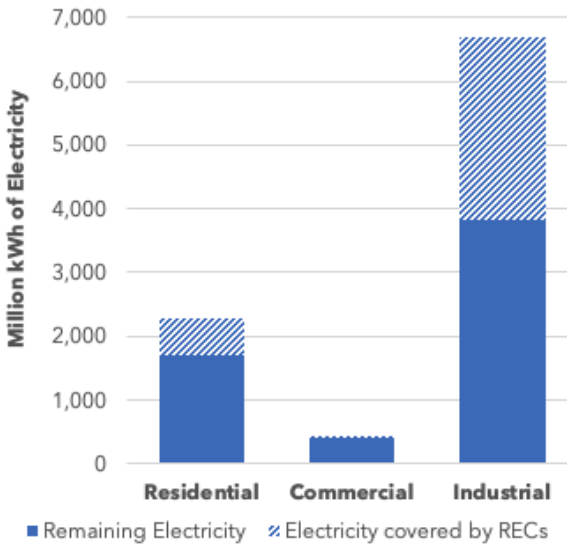
Figure 8: Electricity Emissions Factors



[8] All emissions estimates use market-based accounting for electricity unless otherwise noted. Market-based electric accounting totals **3,042,077 MT CO_2e**, while location-based accounting totals **3,891,311 MT CO_2e**. See Appendix C: Electricity for information about market-based versus location-based accounting.

Bonneville Power Administration-provided hydropower, which is low in emissions. PGE, Calpine, and Shell are investor-owned and use more fossil fuels to meet their demand. In 2021, PGE's emissions factor was 0.315 MT CO_2e per megawatt-hour, a 25% decrease since 2019, meaning that the emissions intensity of electricity generation decreased over time. Note that emissions intensity factors go up and down year-to-year depending on things like consumer demand and maintenance on power plants. The market-based electricity accounting method uses utility-specific factors and accounts for voluntary community participation in utility-sponsored green power programs.

Figure 9: REC Purchases by Sub-Sector



In 2022, PGE's residential, commercial, and industrial customers in Washington County purchased renewable energy in the form of Renewable Energy Certificates equal to about 37% of demand, which decreased market-based electricity accounting emissions by nearly **1.1 million MT CO_2e** (Figure 9). Most of these RECs were purchased by large industrial users.

Transportation

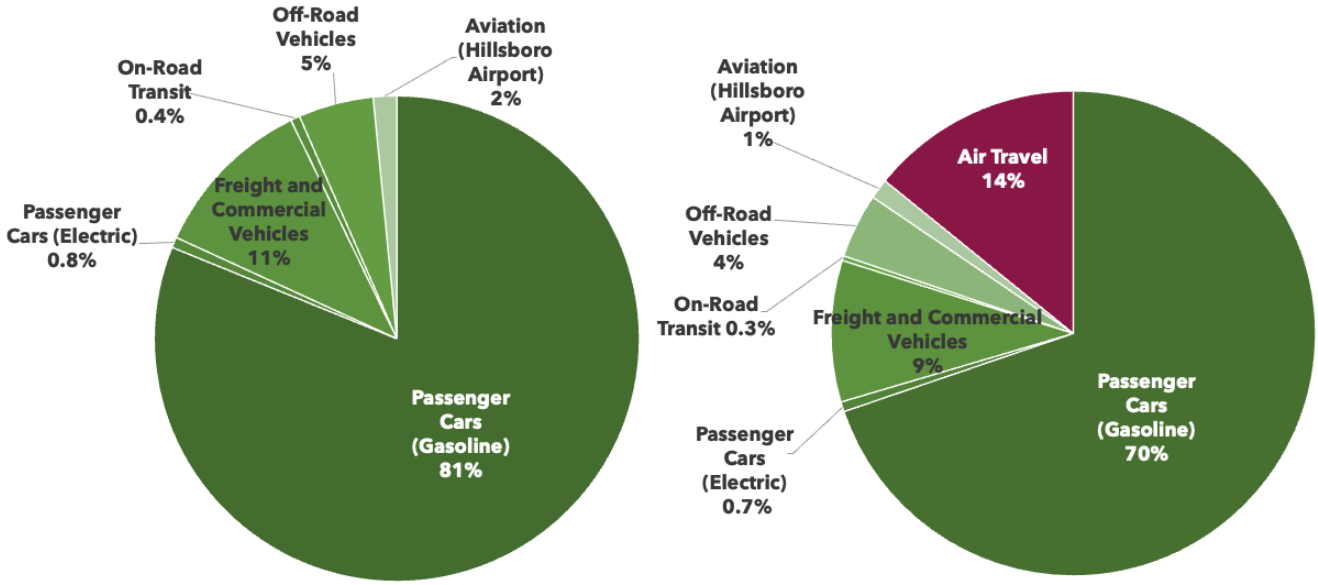
Transportation emissions are the second-largest source of local emissions for Washington County, totaling over **2 million MT CO_2e (31%)**. *See Appendix D*: Summary of Data and Emissions Factors for more information on transportation emissions data sources and reporting accuracy. On-road passenger vehicles were the leading source of local transportation emissions and are responsible for **81%** of local transportation emissions. These emissions originate from fossil gasoline sales, primarily used by private-use cars and trucks, but also include a small percentage of non-road uses, such as small boats. This category also includes the small amount of electricity used by electric vehicles (**<1%**). The next-largest category is fossil diesel sales, primarily used by freight and commercial vehicles at **11%**; most of these emissions are expected to be from on-road vehicles but may also include non-road equipment. Off-road fuel sales were included in this inventory, which included the purchase of propane and diesel and accounted for **5%** of total emissions. Hillsboro Airport is within the Washington County boundary, and jet fuel sales for aviation accounted for **2%** of transportation emissions. Additionally, emissions from TriMet's public transit services were estimated to be less than **1%**. See Figure 10 (next page).

