# Clark County

## Community Greenhouse Gas Inventory

for Calendar Year 2022

July, 2024

Parametrix | good COMPANY

# Acknowledgments

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*Thank you to all the not listed staff from Clark County who provided data and additional insight in support of this inventory.*

*Additionally, a special thank you to the Cities of Battle Ground, Camas, Ridgefield, Washougal and Vancouver; Waste Connections of Washington; Clark Regional Wastewater District; Clark County Public Utility District (PUD) and Northwest Natural Gas for providing necessary data for this inventory.*

**Consulting Team**

Good Company, a division of Parametrix is the sustainability consulting team that conducted this greenhouse gas analysis on behalf of Clark County. Tracy Lunsford served as project manager. Claudia Denton, Beth Miller, and Suzy Godber provided data-gathering assistance and analysis. They are the primary authors of this report.

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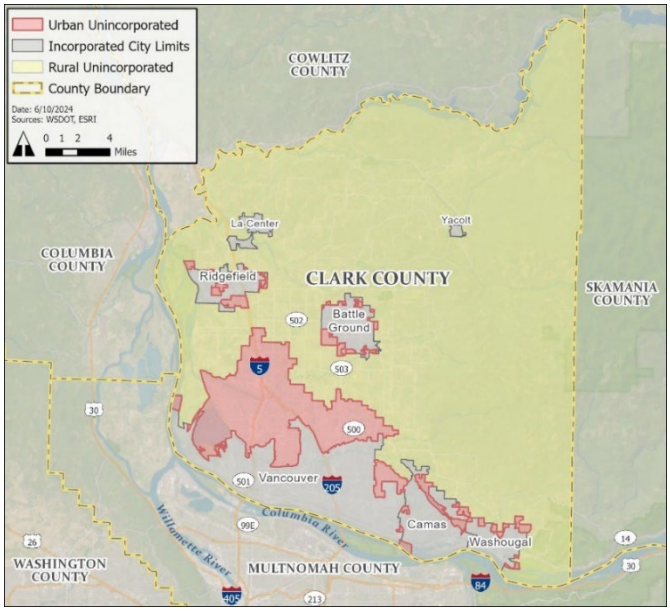
# Executive Summary

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, Clark County conducted a community greenhouse gas (GHG) inventory for their 2025 Comprehensive Plan Update. This inventory is the first for Clark County and will help set targets and strategies to reduce GHG emissions and decrease per capita vehicle miles traveled (VMT).

This inventory follows the internationally recognized Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC) and accounts for all significant sources of GHG emissions driven by activities taking place within Clark County's jurisdictional geographic boundary, which excludes incorporated cities. These emissions are referred to as local emissions. Beyond protocol requirements, the inventory also measures emissions from the consumption of goods and food, air travel, and the purchase of carbon offsets (imported emissions). While Clark County has less control over these emissions compared with sources of local emissions, they are included in the inventory because the imported emissions are large, they are caused by local demand, and opportunities exist to reduce these emissions locally by reducing consumption. A complete list of protocols and data sources as well as the detailed methodology are included in Appendix C.

In this report, "Clark County" refers to all unincorporated areas within the County, including areas which are further defined as urban (unincorporated county within the urban growth areas (UGAs) of the cities within Clark County), and rural (unincorporated land outside of the UGAs). Figure 1 displays a map of the "Urban Unincorporated" and "Rural Unincorporated" geographies used for this inventory. All numbers throughout the report text refer to **the entire unincorporated** county (including unincorporated urban and unincorporated rural) unless otherwise noted. Many of the graphics show side-by-side comparisons of urban and rural emissions. Urban and rural are defined as follows:

**Figure 1: GHG Inventory Geographic Boundary**




- **Urban:** Unincorporated land within Urban Growth Areas (UGAs)
- **Rural:** Unincorporated land outside of UGAs

Additionally, this report does not include data for incorporated cities and towns within Clark County except for in Appendix E: Sub-Jurisdictions GHG Emissions, Figure 18.

# Summary of Findings

## Clark County GHG Emissions

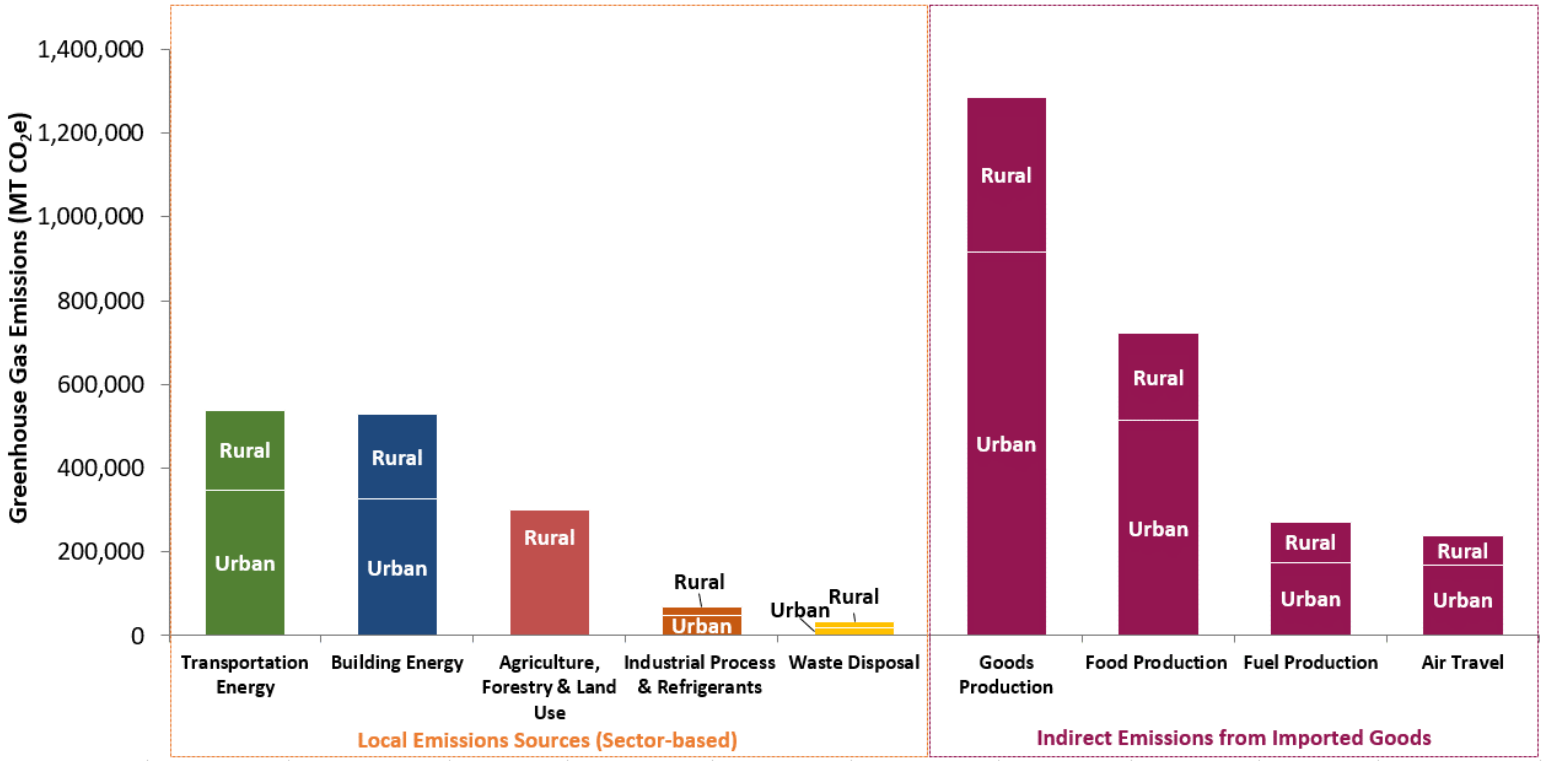
With a population of 240,414, all 2022 GHG emissions combined (local and imported) for Clark County totaled

