



# Camas, Washington

Community Greenhouse Gas Inventory  
for Calendar Year 2022

July, 2024

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## Executive Summary

In 2023, Washington enacted House Bill 1181, amending the Growth Management Act to include a climate goal and mandating the inclusion of a "climate element" in local comprehensive plans. As part of this, the entirety of Clark County conducted a community greenhouse gas (GHG) inventory for their 2025 Comprehensive Plan Update. This inventory for Camas is part of this larger effort and will help set targets and strategies to reduce GHG emissions and decrease per capita vehicle miles traveled (VMT).

This inventory follows internationally recognized Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GCP) and accounts for all significant sources of GHG emissions driven by activities taking place within the City of Camas’s geographic boundary (local emissions). Beyond protocol requirements, the inventory also measures consumption-based emissions from imported goods and food, fuel, air travel, and the purchase of carbon offsets (imported emissions). Cama’s total 2022 emissions are summarized below in Figure 1.

## Summary of Findings


### City of Camas GHG Emissions

With a population of 27,250, all 2022 GHG emissions combined (local and imported) for City of Camas totaled

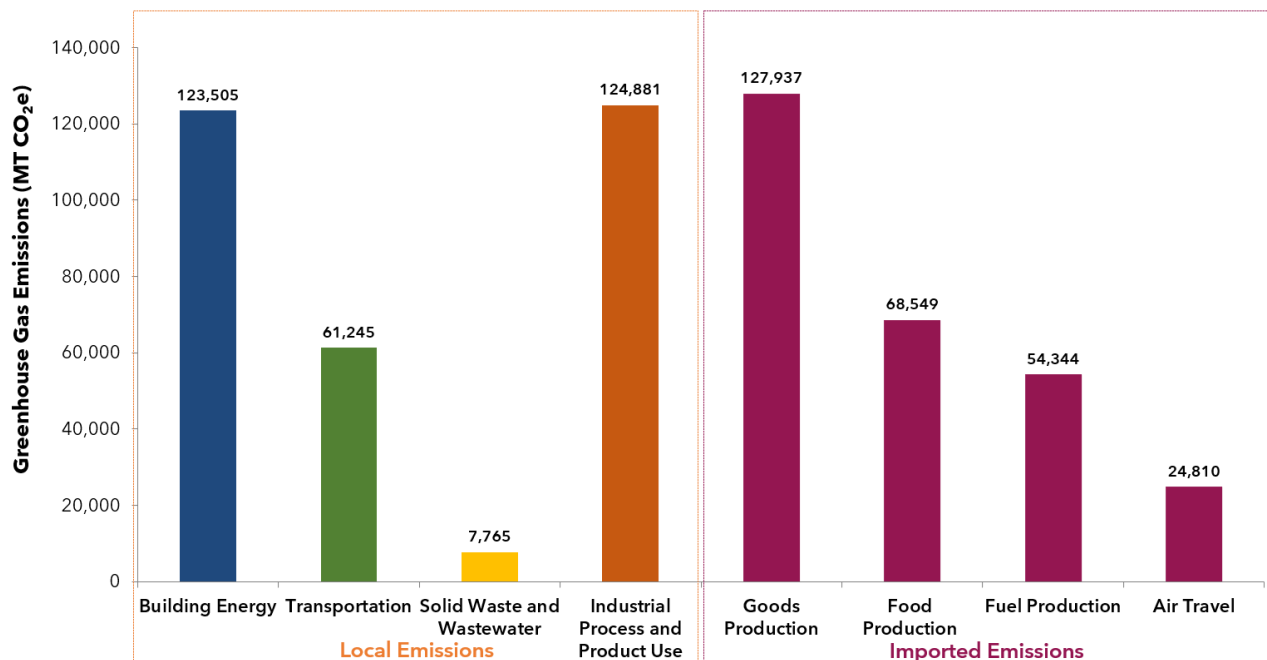
593,035 MT CO<sub>2</sub>e

21.8

MT CO<sub>2</sub>e  
Per Capita



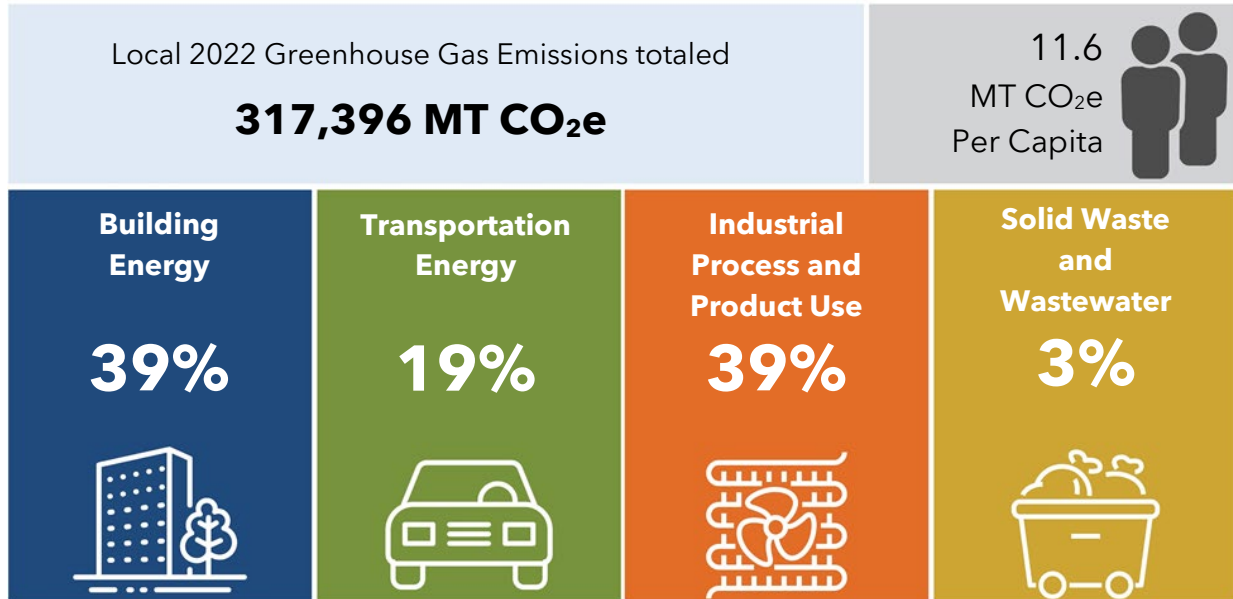
**Figure 1: Camas’s 2022 Emissions**





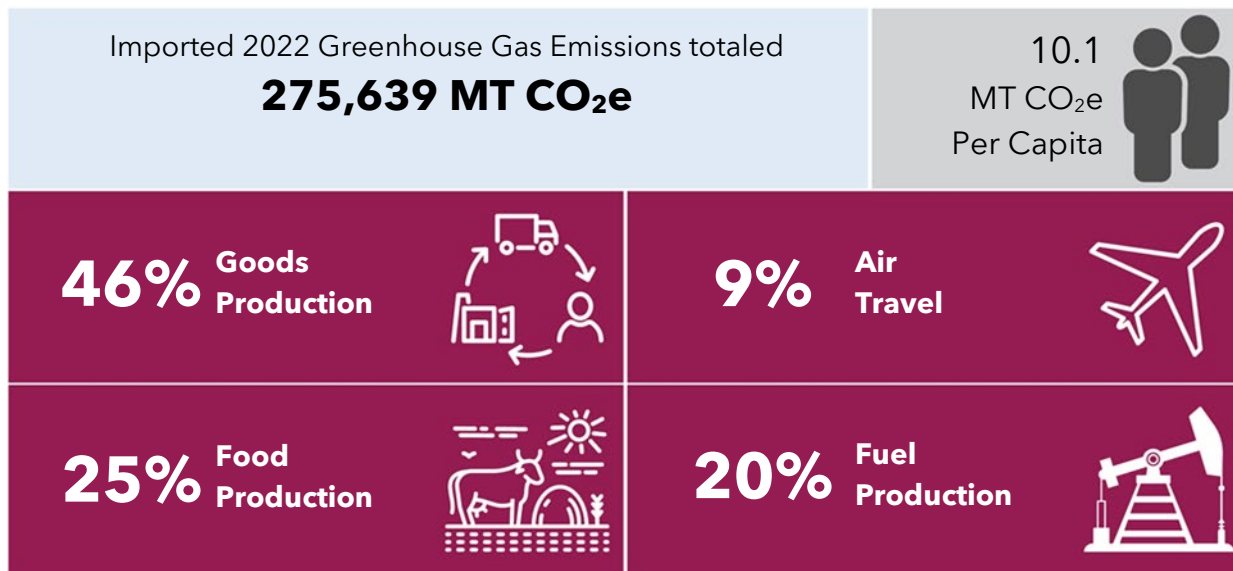
## Local Emissions

**Local emissions** include emissions from activities occurring within Camas’s geographic boundary and include the sectors listed below.