In addition to the Hillsboro Airport fuel usage, which is mostly for noncommercial travel, many residents travel by airplane, whether within the Washington County boundary or not, and air travel is part of the community's **consumption-based emissions**. As is shown in Figure 10, emissions from air travel (**magenta**) are a significant source of emissions in addition to local

transportation emissions (**green**). Consumption-based air travel emissions are estimated at about **330,000 MT CO_2e**. See Appendix D: Summary of Data and Emissions Factors for more information on air travel data sources and reporting accuracy.

Figure 10: Transportation Emissions Breakdown

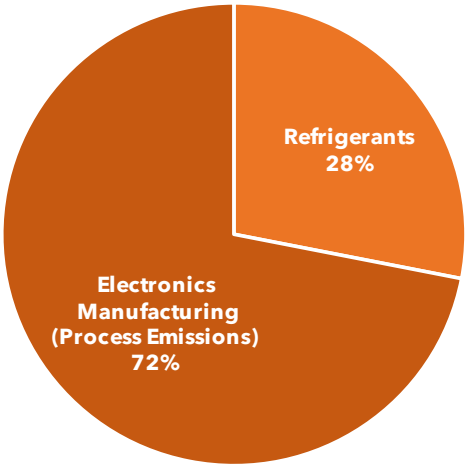
Left: Washington County's transportation emissions, excluding air travel.
Right: Washington County's transportation emissions, including imported emissions from air travel.



Industrial Process and Product Use

Industrial Process and Product Use (IPPU) emissions are the third-largest source of emissions at **734,000 MT CO_2e (11%)**. IPPU emissions are non-energy sources of fugitive emissions from unintentional leaks or discharges of gases and vapors from pressurized equipment or facilities. They come from specialized industrial processes or refrigeration systems—chlorofluorocarbons (CFCs), HFCs, PFCs, SF_6, NF_3—and have a large climate impact, up to 23,500 times the global warming potential of an equivalent weight of CO_2 depending on the gas.

Figure 11: IPPU Emissions



Fugitive loss of refrigerants from residential and commercial buildings and vehicle air conditioning and refrigeration equipment are a smaller proportion of Washington County's IPPU emissions. These sources are estimated for Washington County using state per capita data, downscaling from emissions reported in the State of Oregon's 2015 GHG inventory and are estimated to be over **200,000 MT CO_2e**. Within the State of Oregon, sources of residential, commercial, and transportation

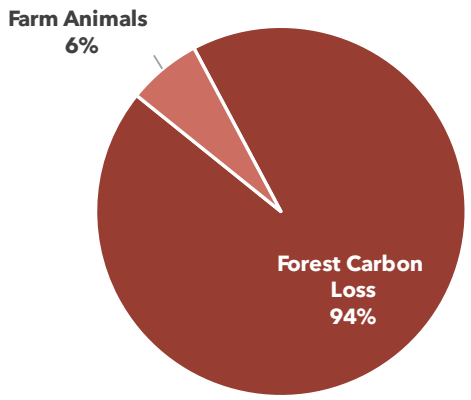
refrigerant emissions (in the Department of Environmental Quality's inventory as High Global Warming Potential [HGWP] gases) have grown by 21% since 2009.[9]

Industrial process emissions (excluding energy use) were identified for five different electronics manufacturing facilities within Washington County using the Oregon Department of Environmental Quality (DEQ) reported greenhouse gas emissions for facilities with air quality permits.[10] These emissions total roughly **525,000 MT CO_2e**[11] for 2022. See Appendix D for more information on industrial process and refrigerants data sources and reporting accuracy.

Agriculture, Forestry, and Land Use

Agriculture, forestry, and land use emitted a total of about **630,000 MT CO_2e**. As shown in Figure 12, the largest contribution to agriculture, forestry, and land use (AFLU) emissions was from forest loss as estimated by satellite analysis, which includes an estimate of land use change. Forest carbon loss/land use change emissions totaled **590,000 MT CO_2e** per year. This figure is calculated as an average over a 21-year window.

Figure 12: AFLU Emissions



During deforestation activities, carbon stored in trees is released into the atmosphere, contributing to climate change. Although these trees will eventually grow back with proper forestry practices, it will take decades for the forests to grow enough to draw that carbon back out of the air. In the meantime, those GHGs are in the atmosphere causing climate damage.

In addition, activities that convert greenspace into developed land can be a large contributor to emissions, especially in a rapidly growing area. The loss of trees is the overwhelming contributor to such emissions (especially in the Pacific Northwest), so the change in forest cover also captures land use change emissions.

Agricultural emissions, specifically methane emissions from livestock, total approximately **40,000 MT CO_2e**. A wide variety of livestock are raised within the county, and these emissions come from enteric fermentation by ruminant animals and manure management.

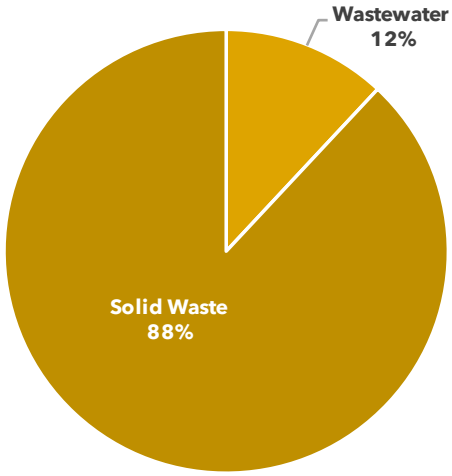
The application of nitrogen fertilizer to farm fields is also expected to be a small source of emissions, but this was excluded as data is not available.