**4,050,857 MT $CO_2e$**

16.8
MT $CO_2e$
Per Capita

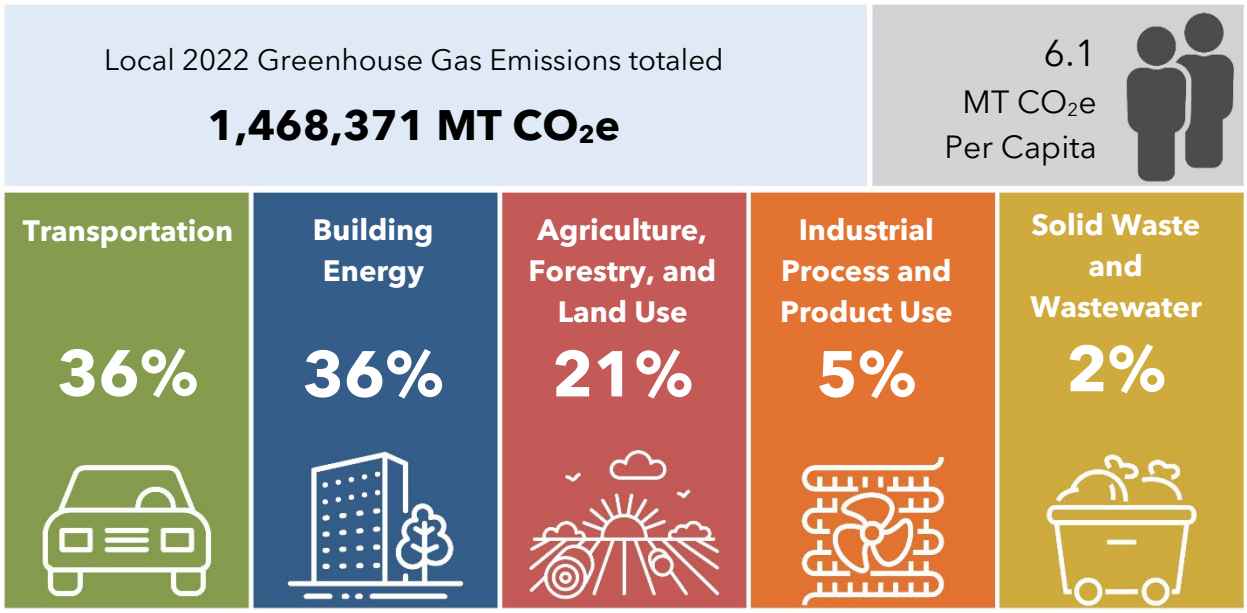
Figure 2 below outlines the summary of results from the 2022 GHG inventory for unincorporated Clark County, split by urban rural. The Summary of Findings section provides definition for MT CO2e, further details the breakdown of local versus imported emissions, and detailed inventory results for each sector listed below.