## Imported Emissions

**Imported emissions** include emissions generated outside of the community during the production of goods, food, fuel, and service products consumed by Camas and include the activities listed below.



## Introduction

Camas's community GHG inventory estimates the GHG emissions associated with the geographic boundaries of Camas. This report represents Camas's carbon footprint, and it provides a baseline for future GHG emissions tracking for the GHG reduction sub-element for the climate element of the comprehensive plan. This inventory can be used to better understand how different sectors impact emissions. The inventory will help provide context 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.

Camas'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 the combustion of natural gas and from electricity generated from fossil fuels to heat water and power buildings. Small quantities of other combusted 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 applicable.

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

**Industrial Process and Product Use:** 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.

**Imported Emissions:** These emissions are generated outside of the community during the production of goods, food, fuels, and service products consumed by residents. Imported emissions are also known as consumption-based emissions.

## Inventory Results

The following section details the results of the GHG inventory for the Camas community for 2022. These emissions include both **local** and **imported** emissions. Further details on emissions by each sector are also provided.

All emissions are reported in metric tons carbon dioxide equivalent (MT CO<sub>2</sub>e) defined to the right.

*A full detailed methodology, list of data used, and details on reporting accuracy are provided in Appendix B, Appendix C, and Appendix D.*

### Definition: MT CO<sub>2</sub>e

Metric tons of carbon dioxide equivalent is 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.

## Local Emissions

Protocols refer to **local emissions** as sector-based emissions that are generated from local sources within the community, such as vehicles and buildings. These emissions are generated close to home and are most often under the community's **direct control**. The Camas community generated **317,396 MT CO<sub>2</sub>e** of local emissions which averages about **11.6 MT CO<sub>2</sub>e** per resident.

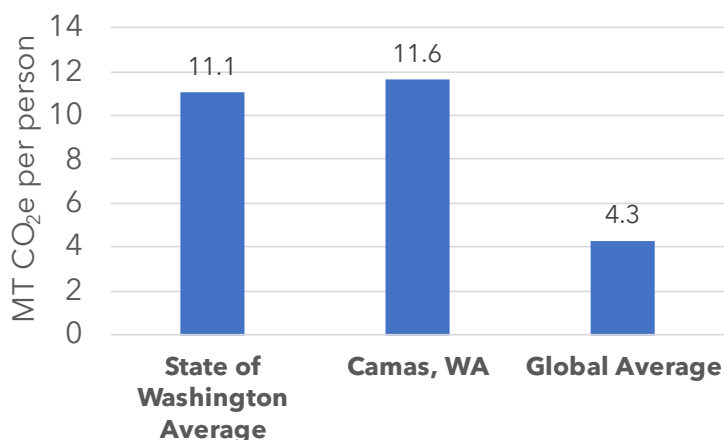


*This quantity of GHGs is equivalent to the carbon sequestered by over 370,000 acres of average U.S. forest land area, about 37 times the size of Camas.<sup>1</sup>*

## Average Per Capita Comparison

Compared to global and state of Washington per capita emissions averages, the **11.6 MT CO<sub>2</sub>e** per person is slightly higher than the Washington state average of **11.1 MT CO<sub>2</sub>e** per person (Figure 2) and is considerably higher than the global average of **4.3 MT CO<sub>2</sub>e** per person.<sup>2</sup>

**Figure 2: Comparison of Per Capita Emissions**



<sup>1</sup> U.S. EPA GHG Equivalencies Calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

<sup>2</sup> Data from World Bank. For details, visit <https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>.

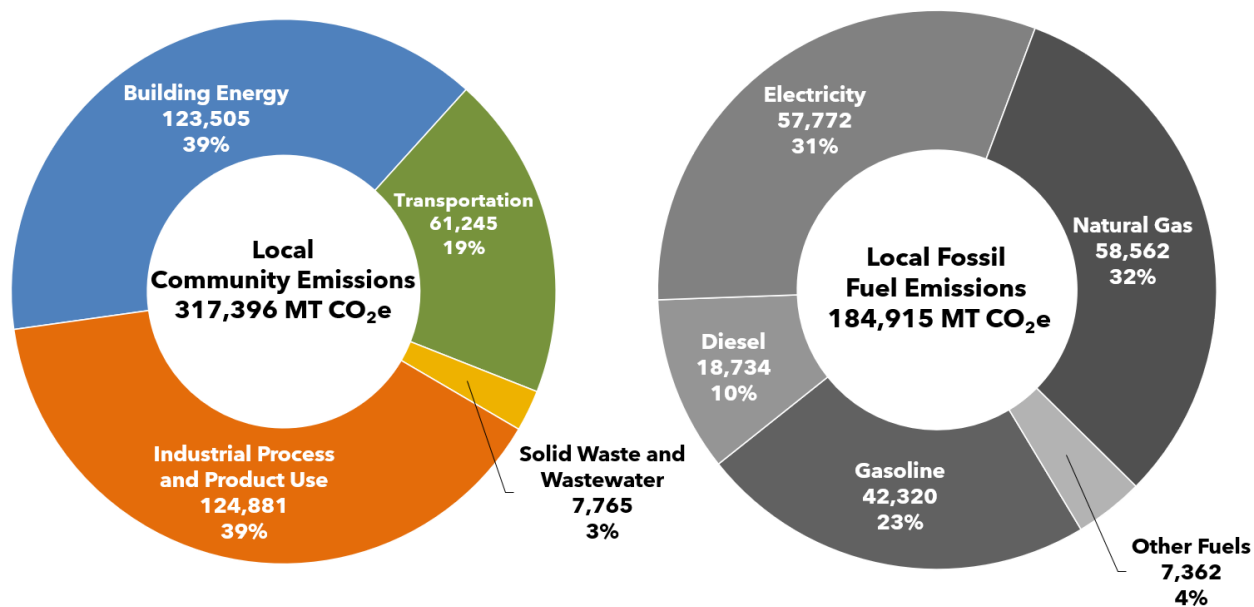


### Local Emissions by Sector and Fossil Fuel Type

Camas’s local emissions are shown on the left side of Figure 3 (below) and primarily come from **building energy**, **industrial process and product use**, and **transportation**. The right side of Figure 3 details fossil fuel use. Note that almost all emissions from **buildings** and **transportation** are from **fossil fuels (58% of local emissions)**. All building energy emissions from fossil fuels are included here. However, not all building or transportation energy sources contribute to emissions. Electricity generated from zero-carbon sources, such as hydropower, does not contribute to the city’s emissions; biofuels, such as R-99 and biodiesel, contribute minimal emissions.

**Industrial process and product use** and **solid waste and wastewater** emit non-fossil fuel emissions. These emissions include, but are not limited to, greenhouse gases from waste processing and water treatment, as well as high-global warming potential (GWP) gases – such as refrigerants. The emissions from these non-fossil sources are further discussed in the corresponding sector sections.

**Figure 3: 2022 Local Community Emissions and Fossil Fuels Details**



## Imported Emissions

In addition to accounting for local emissions, the inventory also estimates **imported (consumption-based) emissions**, which are generated outside of Camas to produce and provide the imported **goods, food, air travel**, and **production and transport of fuels** consumed by local households. Imported emissions total **275,639 MT CO<sub>2</sub>e** in addition to sources of local emissions.