[9] Oregon Greenhouse Gas Sector-Based Inventory: https://www.oregon.gov/deq/aq/programs/Pages/GHG-Inventory.aspx.
[10] Available at https://www.oregon.gov/deq/aq/programs/Pages/GHG-Emissions.aspx.
[11] These facilities are monitored by EPA's Facility Level Information on GreenHouse Gases Tool (FLIGHT) and/or Oregon's DEQ due to the significant climate impacts. EPA's FLIGHT database values will vary from this analysis, as the online tool uses Intergovernmental Panel on Climate Change (IPCC) AR4 global warming potential (GWP) values, and this GHG Inventory uses updated IPCC AR5 GWP values in line with the most recent science. Oregon DEQ also reports AR4 GWP values, but individual gas data was not available to convert into AR5 GWP value totals. Applicable industrial process emissions data for Microchip Technology and ON Semiconductor was calculated from EPA FLIGHT. Applicable industrial process emissions data for Owens Corning Corp. was requested from Oregon DEQ. Building energy was excluded.

Solid Waste & Wastewater

Solid Waste and Wastewater emissions total approximately **30,000 MT CO_2e**, less than 1% of local emissions. Figure 13 illustrates the breakdown of emissions from both solid waste and wastewater.

Figure 13: Solid Waste and Wastewater Emissions



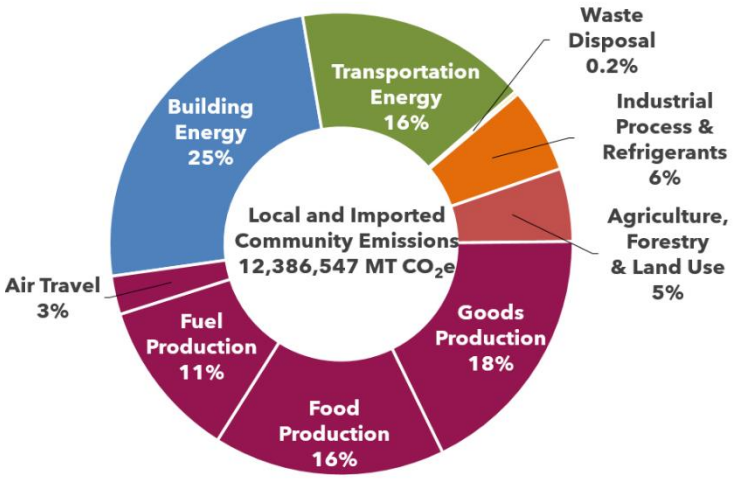
Washington County's haulers send landfilled waste to Columbia Ridge Landfill (Eastern Oregon), Wasco Landfill (Eastern Oregon), and Coffin Butte Landfill (Western Oregon). These landfill emissions are estimated to total roughly **26,000 MT CO_2e**.

Wastewater is processed by Clean Water Services and is included in the analysis. Additionally, there are an estimated 3,000 septic systems within the county. Total wastewater process emissions (including septic) are estimated to total **about 3,600 MT CO_2e**. See Appendix D for more information on data sources and reporting accuracy related to solid waste and wastewater treatment.

Imported Emissions: Consumption of Goods, Food, Fuel, and Air Travel

Washington County's inventory goes beyond GPC protocol requirements to highlight the known large sources of **imported emissions** from consumption activities. These emissions are considered Other Scope 3 in GPC protocol. These consumption-based emissions will be in another community's local accounting. This means that the community has less control over these emissions compared with sources of local emissions. That said, these emissions are included in the inventory because they are large, they are caused by local demand, the inventory follows State of Oregon inventory practices, and opportunities exist to reduce these emissions locally by reducing consumption. These emissions were estimated at nearly **6 million MT CO_2e** and make up **48% of total emissions** (Figure 14). See Appendix D for more information on sources

Figure 14: 2022 Community Local + Imported Emissions



and reporting accuracy for imported emissions, including goods, food, services, and upstream fuel production.

Consumption of imported **goods** is the largest source for Washington County's imported emissions at **16% of imported emissions**. The largest contributors to this category **include building materials, vehicle parts,** and **furnishings and supplies**. The next-largest category is **food** and beverage, where the largest emissions are from **meat**, especially **beef** products. Upstream **fuel production**, specifically gasoline production, is another large source, which goes hand in hand with passenger transportation being a large local emissions source. **Air travel** is also a significant source of Washington County's consumption-based emissions. Note that these air travel emissions are from air travel trips taken by residents regardless of airport location and are not based on Hillsboro or Portland airport fuel use alone.

Category Descriptions

- **Goods:** Emissions from extraction, manufacture, and transport of raw materials into final products such as building materials, automobile, furniture, clothing, and other goods.
- **Food & Beverage:** Emissions from agriculture (energy for irrigation, production of fertilizers, methane emissions from livestock, etc.), transportation of raw materials, and finished products emissions. Categories include produce, cereals, dairy, meat, and other foods.
- **Upstream Fuel Production:** Process and energy emissions from the extraction and production of usable fuel products (electricity from household outlets, gasoline pumped into cars, natural gas combusted by furnaces, etc.). These upstream emissions are considered at the community scale for electricity, natural gas, gasoline, and diesel (not available for propane and fuel oil). These emissions are separate from those that are generated when the fuel is used in your car or house.
- **Air Travel:** Emissions associated with air travel by the community (regardless of the airport's location).

Figure 15 on the following page gives a full categorical breakdown of all emissions.

Negative Emissions

Negative emissions are from carbon offsets purchased by natural gas consumers. Less than 1% of the natural gas used in Washington County is offset by community members who participate in Northwest Natural's Smart Energy Offsets program (**42,340 MT CO_2e**). This program allows customers to purchase carbon offsets from The Climate Trust on their bill to offset emissions from their natural gas use. See Appendix D for more information on carbon offset data sources and reporting accuracy.