**Figure 2: Clark County's 2022 Emissions**



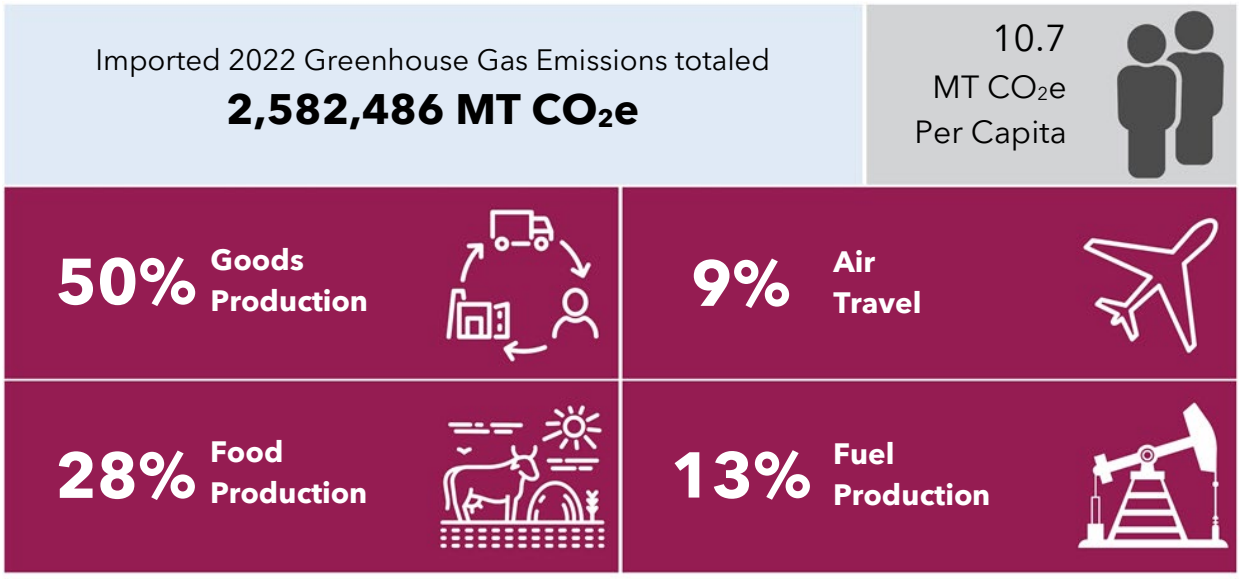
## Local Emissions

**Local emissions** include emissions from activities occurring within Clark County's unincorporated 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 unincorporated Clark County residents and include the activities listed below.



# Introduction

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. This inventory represents Clark County's first community GHG inventory to estimate the GHG emissions associated with the geographic boundaries of Clark County. This report represents Clark County's carbon footprint, and it provides a baseline for future GHG emissions tracking 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 GHG reduction (also known as 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.

This inventory follows Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC) 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 International Council for Local Environmental Initiatives' (ICLEI's) U.S. Community Protocol for guidance on calculation of consumption-based emissions (i.e., other Scope 3 as defined by GPC protocol).

In this report, "Clark County" refers to all unincorporated areas within the County, including areas which are further defined as urban (unincorporated county within the urban growth areas (UGAs) of the cities within Clark County), and rural (unincorporated land outside of the UGAs). Figure 1 in the Executive Summary displays the geographic boundary used for this inventory. All numbers throughout the report text refer to **the entire unincorporated** county (including unincorporated urban and unincorporated rural) unless otherwise noted. Many of the graphics show side-by-side comparisons of urban versus rural emissions. Urban and rural are defined as follows:

- **Urban:** Unincorporated land within Urban Growth Areas (UGAs)
- **Rural:** Unincorporated land outside of UGAs

Additionally, this report does not include data for incorporated cities and towns within Clark County except for in Appendix E: Sub-Jurisdictions GHG Emissions, Figure 18.

## Emissions Sources

Clark County's community GHG inventory includes the following emissions sources:

**Transportation:** Gasoline for passenger vehicles and diesel for freight, bus transit, and off-road uses are included in this category. Electricity use by electric vehicles is included here where applicable. Jet fuel and aviation gasoline from local airports are also included.

**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 other combusted fuels are also included. Additionally, a fraction of natural gas is lost during local distribution, releasing methane, a potent greenhouse gas pollutant.

**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).

**Industrial Process & Product Use:** Refrigerant emissions come from a variety of sources, such as cooling and refrigeration systems in both buildings and vehicles. Refrigerants are powerful global warming gases. Therefore, relatively small losses have a large climate impact. In addition, known significant industrial process emissions are included. These emissions are from non-energy sources only.

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

**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, or Other Scope 3, emissions.

# Inventory Results

The following section details the results of the GHG inventory for the Clark County community for 2022, consistent with the Washington Department of Commerce climate element guidance. 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 $CO_2e$) defined to the right.

**Definition: MT $CO_2e$**
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.

*This inventory is based on the most recent, comprehensive data available for the methodology used. A full detailed methodology, list of data used, and details on reporting accuracy are provided in Appendix B, Appendix C, and Appendix D.*

## Local Emissions

Protocols refer to **local emissions** as sector-based emissions that are generated from local sources within a community, such as vehicles and buildings. These emissions are generated close to home and are most often under the community's **direct control**. The Clark County community generated **1,468,37 MT $CO_2e$** of local emissions and **6.1 MT $CO_2e$** per resident.

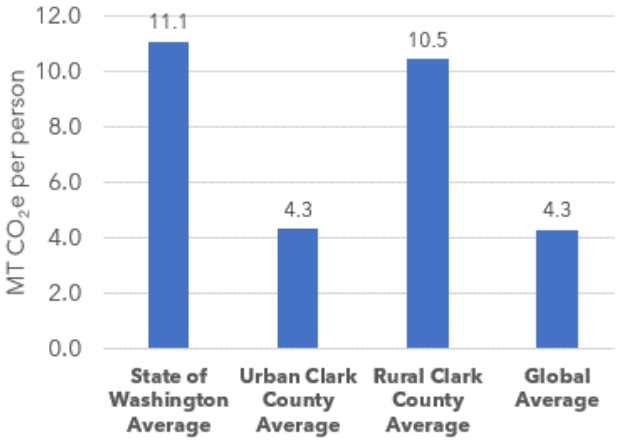
*This quantity of GHGs is equivalent to the carbon sequestered by over 1,700,000 acres of average U.S. forest land area, about 4 times the size of Clark County.*[1]

### Average Per Capita Comparison

Compared to global and state averages, the **4.3 MT $CO_2e$** per person for unincorporated **urban** Clark County is considerably lower than the Washington state average of **11.1 MT $CO_2e$** per person (Figure 3), and the same as the global average of **4.3 MT $CO_2e$** per person.

The **10.5 MT $CO_2e$** per person for **rural** Clark County is just below the Washington state average and considerably higher than the global average.[2] This is largely due to agricultural emissions that are large and not occurring within the urban unincorporated Clark County.