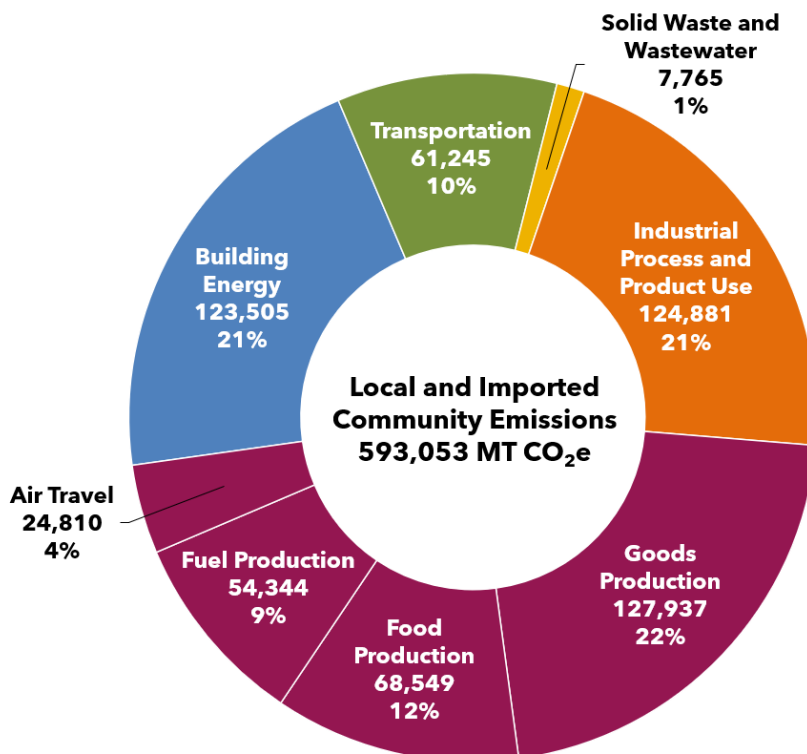


*This quantity of GHGs is equivalent to the carbon sequestered by over 320,000 acres of average U.S. forest,<sup>3</sup> an area 1.4 times the size of Mount Rainier National Park.*

Figure 4 compares the scale of local, sector-based emissions to imported emissions from household consumption. Within **goods**, the largest purchasing categories include **furniture, clothing, construction materials**, and **electronics**. 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 imported emissions.

**Figure 4: Local and Imported Emissions**



<sup>3</sup> U.S. EPA GHG Equivalencies Calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

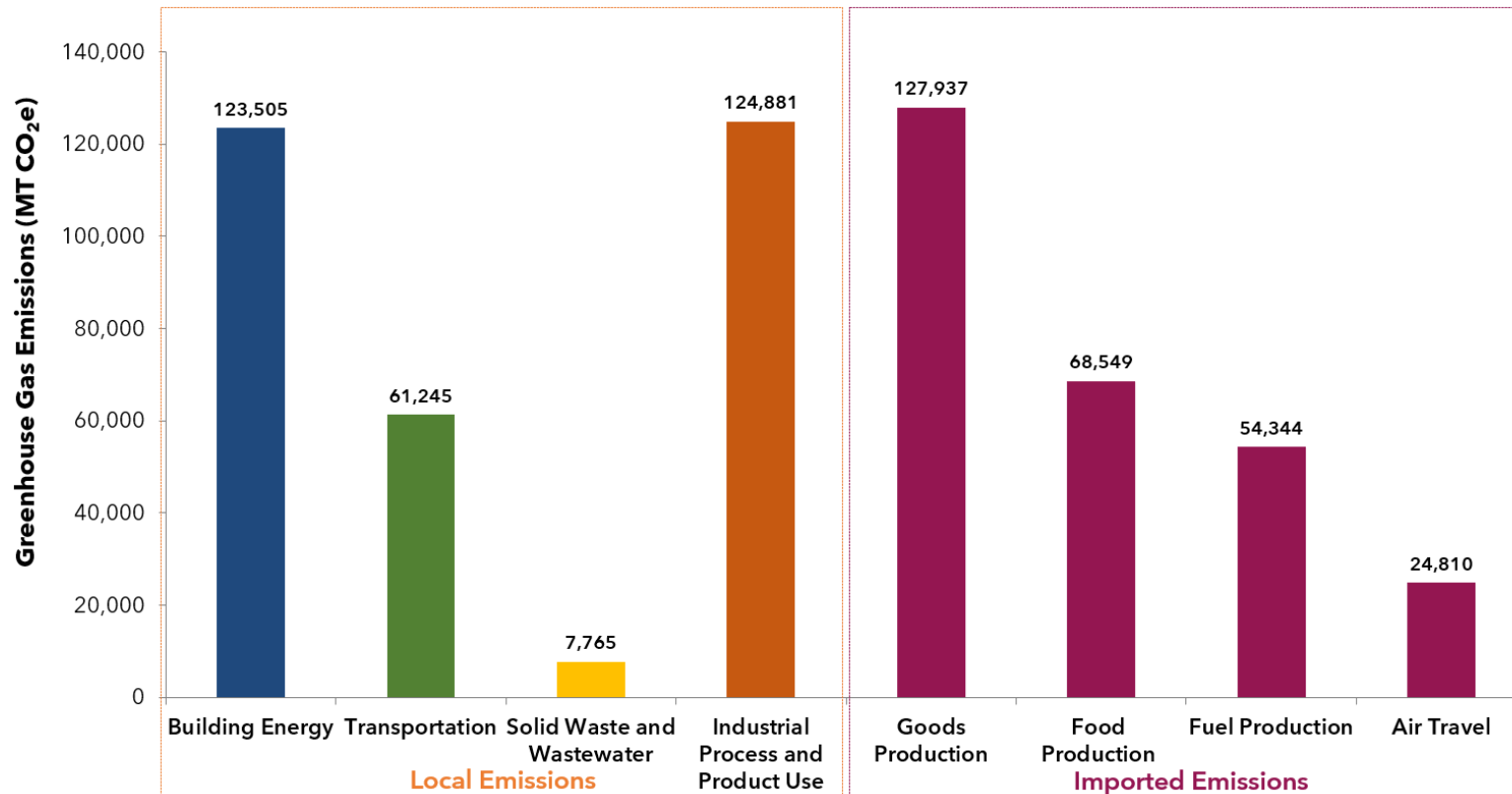
## Total Emissions

Local and imported emissions combine for a total of **593,053 MT CO<sub>2</sub>e** (shown below in Figure 5), or **21.8 MT CO<sub>2</sub>e per resident**. There are **negative emissions** from voluntary purchase of **carbon offsets** from Northwest Natural Gas customers, which are outlined in the Building Energy section (**956 MT CO<sub>2</sub>e**). Note that the net benefit from Clark County Public Utility District customers' purchase of renewable electricity in the form of Renewable Energy Certificates (RECs) is accounted for in the building energy sector (market-based accounting) and reduced emissions by approximately **250 MT CO<sub>2</sub>e**.



*593,053 MT CO<sub>2</sub>e of GHGs is roughly equivalent to the carbon sequestered by about 700,000 acres of average U.S. forest, an area roughly 165% of the size of Clark County*

**Figure 5: Camas's 2022 Emissions Sources**



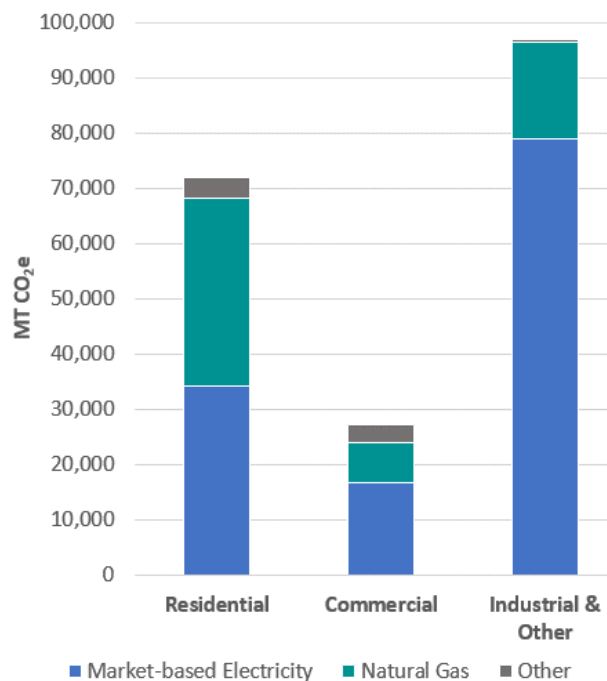
# Inventory Highlights

## Building Energy

Energy used in buildings is Camas’s second largest source of local GHG emissions, accounting for **39%** of local emissions. These emissions come from a mix of electricity, natural gas use, and other stationary combusted fuels, and they result in **123,505 MT CO<sub>2</sub>e**.<sup>4</sup> By energy type, natural gas had the largest impact (47% of total building emissions); closely followed by electricity (47%); and other fuels (6%). Figure 6 shows emissions by subsector 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.

The market-based electricity accounting method uses utility-specific factors and accounts for voluntary community participation in utility-sponsored green power programs.