Figure 15: Full Breakdown of Emissions Categories

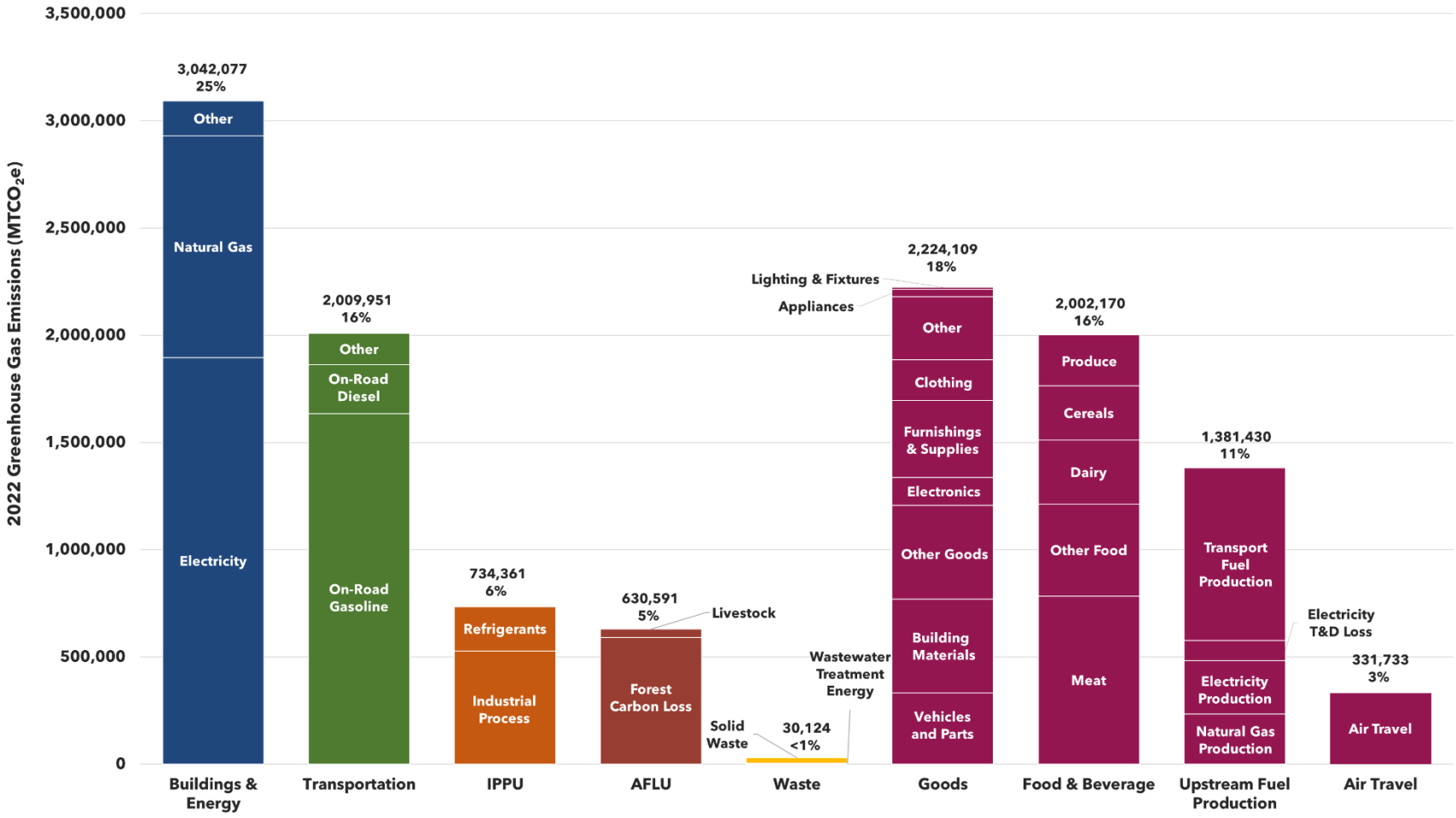


Table 3: Detailed Emissions Breakdown

Emissions Sector / Sub-Sector	2022 Emissions		Per capita	
	Market-based	Location-based	Market-based	Location-based
Stationary Energy	**3,042,077**	**3,891,311**	**5.0**	**6.4**
Residential Buildings				
Electricity	495,653	663,374	0.8	1.1
Natural Gas	525,752		0.9	
Other Fuels	51,763		0.1	
Commercial Buildings				
Electricity	121,967	123,064	0.2	0.2
Natural Gas	254,472		0.4	
Other Fuels	64,819		0.1	
Industrial Facilities				
Electricity	1,246,564	1,928,040	2.0	3.2
Natural Gas	252,369		0.4	
Irrigation	0.2	3	0.0000004	
Potable Water Treatment	1,387	1,275	0.002	0.002
Wastewater Treatment	11,763	10,813	0.02	0.02
Fugitive Emissions from Natural Gas Systems	15,567		0.03	
Transportation	**2,009,951**	**2,013,747**	**3.3**	**3.3**
On-Road Passenger Vehicles (Gasoline)	1,633,875		2.7	
On-Road Passenger Vehicles (Electric)	15,426	14,179	0.03	0.02
On-Road Freight & Commercial Vehicles (Diesel)	220,948		0.4	
On-Road Transit Vehicles	7,306	12,349	0.01	
Off-Road Vehicles and Equipment	101,016		0.2	
Local Aviation (Hillsboro Airport)	31,379		0.1	
Agriculture, Forestry, and Land Use	**630,591**		**1.0**	
Forestry & Land Use	590,000		1.0	
Livestock	40,591		0.1	
Other Agriculture	NE			
Industrial Process and Product Use	**734,361**		**1.2**	
Industrial Processes (Electronics Manufacturing)	528,192		0.9	
Refrigerants	206,169		0.3	
Waste & Wastewater	**30,124**		**0.05**	
Solid Waste Landfill	22,207		0.04	
Compost	4,317		0.01	
Wastewater Treatment & Septic Systems	3,600		0.01	
Incineration of Waste	0.2		0.0	
Consumption-based & Upstream Emissions	**5,939,442**	**6,077,777**	**9.7**	**10.0**
Household Consumption				
Goods	2,224,109		3.7	
Food	2,002,170		3.3	
Upstream Energy Emissions	1,381,430	1,519,765	2.3	2.5
Air Travel	331,733		0.5	
Negative Emissions (Sequestration & Offsets)	**1,192,340**		**2.0**	
Local Carbon Storage	1,150,000		1.9	
Purchased Offsets	42,340		0.1	
Local Emissions	6,447,104	7,300,135	10.6	12.0
Local + Consumption	12,386,547	13,377,912	20.3	22.0

*For an explanation of market versus location-based accounting see Appendix C: Electricity.