**Figure 3: Comparison of Per Capita Emissions**



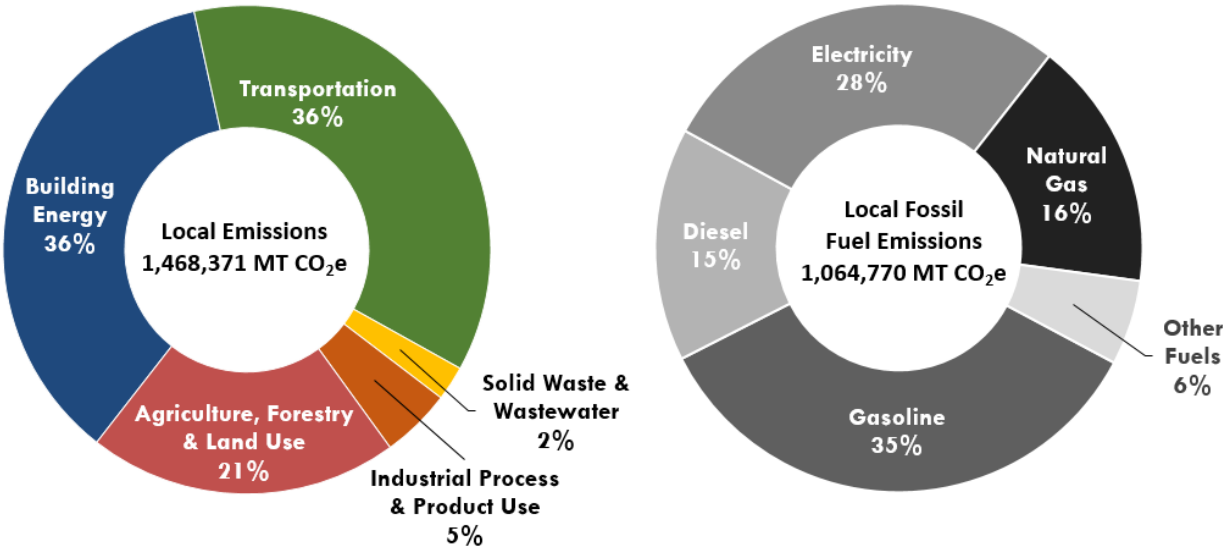

[1] U.S. EPA GHG Equivalencies Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.
[2] Data from World Bank. For details, visit https://data.worldbank.org/indicator/EN.ATM.CO2E.PC.

## Local Emissions by Sector and Fossil Fuel Type

Clark County's local emissions are shown on the left side of Figure 4 (below) and primarily come from **building energy**, **transportation**, and **agriculture, forests, and land use.** Smaller sources of emissions include **industrial process and product use** and **solid waste and wastewater**. The right side of Figure 4 details emissions from specifically fossil fuel use which are generated most heavily in the **buildings** and **transportation** sectors. **72% of local emissions are specifically from fossil fuel use**. All emissions from fossil fuel use are included. 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 county's emissions; biofuels, such as R-99 and biodiesel, contribute minimal emissions.

**Agriculture, forestry, and land use**, **industrial process and product use**, and **solid waste and wastewater** emit non-fossil fuel emissions. These emissions include, but are not limited to, carbon emitted from deforestation, methane from livestock, and 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 4: 2022 Local Community Emissions and Fossil Fuels Details**



## Imported Emissions

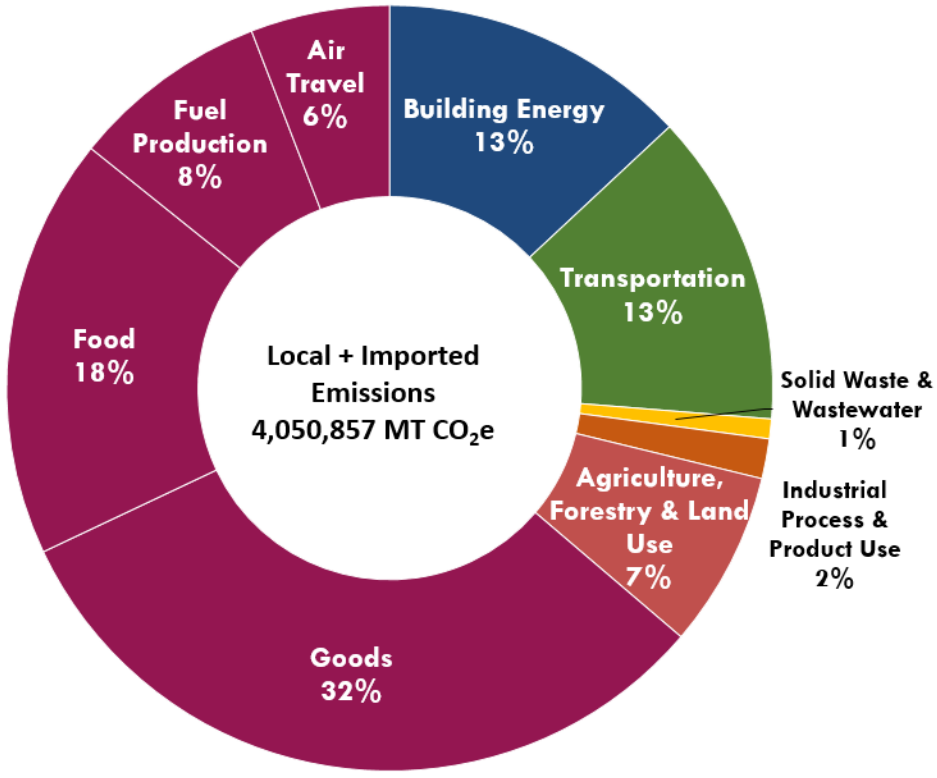
In addition to accounting for local emissions, the inventory also estimates **imported (consumption-based) emissions**, which are generated outside of Clark County to produce and provide the imported **goods** and **food, air travel,** and **production and transport of fuels** consumed by local households. Imported emissions total **2,582,486 MT $CO_2e$**, in addition to sources of local emissions.

*This quantity of GHGs is equivalent to the carbon sequestered by over 3,000,000 acres of average U.S. forest, an area almost 13 times the size of Mount Rainier National Park.*[3]

Figure 5 compares the scale of local, sector-based emissions to imported emissions from household consumption. Within **goods**, the largest purchasing categories include **furniture**, **clothing**, **vehicles & parts**, 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 imported emissions.