**Figure 6: Building Energy Emissions by Source**



### Renewable Electricity Purchase

In 2022, Clark County Public Utility District’s customers in Camas purchased renewable energy in the form of RECs equal to less than 1% of demand, which decreased market-based electricity accounting emissions by nearly **250 MT CO<sub>2</sub>e**. Purchasing these RECs actively reduces Camas’s building energy emissions.

### Natural Gas Offsets

Additional negative emissions are from carbon offsets purchased by natural gas consumers. Less than 1% of the natural gas used in Camas is offset by community members who participate in Northwest Natural’s Smart Energy Offsets program (**956 MT CO<sub>2</sub>e**). This program allows customers to purchase carbon offsets from The Climate Trust on their bill to offset emissions from their natural gas use. Purchasing these offsets does not reduce Camas’s emissions, but they are accounted for separately as negative emissions.

<sup>4</sup> All emissions estimates use market-based accounting for electricity unless otherwise noted. Market-based electric accounting totals **123,505 MT CO<sub>2</sub>e**, while location-based accounting totals **195,817 MT CO<sub>2</sub>e**. See Appendix C: Electricity for information about market-based versus location-based accounting.

## Transportation

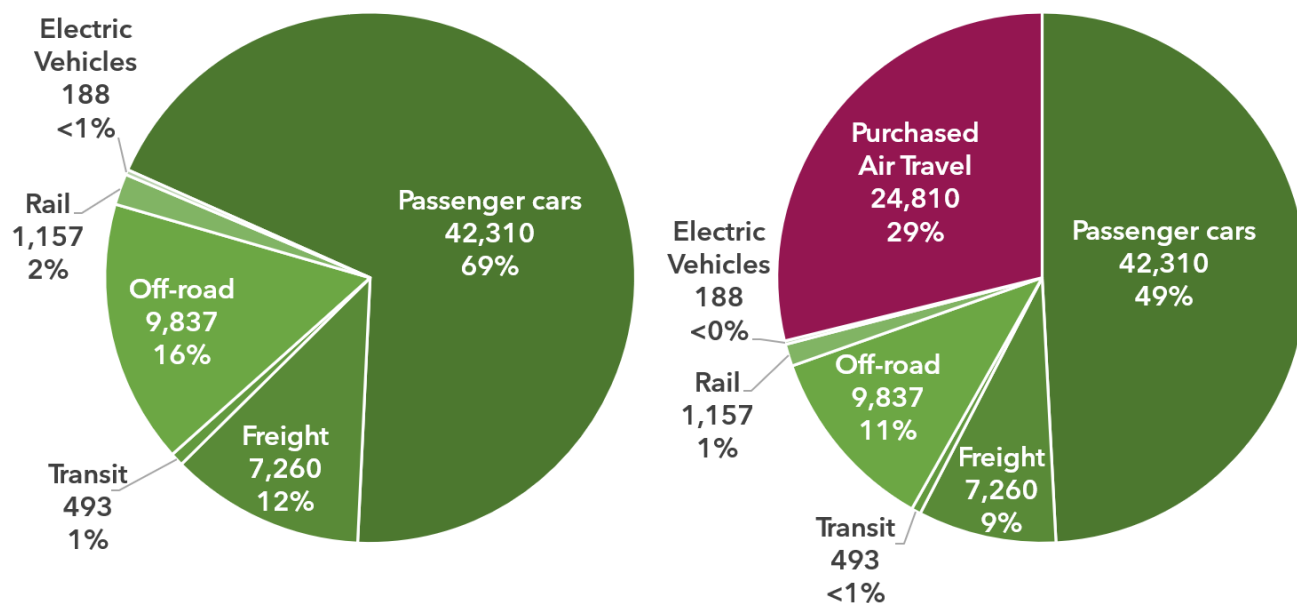
Transportation emissions are the third-largest source of local emissions for Camas, totaling **61,245 MT CO<sub>2</sub>e**. On-road passenger vehicles were the leading source of local transportation emissions and are responsible for **69%** of local transportation emissions. These emissions originate from fossil gasoline sales, primarily used by private-use cars and trucks but also include a small percentage of non-road uses. This category also includes the small amount of electricity used by electric vehicles (**<1%**). The next-largest category is off-road fuel sales, which included the purchase of propane and diesel and accounted for **16%** of total emissions. Fossil diesel sales, primarily used by freight and commercial vehicles, comes as next-highest at **12%**; most of these emissions are expected to be from on-road vehicles but may also include non-road equipment. Rail accounted for **2%** of local transportation emissions and transit accounted for the remaining **1%**. Fuel emissions were calculated based on VMT data, further discussed in Appendix D: Summary of Data and Emissions Factors.

Many residents travel by airplane, whether within the Camas boundary or not (for example, those traveling by air from Portland Airport), and air travel is part of the community's **imported emissions**. As is shown in Figure 7, emissions from air travel (**magenta**) are a significant source of emissions in addition to local transportation emissions (**green**). Imported air travel emissions are estimated at about **24,810 MT CO<sub>2</sub>e**.

**Figure 7: Transportation Emissions Breakdown**

Left: Camas's transportation emissions, excluding air travel.

Right: Camas's transportation emissions, including imported emissions from air travel.



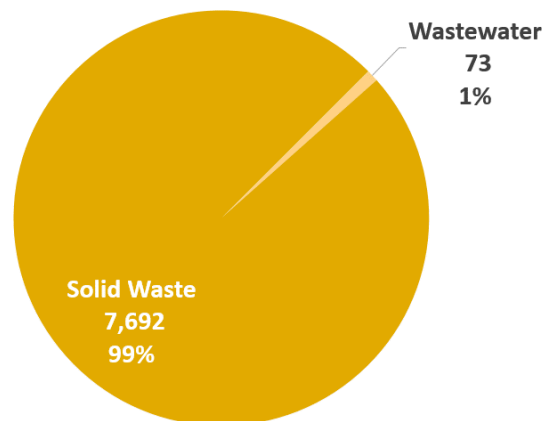
Solid Waste and Wastewater

Solid waste and wastewater emissions total approximately **7,765 MT CO<sub>2</sub>e**, **3%** of local emissions. Figure 8 illustrates the breakdown of emissions from both solid waste and wastewater.

Camas’s solid waste emissions are estimated to total **7,692 MT CO<sub>2</sub>e**. Clark County has no landfills that handle municipal waste within its geographic boundaries. Waste was landfilled at Finley Butte or Wasco County landfills. This includes emissions from the Georgia Pacific industrial landfill within Camas’s boundary.

Wastewater is processed by Clark County Regional Wastewater District and is included in the analysis. Total wastewater process emissions are estimated to total **about 73 MT CO<sub>2</sub>e**.

**Figure 8: Solid Waste and Wastewater Emissions**



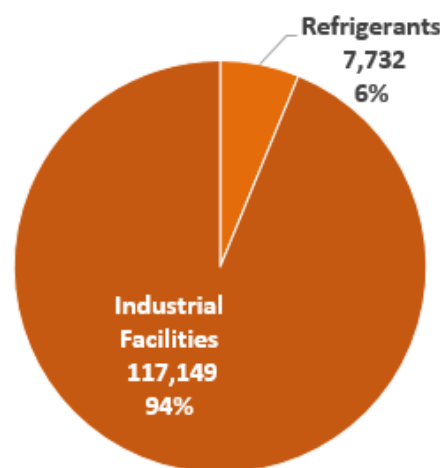
Industrial Process and Product Use

Industrial Process and Product Use (IPPU) emissions are the second largest source of local emissions. IPPU emissions are non-energy sources of emissions from unintentional leaks or discharges of gases from equipment or facilities. They come from refrigeration systems (air conditioning, refrigerators, freezers) or specialized industrial processes – chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF<sub>6</sub>), nitrogen trifluoride (NF<sub>3</sub>) – and have a large climate impact, up to 23,500 times the global warming potential of an equivalent weight of CO<sub>2</sub> depending on the gas. Figure 9 illustrates the breakdown of IPPU emissions.

Fugitive loss of refrigerants from residential and commercial buildings and vehicle air conditioning and refrigeration equipment are a smaller proportion of Camas’s IPPU emissions. These sources are estimated to be **7,732 MT CO<sub>2</sub>e**.