Appendix B: Glossary of Terms

Carbon (or GHG) footprint

Total emissions of greenhouse gases that are directly and indirectly released in the atmosphere each year by a given activity, which can be of an individual, a community, an organization, a process, a product or service, or an event, among other things. It is usually measured in tons of CO_2e (carbon dioxide equivalent).

Climate Action Plan (CAP)

A comprehensive response to climate change tailored to local circumstances that includes a GHG inventory, goals for emissions reduction, and feasible strategies for action. It is a road map for making informed decisions and understanding how to achieve the most impactful and cost-effective greenhouse gas reductions in alignment with the organizational mission.

Climate Change

A change in global or regional climate patterns in particular a change apparent from the mid- to late 20th century onward and attributed largely to the increased levels of atmospheric carbon dioxide (CO_2) produced by the use of fossil fuels.

CO_2

Short for carbon dioxide. CO_2 is the most common and abundant greenhouse gas, and it is produced in large amounts when fossil fuels are burned.

Fugitive Emissions

Unintentional emission, leakage, or discharge of gases from pressure-containing equipment or facilities and components, such as valves, piping flanges, pumps, storage tanks, etc.

Fossil Fuels

Combustible material obtained from below ground and formed during a geological event. Of particular importance to climate change are coal, oil, and natural gas.

GHG

Short for greenhouse gases. Emission of greenhouse gases are the cause of current climate change. An inventory of GHGs measures gases in units of carbon dioxide equivalents (CO_2e). A GHG inventory is also known as a carbon footprint.

GHGP/GPC/Protocol

This type of inventory follows a set protocol, the GHG Protocol (GHGP) standard for cities and communities known as Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). This protocol determines what is included within a set boundary and categorizes emissions by sector. See Sector-Based Inventory for more information.

GWP

Short for global warming potential. This refers to the potency of emissions to trap heat in the atmosphere. Carbon dioxide has a GWP of 1, and other GHG gases are more potent and expressed as a multiple of carbon dioxide. For example, methane has a GWP of 28, meaning one molecule has 28 times the effect of one molecule of carbon dioxide (IPCC AR5 values).

Imported, Consumption-Based Emissions (Other Scope 3)

Emissions from consumption of imported goods and services, also known as Other Scope 3 Emissions per GPC protocol, include emissions from upstream fuel production and household consumption, such as food, household goods, and air travel.

IPCC AR5

The United Nations Intergovernmental Panel on Climate Change (IPCC) releases assessment reports every few years providing an overview of the state of knowledge concerning climate change science. The fifth report, AR5, was released in 2014. The sixth report (AR6) was released in 2023, but the new values have not yet been widely adopted.

kWh

Short for kilowatt hour. Kilowatt hours are a standard unit for electricity consumption and a measure of electrical energy equivalent to a power consumption of 1,000 watts for 1 hour. For example, a 50-inch LED TV uses about 0.016 kWh per hour. It would take roughly 62.5 hours for this TV to use 1 kWh of energy.[12]

Local Emissions (Sector-Based) Greenhouse Gas Inventory

This refers to an inventory that is broken down by various sectors of the community that have common GHG characteristics. This type of inventory follows a set protocol (GPC) determining what is included in each sector. It is referred to as sector-based emissions in protocol but called **local emissions** here for clarity. Mainly, sector-based emissions include emissions from building energy and vehicles, along with local sources of GHGs from waste, uncontrolled loss of industrial and refrigerant gases, and agriculture. Note that emissions from household consumption of goods and services are not included in sector-based inventories. Standard emissions included in a sector-based inventory include:

- **Building Energy:** Emissions from energy used or produced in a fixed location (e.g., electricity, natural gas, propane, and fuel oil). The GPC term is stationary energy.
- **Transportation:** Emissions from vehicles and mobile equipment.
- **Waste:** Landfilled waste emissions and wastewater treatment emissions.
- **Process Emissions & Product Use:** Refrigerants and other fugitive gases from industrial processes.
- **Agriculture, Forestry & Land Use:** emissions from agriculture (e.g., animal waste and agricultural inputs) and community land use change (e.g., development of forest or grasslands).

[12] Electricity Plans: https://electricityplans.com/kwh-kilowatt-hour-can-power/#:~:text=Here%20are%20some%20of%20the,around%202.3%20kWh%20per%20hour.

Location-Based Electricity Emissions Accounting

Refers to GHG intensity of the regional electricity grid, representing the average impacts of electricity use and efficiency efforts across the region. Contrast with market-based electricity emissions accounting as defined in the Electricity section in Appendix B.

Market-Based Electricity Emissions Accounting

Refers to the GHG intensity of electricity contracts with local utilities and direct purchases, including renewables. Contrast with location-based electricity emissions accounting as defined in the Electricity section in Appendix B.

MT

Short for metric ton (~2,200 lbs.). This is a common unit by international standards.

MT CO_2e

Metric tons of carbon dioxide equivalent. Most greenhouse gases are more potent than carbon dioxide in warming the atmosphere. To calculate and compare emissions easily, all gases are calculated and combined into a carbon dioxide equivalent, typically measured in metric tons.

Scope (as in Scope 1, Scope 2, Scope 3)

Scopes are one method to define the source of emissions. Scope categories distinguish between emissions that occur within a geographic boundary (Scope 1) from electricity generation serving the community (Scope 2) and emissions that occur outside the boundary but that are driven by activity within the boundary (Scope 3).