**Figure 5: 2022 Community Local + Imported Emissions**



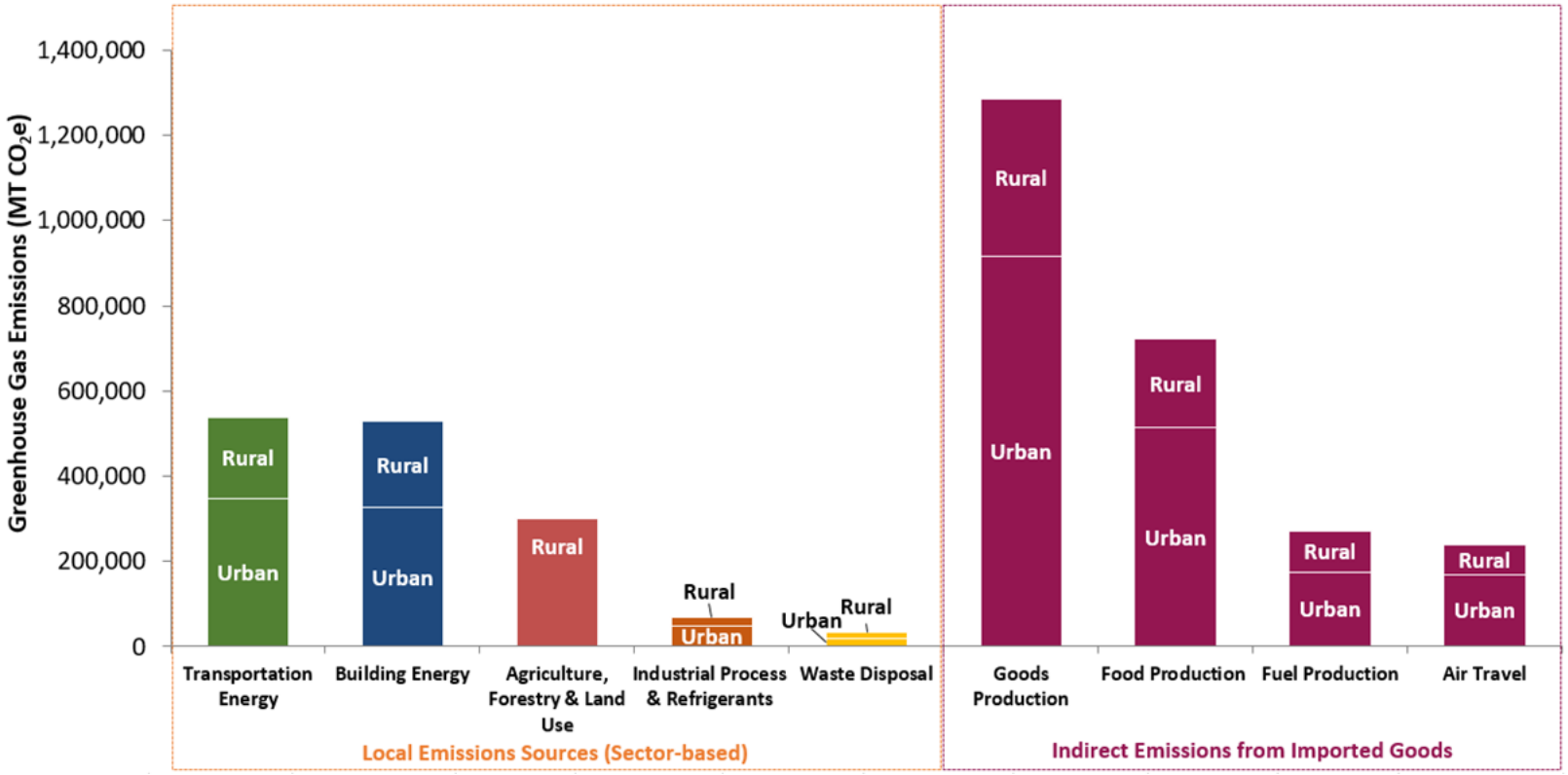

[3] U.S. EPA GHG Equivalencies Calculator: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

## Total Emissions

Local and imported emissions combine for a total of **4,050,857 MT $CO_2e$** (shown below in Figure 6), or **16.8 MT $CO_2e$ per resident.** There are **negative emissions** from voluntary purchases of **carbon offsets** from Northwest Natural Gas customers, which are outlined in the Building Energy section (**4,033 MT $CO_2e$**). 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 **298 MT $CO_2e$**.

*4,050,857 MT $CO_2e$ of GHGs is roughly equivalent to the carbon sequestered by over 4,700,000 acres of average U.S. forest, an area roughly 10% of the size of Washington State.*