Industrial process emissions (excluding energy use) were identified for three different industrial manufacturing facilities within Camas. These emissions total **117,149 MT CO<sub>2</sub>e** for 2022. *All industrial emissions visible in state and federal reporting are limited to building energy emissions and are included in the Building Energy section.*

**Figure 9: Industrial Process and Product Use Emissions**

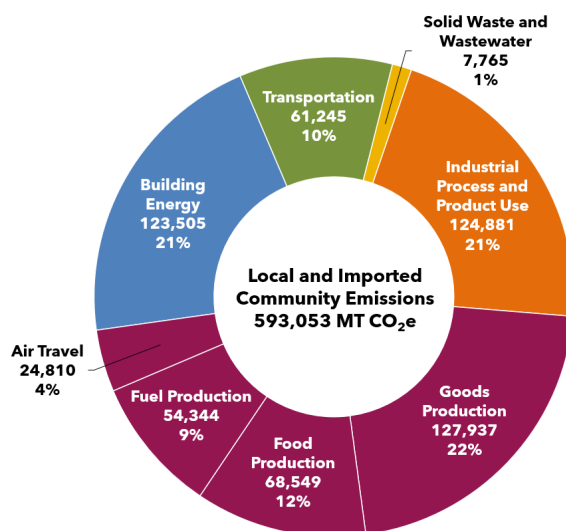




**Imported Emissions: Consumption of Goods, Food, Fuel, and Air Travel**

Camas’s inventory goes beyond GPC requirements to highlight the known large sources of **imported emissions** from consumption activities. These emissions are considered Other Scope 3 in GPC protocol. These imported 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, and opportunities exist to reduce these emissions locally by reducing consumption. These emissions were estimated at **275,639 MT CO<sub>2</sub>e** and make up **47% of total emissions** (Figure 10).

**Figure 10: Imported Emissions Detail**



Consumption of imported **goods** is the largest source for Camas’s imported emissions. The largest contributors to this category include **furniture, clothing, construction materials, and electronics**. The next-largest category is **food** and beverage, where the largest emissions are from **meat**, especially **beef**. Upstream **fuel production**, specifically gasoline production, is another large source, which goes hand in hand with passenger transportation. **Air travel** is also a significant source of Camas’s imported emissions. Note that these air travel emissions are from air travel trips taken by residents regardless of airport location.

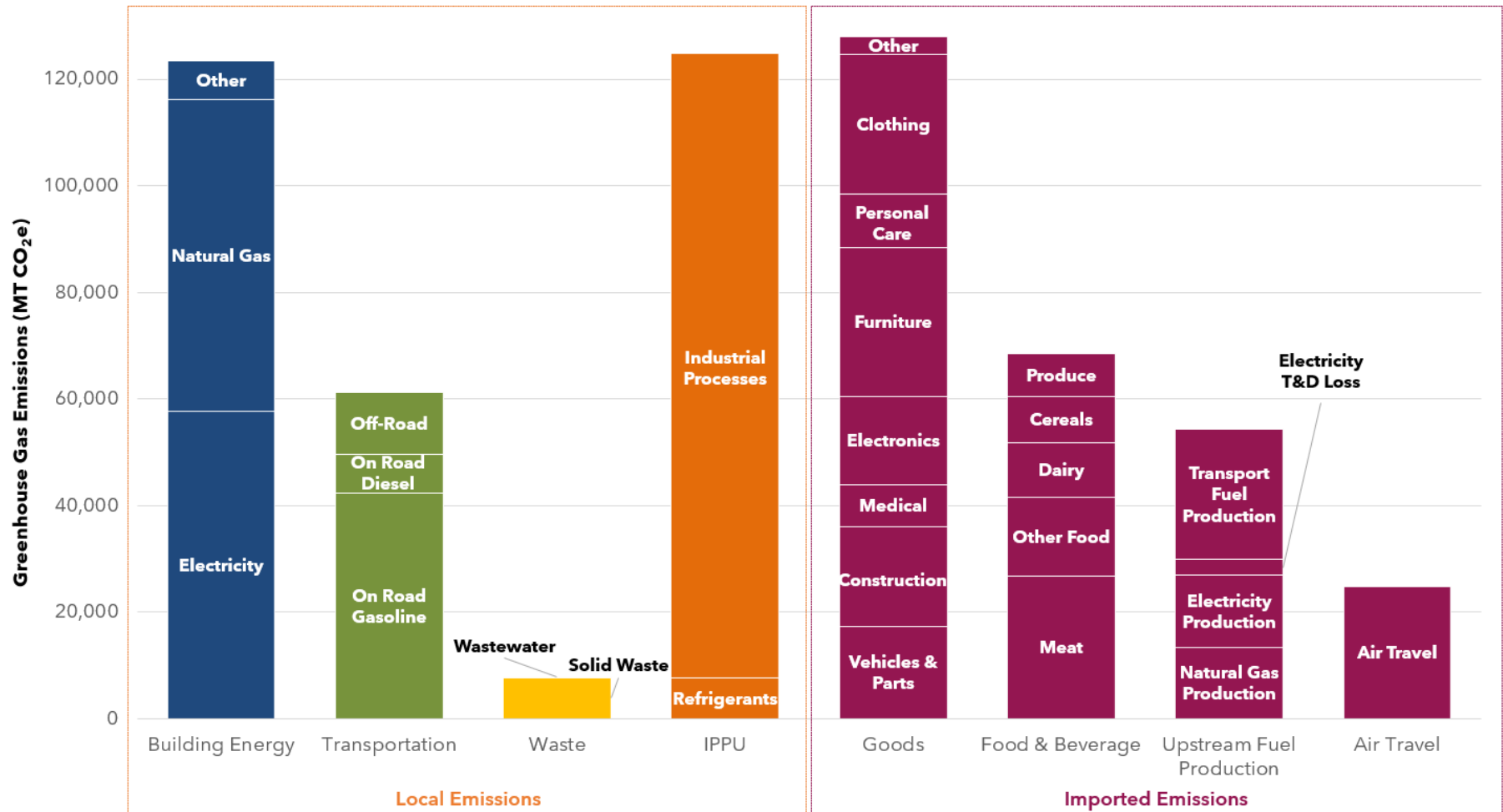
**Category Descriptions**

- **Goods:** These emissions are from extracting, manufacturing, and transporting raw materials into final products such as building materials, automobile, furniture, clothing, and other goods.
- **Food & Beverage:** These emissions are from agriculture (energy for irrigation, production of fertilizers, methane emissions from livestock, etc.) and transportation of raw materials and finished products. Categories include produce, cereals, dairy, meat, and others.
- **Upstream Fuel Production:** Process and energy emissions from the extraction and production of 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).

## Full Breakdown of Emissions Categories

Figure 11 below provides a full breakdown of Camas’s 2022 GHG emissions.

**Figure 11: Full Breakdown of Emissions Categories**



## Appendix A: Glossary of Terms

### **Carbon (or Greenhouse Gas) Footprint**

These are the total emissions of greenhouse gases that are directly and indirectly released into 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 carbon dioxide equivalent.

### **Climate Action Plan**

A comprehensive response to climate change tailored to local circumstances that includes a greenhouse gas 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. A change apparent from the mid- to late-20th century onward and attributed largely to the increased levels of atmospheric carbon dioxide produced using fossil fuels.

### **Carbon Dioxide**

Carbon dioxide (CO<sub>2</sub>) 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. Fossil fuels of importance to climate change are coal, oil, and natural gas.

### **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<sub>2</sub>e). A GHG inventory is also known as a carbon footprint.

### **Global Protocol for Community-Scale Greenhouse Gas Emission Inventories**

This type of inventory follows a set protocol, the Greenhouse Gas 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 Local Emissions (Sector-Based) Greenhouse Gas Inventory for more information.

## Global Warming Potential

Global warming potential (GWP) refers to the potency of emissions to trap heat in the atmosphere. Carbon dioxide has a GWP of 1, and other greenhouse gases are more potent and expressed as a multiple of carbon dioxide. For example, methane has a GWP of 28, meaning one molecule of methane has 28 times the effect of one molecule of carbon dioxide (United Nations Intergovernmental Panel on Climate Change Fifth Assessment Report values [IPCC AR5]).

## Imported Emissions (also known as Consumption-Based Emissions or 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.

## United Nations Intergovernmental Panel on Climate Change Assessment Reports

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 Assessment Report (AR5) was released in 2014. The Sixth Assessment Report (AR6) was released in 2023, but the new values have not yet been widely adopted.

## Kilowatt Hour

Kilowatt hours (kWh) 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.<sup>5</sup>

## 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 greenhouse gas characteristics. This type of inventory follows the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (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. Sector-based emissions include emissions from building energy and vehicles, along with local sources of greenhouse gases 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.