Therm

Common reporting unit of natural gas that represents 100,000 British thermal units. A therm is roughly equivalent to 100 cubic feet of natural gas.

Appendix C: Methodology & Protocols

Protocols and Tools

This inventory follows Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories by Greenhouse Gas Protocol (GHGP). This inventory also follows GHGP's Scope 2 Guidance for location-based and market-based electricity accounting emissions and ICLEI's U.S. Community Protocol for guidance on calculation of consumption-based emissions (i.e., other Scope 3 as defined by GPC protocol).

Good Company's carbon calculator tool *G3C – Community* was used for emissions calculations. Emissions are documented in the Inventory Audit Trail. G3C – Community is an Excel-based calculator that documents all activity data, emissions factors, and emissions calculations used in the inventory. The audit trail catalogs all data, calculation, and resource files used to complete the inventory. These resources are highly detailed and will allow for those conducting future inventories to fully understand and replicate the methods used in this inventory.

GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent (MT CO_2e). The gases considered in the analysis are consistent with protocol and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), and perfluorocarbons (PFCs) per the Kyoto Protocol (sulfur hexafluoride [SF_6] was not applicable). All GHG calculations use 100-year global warming potentials (GWP) as defined in the International Panel on Climate Change's 5th Assessment Report (IPCC AR5).

Data Collection

Project staff worked with Washington County's staff to collect the data required to calculate emissions. Washington County's staff, along with other local and regional government staff and private entities that serve the community, graciously provided time, data, and expertise. Data and emissions factors are described in Appendix D: Summary of Data and Emissions Factors.

Inventory Exclusions

Table 4: Summary of Inventory Exclusions

Emissions Sector/ Sub-Sector	Key	Justification for Exclusion
Building energy: Energy Generation Supplied to the Grid	NO	Although there is a substantial amount of solar energy produced within the county, this is generally "net metered". This means that the energy produced by private solar panels gets subtracted from the overall volume of power supplied. There is no other substantial generation of electricity, such as a power plant.
Building energy: Fugitive emissions from Coal Production	NO	No activity identified within Washington County's geographic boundary.
Building energy: Agriculture,	NE/IE	Electricity and natural gas use emissions are included elsewhere, likely in industrial energy use with no additional splits available.

Emissions Sector/ Sub-Sector	Key	Justification for Exclusion
Forestry, and Fishing		Other sources such as propane and fuel oil are downscaled from state data on a per capita basis and may be included in commercial uses, or possibly off-road transportation fuels based on comprehensive survey work. This data is likely included elsewhere, but if not, is not additionally estimated due to lack of data sources.
Transportation: Rail	NE/IE	A section of freight rail is located within the boundary, but it is not a high-volume rail. The emissions associated with this are expected to be insignificant and because there are no freight stops within the community, this can be excluded by protocol. Additionally, all transportation emissions except transit are based on fuel sales methodology. Following this methodology there would be no rail emissions to report as there are no fueling depots located in the boundary. TriMet light rail is located inside Washington County. The community's share of transit emissions, including the Westside Express Service (WES) rail, are included in on-road transit emissions.
Transportation: Waterborne navigation	NO	Any fuel use for small craft (such as fishing boats) is expected to be insignificant and likely to be included in transportation fuel sales.
Agriculture, Forestry, and Land Use: Agriculture	NO/NE	Data for nitrogen fertilizers used in agriculture is not available but is expected to be insignificant compared to livestock emissions due to the Oregon agricultural context.
Agriculture, Forestry, and Land Use: Forestry, and Land Use	IE/not split	This data was not available split by forestry and deforestation (land use change) and is presented as a combined emissions source.
NE = Emissions occur but are not reported or estimated. IE = Included elsewhere as part of another data set where a split is not available. NO = Activity or process does not occur within boundary.		

Electricity

Activity data was collected from Portland General Electric, West Oregon Electric Cooperative, Forest Grove Light & Power, Calpine, and Shell. Data was collected directly from the utility, including percentage of RECs purchased. Data provided was split by residential, commercial, and industrial.

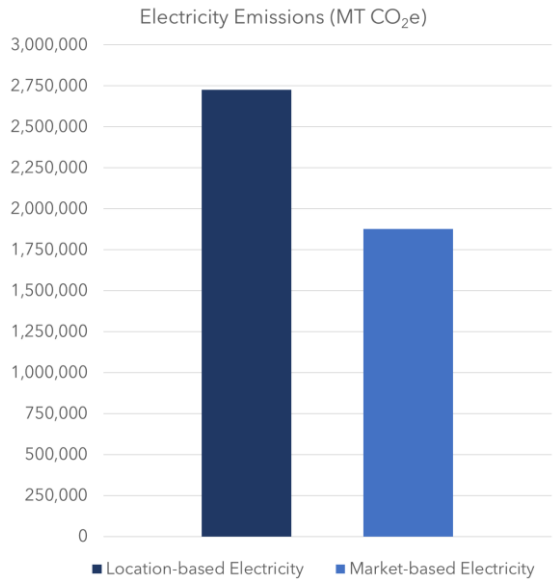
The community inventory protocol (GPC) and Scope 2 guidance requires that communities report electricity emissions using two accounting methods: location-based and market-based.[13] **Market-based accounting** is based on the GHG intensity of electricity contracts with local utilities and is used in most of the figures presented in this report as the GPC protocols recommended methodology to track progress toward goals over time. **Location-based electricity accounting emissions** are calculated using the regional electricity grid's

[13] For details, visit http://www.ghgprotocol.org/scope_2_guidance.

(Northwest Power Pool) GHG intensity and represent the average impacts of electricity use and efficiency efforts.