**Figure 6: Clark County's 2022 Emissions Sources**



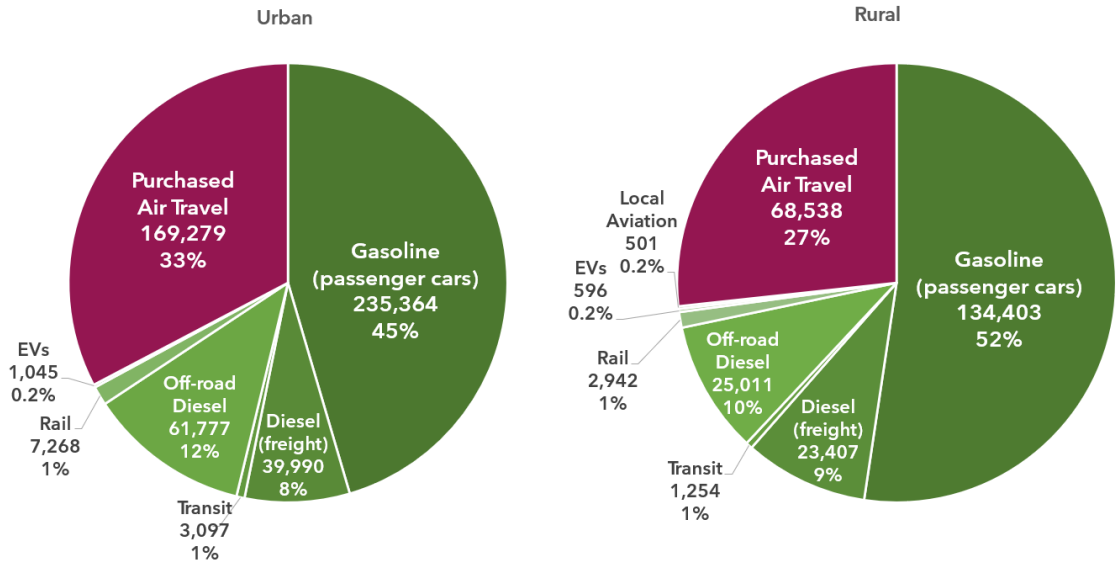
# Inventory Highlights

## Transportation

Transportation emissions are the largest source of local emissions for Clark County, totaling **536,656 MT $CO_2e$**. Figure 7 details the total transportation emissions broken up by urban and rural Clark County. On-road passenger vehicles were the leading source of local transportation emissions for both urban and rural unincorporated Clark County (**369,767 MT $CO_2e$** total). 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 (i.e. construction, recreation, or agricultural uses). The next-largest category of local transportation emissions for both urban and rural Clark County is off-road diesel (**86,788 MT $CO_2e$** total), which included diesel fuel sales. The third-largest category of local transportation emissions for urban and rural Cark County is fossil diesel sales, primarily used by freight and commercial vehicles (**63,397 MT $CO_2e$** total). Most of these emissions are expected to be from on-road vehicles but may also include non-road equipment. Fuel emissions were calculated based on VMT data, further discussed in *Appendix C: Methodology & Protocols*. Rail, transit, and electric vehicles (EVs) were both among the smallest sources of transportation emissions for urban and rural Clark County. Additionally, aviation gasoline and jet fuel sales accounted for 0.2% of rural transportation emissions.

In addition to fuel used at local airfields, many residents travel by airplane, whether within the Clark County boundary or not (for example, those traveling by air from Portland International 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**). Consumption-based air travel emissions are estimated at about **237,816 MT $CO_2e$**. Once added to local emissions, air travel becomes the second largest source of transportation emissions overall.

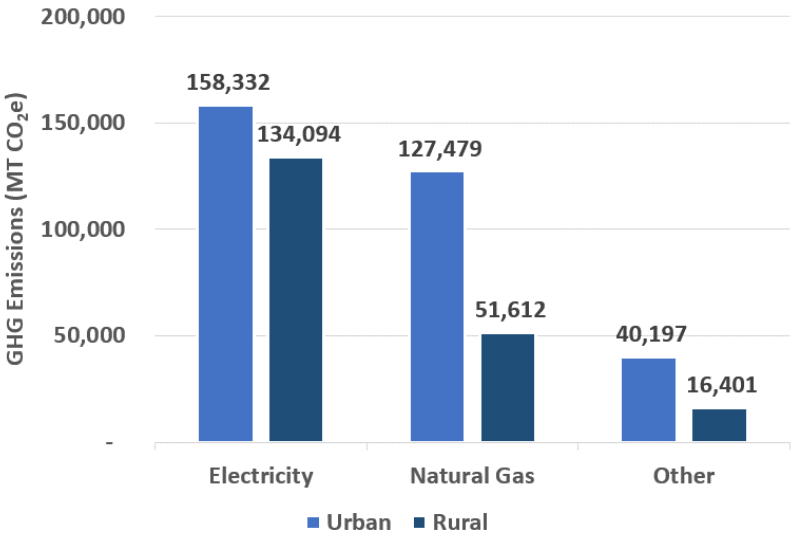
**Figure 7: Transportation Emissions Breakdown**



## Building Energy

Energy used in buildings is Clark County's second largest source of local GHG emissions, accounting for **36%** of local emissions. These emissions come from a mix of electricity, natural gas use, and other stationary combusted fuels, and they result in **528,115 MT $CO_2e$**.[4] By energy type, electricity had the largest impact (55% of total building emissions); followed by natural gas (33%); and other fuels (11%). Figure 8 compares emissions by energy type between urban and rural unincorporated Clark County. 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 8, as they account for less than 1% of total building energy emissions.

**Figure 8: Building Energy Emissions**




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

### Renewable Electricity Purchase

In 2022, Clark County Public Utility District's customers in Clark County purchased renewable energy in the form of RECs equal to less than 1% of demand, which decreased market-based electricity accounting emissions by approximately **298 MT $CO_2e$**. Purchasing these RECs actively reduces Clark County's building energy emissions.

### Natural Gas Offsets

Additional negative emissions are from carbon offsets purchased by natural gas consumers. Less than 1% of the emissions from natural gas use in Clark County is offset by community members who participate in Northwest Natural's Smart Energy Offsets program (**4,033 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. Purchasing these offsets does not reduce Clark County's emissions, but they are accounted for separately as negative emissions.

[4] All emissions estimates use market-based accounting for electricity unless otherwise noted. Market-based electric accounting totals **528,115 MT $CO_2e$**, while location-based accounting totals **804,715 MT $CO_2e$**. See Appendix C: Electricity for information about market-based versus location-based accounting.

## Agriculture, Forestry, and Land Use

Agriculture, forestry, and land use (AFLU) emissions only apply to rural areas (unincorporated urban areas are not included in the numbers or graphics in this section) and are the third largest source of local emissions for Clark County. AFLU sources in rural Clark County emitted **301,743 MT $CO_2e$**. As shown in Figure 9, the largest contribution to 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 about **227,000 MT $CO_2e$**. This estimate is calculated as a "net forest carbon loss", calculating the sequestration efforts of existing forests subtracted from total emissions of forest lost, as shown in Figure 10. This figure is calculated as an average over a 21-year window.