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<sup>5</sup> Electricity Plans: <https://electricityplans.com/kwh-kilowatt-hour-can-power/#:~:text=Here%20are%20some%20of%20the,around%202.3%20kWh%20per%20hour.>

- **Industrial Process and Product Use (IPPU):** Refrigerants and other fugitive gases from industrial processes.
- **Agriculture, Forestry and Land Use (AFLU):** emissions from agriculture (e.g., animal waste and agricultural inputs) and community land use change (e.g., development of forest or grasslands).

### **Location-Based Electricity Emissions Accounting**

Refers to the greenhouse gas 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 Accounting section in Appendix B.

### **Market-Based Electricity Emissions Accounting**

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

### **Metric Ton**

A metric ton (MT) is about 2,200 lbs. This is a common unit by international standards.

### **Metric tons of carbon dioxide equivalent**

Greenhouse gases are often measured in metric tons of carbon dioxide equivalent (MT CO<sub>2e</sub>). 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.

### **Scopes**

Scopes (as in Scope 1, Scope 2, and Scope 3) 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 B: Detailed Emissions Breakdown

**Table 1: Detailed Emissions Breakdown—Market-Based Accounting**

| <b>Camas Emissions by Sector / Sub-Sector</b><br><i>Using market-based accounting for electricity</i> | <b>2022 Emissions</b> | <b>Per capita</b> |
|---|-----------------------|-------------------|
| <b>Building Energy</b>  | <b>123,505</b>        | <b>4.5</b>        |
| Residential Buildings   |                       |                   |
| Electricity   | 17,527                | 0.6               |
| Natural Gas   | 33,856                | 1.2               |
| Other Fuels & Emissions   | 3,774                 | 0.1               |
| Commercial Buildings  |                       |                   |
| Electricity   | 8,539                 | 0.3               |
| Natural Gas   | 7,216                 | 0.3               |
| Other Fuels & Emissions   | 3,248                 | 0.1               |
| Industrial and Other Facilities   |                       |                   |
| Electricity   | 31,518                | 1.2               |
| Natural Gas   | 17,490                | 0.6               |
| Other Fuels & Emissions   | 338                   | 0.0               |
| <b>Transportation</b>   | <b>61,245</b>         | <b>2.2</b>        |
| Passenger cars  | 42,310                | 1.6               |
| Freight   | 7,260                 | 0.3               |
| Transit   | 493                   | 0.0               |
| Off-road  | 9,837                 | 0.4               |
| Rail  | 1,157                 | 0.0               |
| Electric Vehicles   | 188                   | 0.0               |
| <b>Solid Waste and Wastewater</b>   | <b>7,765</b>          | <b>0.3</b>        |
| Solid Waste Landfill  | 7,692                 | 0.3               |
| Wastewater Treatment & Septic Systems   | 73                    | 0.0               |
| <b>Industrial Process and Product Use</b>   | <b>124,881</b>        | <b>4.6</b>        |
| Refrigerants  | 7,732                 | 0.3               |
| Industrial Facilities   | 117,149               | 4.3               |
| <b>Imported Emissions</b>   | <b>275,639</b>        | <b>10.1</b>       |
| Household Consumption   |                       |                   |
| Goods   | 127,937               | 4.7               |
| Food  | 68,549                | 2.5               |
| Upstream Energy Production  | 54,344                | 2.0               |
| Air Travel  | 24,810                | 0.9               |
| <b>Negative Emissions</b>   | <b>-956</b>           |                   |
| Purchased Offsets   | -956                  |                   |
| Local Emissions   | 317,396               | 11.6              |
| Local + Imported  | 593,035               | 21.8              |



**Table 2: Detailed Emissions Breakdown—Location-Based Accounting**

| <b>Camas Emissions by Sector / Sub-Sector</b><br><i>Using location-based accounting for electricity</i> | <b>2022 Emissions</b> | <b>Per capita</b> |
|---|-----------------------|-------------------|
| <b>Building Energy</b>  | <b>195,817</b>        | <b>7.2</b>        |
| Residential Buildings   |                       |                   |
| Electricity   | 34,221                | 1.3               |
| Natural Gas   | 33,856                | 1.2               |
| Other Fuels   | 3,774                 | 0.1               |
| Commercial Buildings  |                       |                   |
| Electricity   | 16,672                | 0.6               |
| Natural Gas   | 7,216                 | 0.3               |
| Other Fuels   | 3,248                 | 0.1               |
| Industrial and Other Facilities   |                       |                   |
| Electricity   | 79,003                | 2.9               |
| Natural Gas   | 17,490                | 0.6               |
| Other Fuels   | 338                   | 0.0               |
| <b>Transportation</b>   | <b>61,422</b>         | <b>2.3</b>        |
| Passenger cars  | 42,310                | 1.6               |
| Freight   | 7,260                 | 0.3               |
| Transit   | 493                   | 0.0               |
| Off-road  | 9,837                 | 0.4               |
| Rail  | 1,157                 | 0.0               |
| Electric Vehicles   | 365                   | 0.0               |
| <b>Solid Waste and Wastewater</b>   | <b>7,765</b>          | <b>0.3</b>        |
| Solid Waste Landfill  | 7,692                 | 0.3               |
| Wastewater Treatment & Septic Systems   | 73                    | 0.0               |
| <b>Industrial Process and Product Use</b>   | <b>124,881</b>        | <b>4.6</b>        |
| Refrigerants  | 7,732                 | 0.3               |
| Industrial Facilities   | 117,149               | 4.3               |
| <b>Imported Emissions</b>   | <b>296,342</b>        | <b>10.9</b>       |
| Household Consumption   |                       |                   |
| Goods   | 127,937               | 4.7               |
| Food  | 68,549                | 2.5               |
| Upstream Energy Production  | 75,046                | 2.8               |
| Air Travel  | 24,810                | 0.9               |
| <b>Negative Emissions</b>   | <b>-956</b>           |                   |
| Purchased Offsets   | -956                  |                   |
| Local Carbon Storage  | 0                     |                   |
| Local Emissions   | 389,885               | 14.3              |
| Local + Imported  | 686,227               | 25.2              |

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

## Appendix C: Methodology & Protocols

### Protocol and Inventory Boundaries

This inventory follows [Global Protocol for Community-Scale Greenhouse Gas Emission Inventories](#) (GPC) 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).

Good Company's carbon calculator tool G3C - Community was used for greenhouse gas (GHG) 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<sub>2</sub>e). The gases considered in the analysis are consistent with protocol and include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs), sulfur hexafluoride (SF<sub>6</sub>), and perfluorocarbons (PFCs) per the Kyoto Protocol. All GHG calculations use 100-year global warming potentials as defined in the International Panel on Climate Change's Fifth Assessment Report (IPCC AR5).