- **Location-based method** (or regional grid) multiplies an organization's electricity use by the average emissions intensity of a specific regional electricity grid that is published by the Environmental Protection Agency (eGRID 2021). Note that over time, there may be differences in emissions results for inventory years due to the use of an updated eGRID emissions factor (typically released every 1 to 2 years). Location-based electricity accounting offers a means of assessing the average impacts of electricity use on the regional electricity grid.

Figure 16: Electricity Emissions Using Both Accounting Methods



- **Market-based method** (or utility-specific) represents emissions specific to the utility and considers community purchase of Renewable Energy Certificates. Market-based electricity accounting is commonly used for target and goal tracking and is useful to assess and manage GHGs associated with electricity generation and supply. It also highlights benefits for energy-efficiency actions, particularly in communities served by utilities with very low GHG electricity. That is, the less electricity used in the community, the more low-GHG electricity there is available for export to communities with more GHG-intensive electricity sources.

Appendix D: Summary of Data and Emissions Factors

Emissions Category	Category Description
Building Energy (Stationary Energy in GPC Protocol)	
Residential Energy	*These categories include direct emissions from natural gas, fuel oil, and propane combustion by the residential, commercial, and industrial sub-sectors within the geographic boundary. They also include the emissions from grid electricity used by the same sub-sectors for the same geographic boundary.*
Commercial Energy	
Industrial Energy	
Electricity and natural gas data provided by Portland General Electric, Northwest Natural Gas, Forest Grove Light & Power, West Oregon Electric Co-op, Calpine, Shell Energy, and CMS Energy Advisors. Electricity and natural gas data included information on retail sales, transported gas, and participation in renewable electricity and carbon offset programs. In addition, there were roughly 2.5 billion kWh of third-party Renewable Energy Certificates purchased by large industrial users. These Renewable Energy Certificates are still counted as a credit toward their electricity usage even if they are not purchased through their actual electricity supplier, as the credit owners are local. Residential and commercial fuel oil and propane use was estimated using state-level per capita 2019 fuel usage data downscaled by Washington County's 2022 population. Emissions factors for natural gas, fuel oil, and propane are from U.S. EPA's emissions factors hub and The Climate Registry's 2018 default emissions factors and are considered highly accurate. Location-based electricity emissions factors are taken from EPA eGRID 2021 data for the Northwest Power Pool (NWPP) sub-region. Market-based electricity accounting emissions factors for electric utilities are taken from Oregon Department of Environmental Quality's report titled, *2010–2021 Greenhouse Gas Emissions from Electricity Use*, available online via the Department of Environmental Quality (DEQ). Utility data is considered highly accurate; non-utility data (e.g., fuel oil and propane) is considered to have medium accuracy.	
Fugitive Natural Gas System Emissions	*Fugitive loss of natural gas from the local product distribution system.*
Northwest Natural Gas (NWN) reported a 0.08% system leakage rate. Note that the NWN-reported rate is lower than the protocol default proxy value of 0.3%. This data is considered highly accurate.	
Transportation	
On-Road Energy	*Direct emissions from gasoline and diesel for passenger & freight transportation.*
Fuel sales data for gasoline blends, diesel blends, propane, and compressed natural gas (CNG) was provided by the ODOT Fuels Tax Group. It quantifies the total volume of fuel sold within the jurisdiction. This data is considered highly accurate. This is following the fuel sales	

methodology from the GPC. It has the advantage of being inexpensive to collect and easy to compare across years. An estimate of vehicle miles traveled (VMT), not used for GHG estimation here, comes to 2.5 billion vehicle miles traveled per year, according to cell phone tracking done by Replica.	
Transit	*Direct emissions from gasoline and diesel (on-road) and electricity (light rail) for passenger transit transportation.*
Emissions data was collected from TriMet Transit District's Operational GHG inventory for fiscal year 2022. These emissions were estimated and downscaled by Washington County's service territory population to TriMet's service territory. Data received from TriMet is considered highly accurate; however, the estimate based on population is considered moderately accurate.	
Rail – Passenger & Freight	*Direct emissions from passenger and freight transportation within the geographic boundary.*
WES emissions are included in transit emissions. No Amtrak or other passenger rail activity occurring in the boundary. Not estimated: A section of freight rail is located within the boundary, but it is not a high-volume rail. The emissions associated with this are expected to be insignificant, and because there are no freight stops within the community, this can be excluded by protocol. Additionally, all transportation emissions except transit are based on fuel sales methodology. Following this methodology, there would be no rail emissions to report as there are no fueling depots located in the boundary.	
Off-Road	*Direct emissions from gasoline and diesel for off-road vehicles, such as construction equipment, etc.*
Fuel quantities for off-road use diesel was taken from Oregon DEQ's 2017 *Oregon Nonroad Diesel Equipment Survey and Emissions Inventory*. Although this is an older reference, it is more comprehensive and accurate than off-road diesel sales reporting, which is not taxed or reported in the same way as on-road diesel. This is considered to be of medium accuracy.	
Agriculture, Forestry, and Land Use	
Forestry	*Direct emissions from forestry activities, primarily the loss of trees to logging activities.*
Emissions from forestry were estimated using Global Forest Watch's satellite-based imaging. This service estimates the loss or gain of tree canopy over the last 21 years (from 2001 to 2022) and the uses regional climate data to estimate the annual average amount of forest carbon gained and lost. The method of comparing tree growth to tree loss as performed here is preferable because it fully accounts for all carbon fluxes. It is considered to be highly accurate, however it does not take into account the fate of harvested wood products.	