**Figure 9: AFLU Emissions**

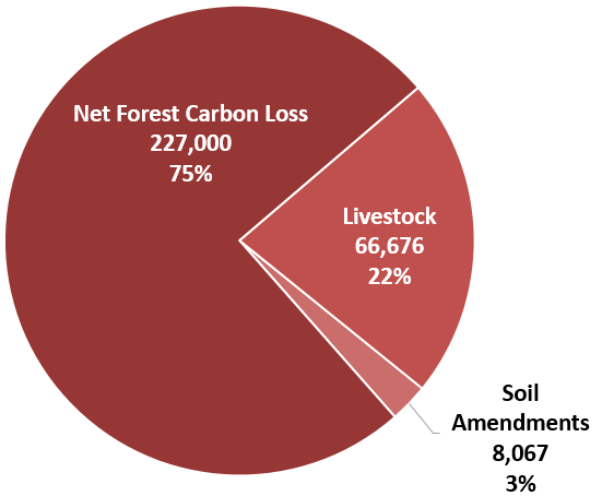
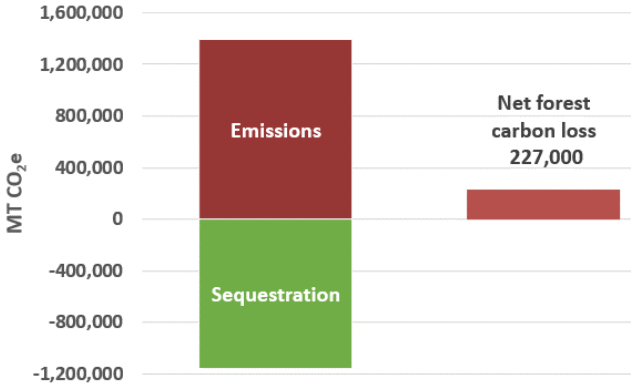



**Figure 10: Net Forest Carbon Loss Emissions**




During deforestation activities, carbon stored in trees is released into the atmosphere, contributing to climate change. 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. 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 contributing to global warming.

Forests also sequester a large amount of carbon, so what is presented in Figure 10 is the net carbon loss: emissions from tree loss minus sequestration from tree growth. Also note that some forest carbon sequestration might be included in carbon market financial products and so this estimate should not be taken as legal ownership of carbon rights.

Agricultural emissions, specifically methane emissions from livestock, total **66,676 MT $CO_2e$**. A wide variety of livestock are raised within the county, and these emissions come from enteric fermentation (digestive process) by ruminant animals (animals with more than one stomach) and manure management. The application of nitrogen fertilizer to farm fields is also a small source of emissions, and total **8,067 MT $CO_2e$**.

## Industrial Process and Product Use

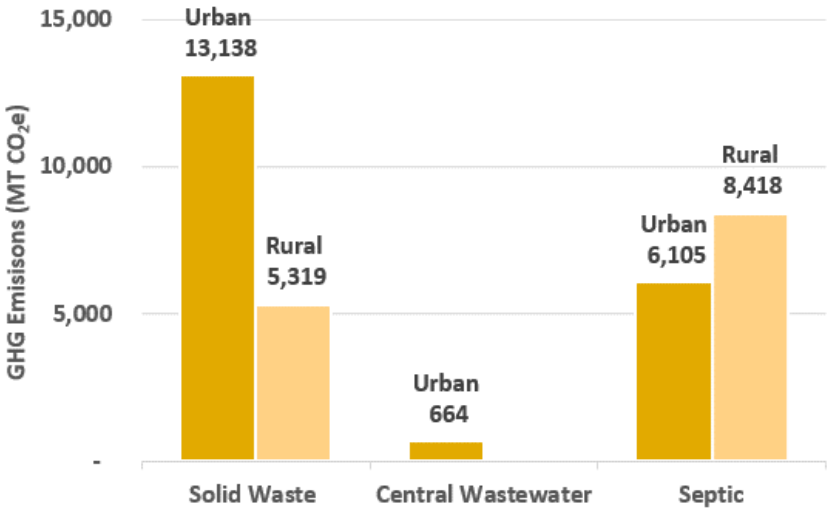
Industrial Process and Product Use (IPPU) emissions are the fourth-largest source of local emissions. IPPU emissions are non-energy sources of emissions from unintentional leaks or discharges of gases from equipment or facilities. They come from refrigeration systems (air conditioning, refrigerators, freezers) or specialized industrial processes – chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride ($SF_6$), nitrogen trifluoride ($NF_3$) – 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.

Fugitive loss of refrigerants from residential and commercial buildings and vehicle air conditioning and refrigeration equipment make up the entirety of Clark County's IPPU emissions. These sources are estimated to be **68,215 MT $CO_2e$**. *All industrial emissions visible in state and federal reporting are limited to building energy emissions and are included in the Building Energy section.*

## Solid Waste & Wastewater

Solid waste and wastewater emissions total approximately **33,643 MT $CO_2e$**, and are the smallest source of Clark County's emissions, accounting for only 2% of total local emissions. Figure 11 illustrates the breakdown of emissions from both solid waste and wastewater.

**Figure 11: Solid Waste and Wastewater Emissions**



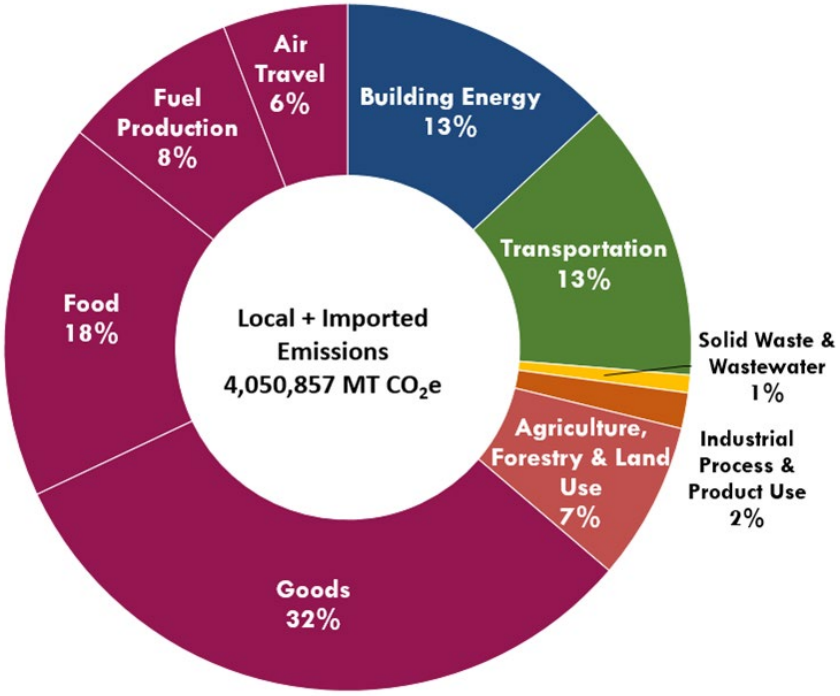

Clark County's solid waste emissions are estimated to total **18,457 MT $CO_2e$**. Clark County has no active landfills that handle municipal waste within its geographic boundaries. Waste is landfilled at Finley Butte or Wasco County landfills.