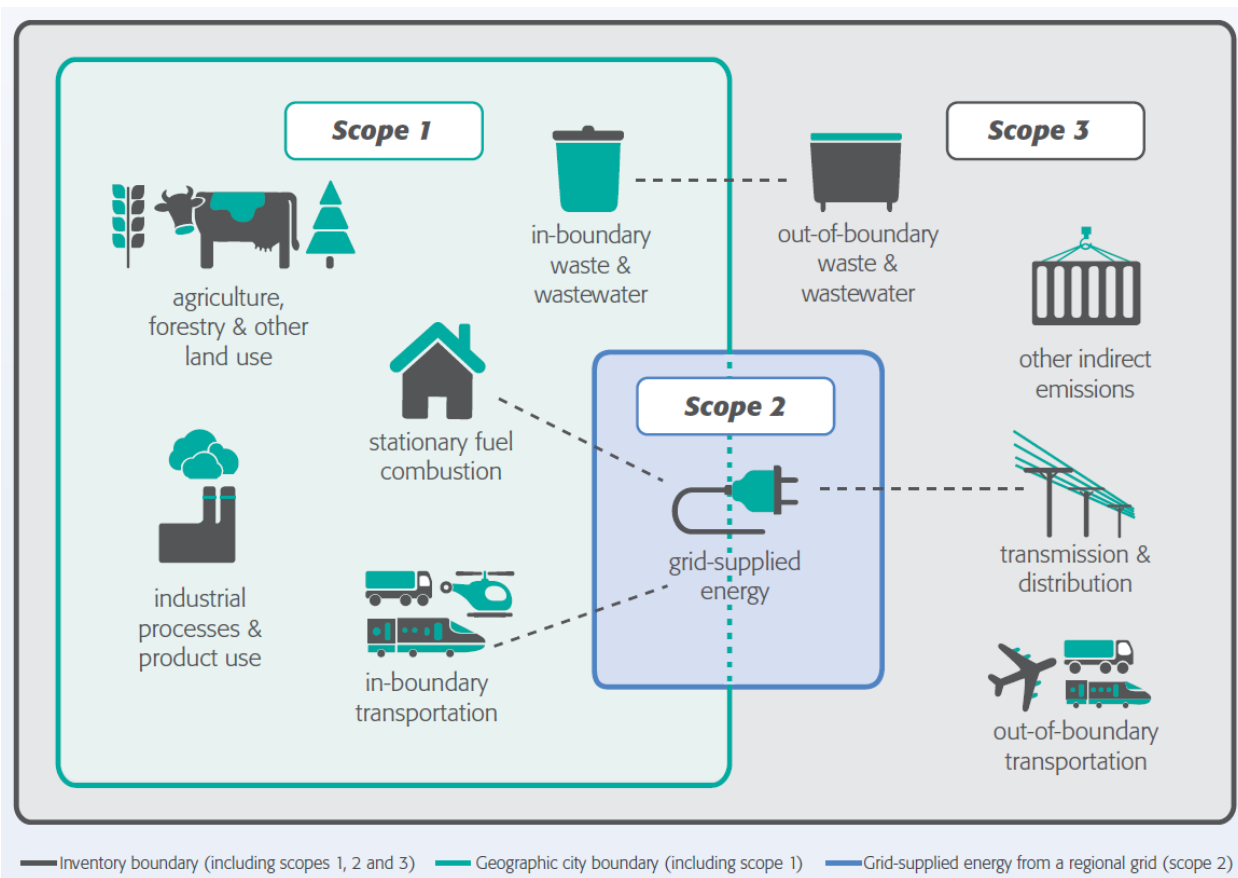
### Scopes

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 3 and Figure 12 (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 subsectors included in the GPC are shown in Table 4 (page C-3). These are compared with emissions included in the 2022 community inventory by scope category.

**Table 3: 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 12: Graphical Illustration of Scopes<sup>6</sup>**



<sup>6</sup> Global Protocol for Community-Scale Greenhouse Gas Inventories.

**Table 4: Crosswalk of Emissions and Scopes**

| Emissions Sector / Sub-Sector  | Scope 1 | Scope 2 | Scope 3 |
|--|---------|---------|---------|
| <b>Building Energy</b>   |         |         |         |
| Residential Buildings  | ✓       | ✓       |         |
| Commercial Buildings   | ✓       | ✓       |         |
| Industrial Facilities  | ✓       | ✓       |         |
| Potable Water Treatment Energy   | ✓       | ✓       |         |
| Wastewater Treatment Energy  | ✓       | ✓       |         |
| Fugitive Emissions from Natural Gas Systems  | ✓       |         |         |
| Fugitive Sulfur Hexafluoride   | ✓       |         |         |
| <b>Transportation</b>  |         |         |         |
| On-Road Passenger Vehicles   | ✓       | ✓       |         |
| On-Road Heavy-Duty and Freight   | ✓       | ✓       |         |
| Transit Vehicles   | ✓       |         |         |
| Off-Road Vehicles and Equipment  | ✓       |         |         |
| Rail   | ✓       |         |         |
| Local Aviation   | ✓       |         |         |
| <b>Solid Waste and Wastewater</b>  |         |         |         |
| Landfill Waste   | ✓       |         | ✓       |
| Central Wastewater Treatment   | ✓       |         |         |
| <b>Industrial Process and Product Use</b>  |         |         |         |
| Refrigerants   | ✓       |         |         |
| Industrial Process Emissions   | ✓       |         |         |
| <b>Imported Emissions</b>  |         |         |         |
| Household Consumption  |         |         | ✓       |
| Air Travel   |         |         | ✓       |
| Upstream Energy Production   |         |         | ✓       |
| <b>Negative Emissions</b>  |         |         |         |
| Purchased carbon offsets   | ✓       |         |         |
| Other emissions activities not listed above do not occur within the boundary - see list of exclusions.<br>NE = Emissions occur but are not reported or estimated.<br>IE = Included elsewhere as part of another data set where a split is not available. |         |         |         |

## Inventory Exclusions

**Table 5: Summary of Inventory Exclusions**

| Inventory Emissions Sources by Sector/Sub-Sector                                |   |              |   |
|---|---|--------------|---|
| GPC Terminology   | Report Terminology                          | Notation Key | Explanation   |
| <b>Stationary Energy</b>  | <b>Building Energy</b>                      |              |   |
| Residential buildings   | Residential buildings                       | Included     |   |
| Commercial and institutional buildings and facilities                           | Commercial buildings                        | Included     |   |
| Manufacturing industries and construction                                       | Industrial facilities                       | Included     |   |
| Energy industries   |   | NO           | No emissions are associated with solar energy production. There is no other substantial generation of electricity, such as a power plant.   |
| Agriculture, forestry, and fishing activities                                   |   | NE/IE        | Electricity and natural gas use emissions are included elsewhere, likely in industrial energy use with no additional splits available. 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 in off-road diesel estimates. This data is likely included elsewhere, but if not, is not additionally estimated due to lack of data sources. |
| Fugitive emissions from mining, processing, storage, and transportation of coal |   | NO           | No activity identified within the geographic boundary.  |
| Fugitive emissions from oil and natural gas systems                             | Fugitive emissions from natural gas systems | IE           | In Other Emissions by subsector.  |
| Non-specified sources   | Fugitive sulfur hexafluoride                | IE           | In Other Emissions by subsector.  |
| <b>Transportation</b>   |   |              |   |
| On-road   | On-road passenger vehicles                  | Included     |   |
|   | On-Road heavy-duty and freight              | Included     |   |
|   | Transit vehicles                            | Included     |   |
| Railways  | Rail  | Included     |   |
| Waterborne navigation   |   | NO           | No significant activity within the geographic boundary. Any emissions associated with small, private craft on   |

|  |  |          |   |
|--|--|----------|---|
|  |  |          | the Columbia River launched from locations inside the boundary are not captured but are not significant. Commercial transport emissions from Columbia River are not considered part of the geographic boundary. |
| Aviation   | Local aviation                               | NO       | There are no airports within the city boundaries. Emissions from air travel are included in the consumption emissions and estimated from economic data.   |
| Off-road   | Off-road vehicles and equipment              | Included |   |
| <b>Waste</b>   | <b>Solid Waste and Wastewater</b>            |          |   |
| Solid waste disposal   | Landfill waste                               | Included |   |
| Biological treatment of waste                                      |  | NO       | No waste collection processed as composting.  |
| Incineration and open burning                                      |  | NO       | No waste collection processed as incineration or open burning.  |
| Wastewater treatment and discharge                                 | Central wastewater treatment                 | Included |   |
|  | Septic systems                               | NO       | No septic systems are reported within the geographic boundary.  |
| <b>Industrial Process and Product Use (IPPU)</b>                   |  |          |   |
| Industrial Processes   | Industrial process emissions                 | Included |   |
| <b>Agriculture, Forestry, &amp; Other Land Use</b>                 | <b>Agriculture, Forestry, &amp; Land Use</b> |          |   |
| Livestock  |  | NO       | No activity identified within the geographic boundary.  |
| Land   | Land use emissions                           | NO       |   |
|  | Land use sequestration (annual growth)       | NO       |   |
| Aggregate sources and non-CO <sub>2</sub> emission sources on land | Agricultural soil amendments                 | NO       |   |
| <b>Other Scope</b>   | <b>Imported Emissions</b>                    |          |   |
|  | Household consumption                        | Included |   |
|  | Air travel                                   | Included |   |
|  | Upstream energy production                   | Included |   |

Included=Emissions occur and are estimated and included within the results.



NE = Emissions occur but are not reported or estimated.  
 IE = Included elsewhere as part of another data set where a split may not be available.  
 NO = Activity or process does not occur within boundary.

## Electricity Accounting

Activity data was collected from Clark Public Utility District. Data was collected directly from the utility, including volume of renewable energy certificates purchased. Data provided was split by residential, commercial, and industrial.

The GPC and Scope 2 guidance requires that communities report electricity emissions using two accounting methods: market-based and location-based.<sup>7</sup> **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 accounting** is calculated using the regional electricity grid’s (Northwest Power Pool) GHG intensity and represents the average impacts of electricity use and efficiency efforts for the region. Figure 13 displays 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.
- 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 2022).<sup>8</sup> 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

**Figure 13: Electricity Emissions Using Both Accounting Methods**



<sup>7</sup> For details, visit [http://www.ghgprotocol.org/scope\\_2\\_guidance](http://www.ghgprotocol.org/scope_2_guidance).