Agriculture	*Direct emissions from agricultural activities, primarily from the management of animal enteric fermentation and manure management.*
Activity data for livestock taken from USDA's 2017 census of agriculture for Washington County. Emissions factors (per head of livestock for various breeds) are taken from ICLEI's U.S. Community Protocol, Appendix G. Activity data is considered highly accurate but slightly dated.	
Waste	
Landfill Solid Waste	*Fugitive methane emissions from mixed solid waste generated in the community regardless of disposal location.*
Washington County has multiple destination landfills. For waste landfilled at Coffin Butte, Wasco, and Arlington landfills, or combusted at Covanta Waste-to-Energy, 2022 EPA-reported emissions were downscaled based on reported short tons from Washington County customers. This methodology follows IPCC's first order decay model and is designated by EPA as EE-6 calculations. This activity data is considered highly accurate.	
Wastewater Treatment Process Emissions	*Wastewater treatment plant biogas combustion, denitrification process, and fugitive nitrous oxide emissions from discharge of treated effluent (wastewater).*
Wastewater treatment plant process emissions for biogas combustion, and effluent discharge are calculated using data provided by Clean Water Services staff. For biogas combustion data included standard cubic feet per day of biogas and the percentage of methane in the biogas. Similarly, nitrogen effluent discharge data was provided by Clean Water Services. Emissions calculations for nitrification/denitrification are based on service population. This activity data is considered highly accurate.	
Septic Systems	*Direct emissions from the decomposition of biosolids (wastewater).*
Septic fugitive emissions were estimated based on service population data from Clean Water Services. They provide septic cleanout services and have a reasonable count of the number of septic systems in the county (county population subtracting service population). It is likely that there are septic systems not serviced by CWS, so this is an undercount of the total number of systems. This undercount is likely balanced by a slight double count of the number of sewage systems since the pumped septic tanks end up in the wastewater treatment system and are therefore partially included in the wastewater treatment data. This activity data is considered moderately accurate.	
Industrial Process & Process & Product	
Refrigerants (product use in GPC protocol)	*Fugitive loss of refrigerants and other high GWP gases from building and vehicle air conditioning systems.*

Fugitive refrigerant loss and other non-industrial high-GWP gas emissions are estimated using Oregon state-level data attributed to the community on a per capita basis. Activity data for state-level fugitive emissions from refrigerants, aerosols, and fire suppression systems is reported in the Oregon Department of Environmental Quality's Oregon Greenhouse Gas Inventory (as High Global Warming Potential [HGWP] sources) in quantities of CO_2e. Data used is from Oregon's GHG inventory and includes HGWPs for the residential and commercial and transportation sub-sector (industrial emissions are calculated separately; see Industrial Processes below). High-GWP gas emissions are estimated from State of Oregon totals and therefore are considered as having moderate accuracy.	
Industrial Processes	*Fugitive loss of industrial high-GWP gases from industrial processes. Stationary building emissions (fuel combustion, etc.) are not included and are part of Building Emissions.*
Seventeen applicable facilities inside the county boundary were identified by the EPA Facility Level Information on GreenHouse Gases Tool (FLIGHT) tool and/or Oregon DEQ's air quality monitoring reports. These industrial facilities are required to report significant air quality and/or climate emissions. Five of these had non-energy emissions. Building energy emissions do not apply. Oregon DEQ reports total emissions in CO_2e and does not list specific high-GWP gases or quantities, nor does it split between industrial process and building energy emissions. Oregon DEQ was contacted with a request for an industrial process split, which was provided. Emissions were reported using AR4 GWP values and were not possible to re-calculate using AR5 values. Other DEQ-reported facilities emitted either biogenic emissions or 100% building energy emissions and were not included. This data is considered highly accurate.	
Imported Emissions	
Goods	*Upstream energy and process emissions raw material extraction, manufacturing, and out-of-state transportation of goods.*
Food	*Upstream energy and process emissions from the growing, processing and transportation of foods.*
Services	*Upstream energy emissions from air travel by community members from all airports regardless of location.*
Accurate data on quantities and suppliers for the goods and food consumed by community households are not readily available. Therefore, the State of Oregon's 2015 consumption-based emissions inventory (CBEI) was used to estimate these sources of emissions. State of Oregon CBEI results were downscaled for Washington County using U.S. Census Bureau data on household income and number of households within various income brackets. Note that DEQ conducts the Oregon CBEI every 5 years; therefore, this methodology may not be used to estimate emissions on an annual basis. Emissions estimates were therefore adjusted	

for inflation and nationwide trends in spending between 2015 and 2019. Spending trends were taken from the Bureau of Labor Statistics.

Air travel is based on U.S. Census Data and Oregon's version of the UC Berkeley Household Cool Climate Calculator. Given the inventory year and given that data is estimated from a large and complicated economic model, this activity data is considered as having mid to low accuracy.

Upstream Fuel Production	*Upstream energy and process emission from the production and distribution of natural gas, gasoline, diesel, and electricity consumed either directly or indirectly by the community.*

Data for gasoline, diesel, natural gas, and electricity use is the same as previously described. Life-cycle emissions factors for the various fuel types are provided by Oregon Department of Environmental Quality's Clean Fuels program carbon intensity scores. Upstream fuel and energy emissions are calculated as the difference between direct tailpipe emissions (reported under Transportation) and total life-cycle emissions.

Activity data for electricity and natural gas is considered highly accurate, while transportation fuel use is considered moderately accurate because the precise feedstocks for biofuels sold within the community are not readily available. Upstream emissions can vary significantly for biofuels depending on feedstocks; therefore, calculated emissions are considered moderately accurate.

Negative Emissions	
Purchased Carbon Offsets	*Community purchase of verified carbon offsets.*

Carbon offsets purchased by Northwest Natural Gas account holders' participation in NWN's Clean Energy program were provided by the utility as therm-equivalents and MT CO_2e. This activity data is considered highly accurate.

Forest carbon gain was assessed by Global Forest Watch. This organization monitors changes in forest canopy cover globally and for a given boundary (Washington County) and can estimate the increases and decreases in forest canopy. This canopy change information is combined with climate data to estimate the carbon lost or gained by the trees. The data is estimated over the course of 20 years and reported as a yearly average rate of loss and gain. Note that this is the annual average additional carbon stored, which is separate from total carbon storage and is not part of GHG accounting.