<sup>8</sup> [https://www.epa.gov/system/files/documents/2024-01/egrid2022\\_summary\\_tables.pdf](https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf)

accounting offers a means of assessing the average impacts of electricity use on the regional electricity grid.

# Appendix D: Summary of Data and Emissions Factors

## Data Collection

Project staff worked with City and Clark County staff to collect the data required to calculate emissions. City and Clark County 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 detail below.

| Emissions Category  | Category Description  |
|---|---|
| <b>Building Energy (Stationary Energy in GPC Protocol)</b>  |   |
| <b>Residential Energy</b>   | <i>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 providing grid electricity used by the same sub-sectors for the same geographic boundary.</i> |
| <b>Commercial Energy</b>  |   |
| <b>Industrial Energy</b>  |   |
| <p>Electricity and natural gas data provided by Clark Public Utility District, Northwest Natural and private users with other energy supply contracts. Electricity and natural gas data included information on retail sales, transported gas and electricity, and participation in renewable electricity and carbon offset programs. Residential and commercial fuel oil and propane use was estimated using state-level per capita 2021 fuel usage data downscaled by the city’s 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 2022 data for the Northwest Power Pool (NWPP) sub-region. Market-based electricity accounting emissions factors for Clark Public Utility District was provided by the utility along with its usage data and SF<sub>6</sub> emissions. Emissions factors for Clatskanie Public Utility Department in Oregon were taken from Oregon Department of Environmental Quality’s report titled, <i>2010-2022 Greenhouse Gas Emissions from Electricity Use</i>, 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.</p> |   |
| <b>Fugitive Natural Gas System Emissions</b>  | <i>Fugitive loss of natural gas from the local product distribution system.</i>   |
| <p>Northwest Natural Gas (NWN) reported a system leakage quantity. This data is considered highly accurate.</p>   |   |

| Transportation   |   |
|--|---|
| <b>On-Road Energy</b>  | <i>Direct emissions from gasoline and diesel for passenger and freight transportation.</i>                                    |
| <p>Emissions from on-road energy were calculated using a combination of vehicle miles traveled (VMT) modeling approaches. First, the city's boundary was uploaded to Replica software, which uses cell phone GPS data to estimate typical weekday and weekend VMT, and it updates the data by season and by year. This inventory used typical VMT data for a Thursday and a Saturday in fall 2022. The software also provides an estimated breakdown of "passenger," "freight," and "transit" trip types. Using the Thursday data as a typical workday and the Saturday as a typical non-workday, annual passenger, freight, and transit VMT were estimates for each geography. All passenger miles were assumed to be in gas or electric vehicles and all freight miles were assumed to be in diesel vehicles.</p> <p>The annual VMT values were then adjusted to match the total county VMT estimates provided by the Washington State Department of Transportation (WSDOT), pro-rated by population in the city. Overall, WSDOT estimates were larger by about 20% but are assumed to be more accurate and the preferred data source.</p> <p>To convert VMT into emissions, the population of cars was estimated using the county's registration records for 2022, which includes whether the car was electric or internal combustion. The electric car population was assumed to be consistent across the county. Fuel efficiencies for diesel, gasoline, and electric vehicles were taken from the AFLEET model's Washington data. All diesel usage was assumed to be B5 (5% biodiesel, 95% fossil diesel), and all gasoline was assumed to be E10 (10% ethanol, 90% fossil gasoline). All electric usage was assumed to have Clark Public Utility District's emissions factor (and subtracted from the overall residential electricity usage).</p> <p>Note that C-TRAN fuel use was subtracted from freight diesel outside of the model.</p> |   |
| <b>Transit</b>   | <i>Direct emissions from gasoline and diesel (on-road) and electricity (light rail) for passenger transit transportation.</i> |
| <p>Emissions data was collected from C-TRAN. C-TRAN staff provided fuel use, fuel blend, and VMT for all vehicles. Emissions were then downscaled by population and subtracted from on-road vehicle emissions to avoid double counting.</p>  |   |
| <b>Off-Road including Rail</b>   | <i>Direct emissions from gasoline and diesel for off-road vehicles, such as construction equipment, etc.</i>                  |
| <p>Emissions from off-road vehicles were estimated based on the <a href="#">state of Washington's GHG inventory</a> (2019, used as proxy) and were downscaled by population. Off-road transportation data was available split into air transport, marine transport, locomotives, and "other"; air and marine transport were excluded since no significant sources, such as ferries and airports, exist in the community. Data was given in carbon dioxide equivalent (CO<sub>2</sub>e).</p>  |   |

| <b>Solid Waste and Wastewater</b>   |   |
|---|---|
| <b>Landfilled Solid Waste</b>   | <i>Fugitive methane emissions from mixed solid waste generated in the community regardless of disposal location.</i>  |
| Clark County has no landfills that handle municipal waste within its geographic boundaries. Waste was landfilled at Finley Butte or Wasco County landfills, and the total tonnage sent to each landfill from the entire region was available, but the proportion attributable to each geography was not available. Total 2022 EPA-reported emissions from Finley Butte and Wasco were downscaled based on reported short tons from Clark County customers. Then, the total emissions were downscaled for the city by population. This activity data is moderately accurate. |   |
| <b>Wastewater Treatment Process Emissions</b>   | <i>Wastewater treatment plant biogas combustion, denitrification process, and fugitive nitrous oxide emissions from discharge of treated effluent (wastewater).</i>                     |
| Emissions calculations for nitrification/denitrification are based on service population. Applicable wastewater treatment plant process emissions were provided by the wastewater utility. This activity data is considered highly accurate.  |   |
| <b>Septic Systems</b>   | <i>Direct emissions from the decomposition of biosolids (wastewater).</i>   |
| Septic fugitive emissions were estimated based on service population data from wastewater treatment providers compared to the city population. This activity data is considered moderately accurate.  |   |
| <b>Industrial Process and Product Use</b>   |   |
| <b>Product Use (Refrigerants)</b>   | <i>Fugitive loss of refrigerants and other high global warming potential (GWP) gases from building and vehicle air conditioning systems.</i>  |
| Fugitive refrigerant loss and other non-industrial high-GWP gas emissions are estimated using EPA estimates for Washington state and downscaled on a per capita basis. Activity data for state-level fugitive emissions from refrigerants, aerosols, and fire suppression systems is reported in the EPA's state-level emissions inventory as Substitute Ozone Depleting Substances. Emissions are considered as having moderate accuracy.  |   |
| <b>Industrial Processes</b>   | <i>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.</i> |
| Two applicable facilities inside the city boundary were identified by the EPA Facility Level Information on GreenHouse Gases Tool (FLIGHT) tool. These industrial facilities are required to report significant air quality and/or climate emissions. Emissions were reported using AR4 GWP values as not all gases were listed and could therefore not be recalculated using AR5   |   |

values. Therefore, a decision was made to leave the results in AR4 to match the state results. This data is considered highly accurate.

**Imported Emissions**

|                 |  |
|-----------------|--|
| <b>Goods</b>    | <i>Upstream energy and process emissions raw material extraction, manufacturing, and out-of-state transportation of goods.</i> |
| <b>Food</b>     | <i>Upstream energy and process emissions from the growing, processing and transportation of foods.</i>                         |
| <b>Services</b> | <i>Upstream energy emissions from air travel by community members from all airports regardless of location.</i>                |

Accurate data on quantities and suppliers for the goods and food consumed by community households are not readily available. Therefore, the Berkeley Cool Climate Calculator was used to estimate emissions based on the city’s household income distribution. Income data was acquired from the U.S. Census Bureau. Because the data is estimated from a large and complicated economic model, this activity data is considered as having low accuracy.

|                                 |   |
|---------------------------------|---|
| <b>Upstream Fuel Production</b> | <i>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.</i> |
|---------------------------------|---|

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. These results are expected to be the same for Washington communities because the fuel products are generally the same. 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**

|                                 |   |
|---------------------------------|---|
| <b>Purchased Carbon Offsets</b> | <i>Community purchase of verified carbon offsets.</i> |
|---------------------------------|---|

Carbon offsets purchased by NWN account holders’ participation in NWN’s Clean Energy program were provided by the utility as therm-equivalents and metric ton CO<sub>2</sub>e. This activity data is considered highly accurate.