Wastewater is processed by Clark Regional Wastewater District and is included in the analysis. Additionally, there are about 120,000 people served by septic systems within the county. Septic systems are more GHG intensive than centralized wastewater treatment because of the different treatment processes. Total wastewater process emissions (including septic) are estimated to total **about 15,187 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

Clark County'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 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. 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 **2,582,486 MT $CO_2e$** and make up **64% of total emissions** (Figure 12). See Appendix D for more information on sources and reporting accuracy for imported emissions, including goods, food, services, and upstream fuel production.

**Figure 12: Local and Imported Emissions**




### 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.

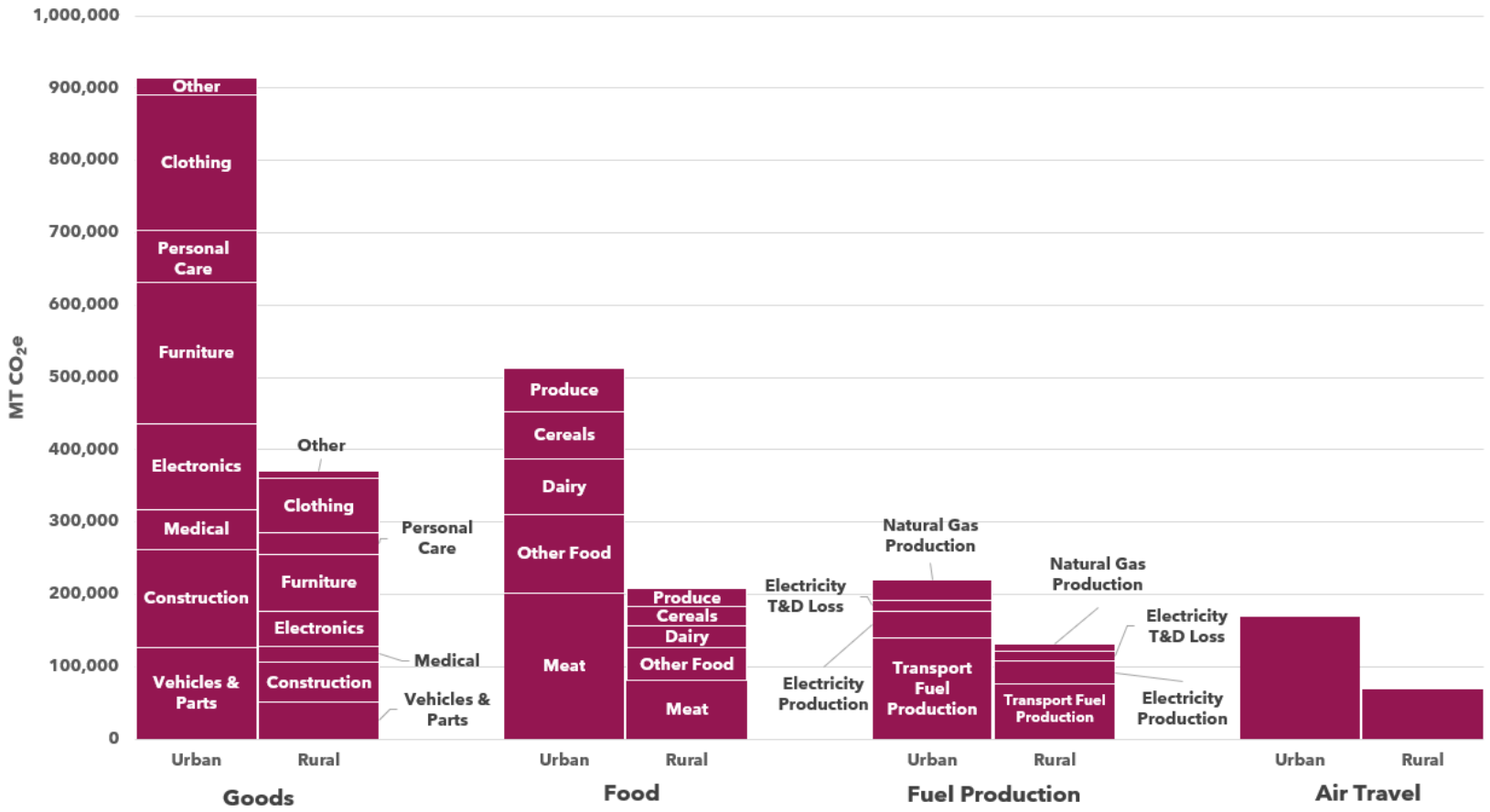
**Food & Beverage:** These emissions are from agriculture (energy for irrigation, production of fertilizers, methane emissions from livestock, etc.) transportation of raw materials, and finished products emissions. Categories include produce, cereals, dairy, meat, and other foods.

**Upstream Fuel Production:** Process and energy emissions from the extraction and production of usable fuel products (coal used for building electricity, 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).

A full breakdown of consumption emissions by the categories listed above are provided below in Figure 13. Consumption of imported **goods** is the largest source for Clark County's imported emissions. The largest contributors to this category **include furniture, clothing, vehicles & parts**, and **construction**. 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. **Air travel** is also a significant source of Clark County's imported emissions. Note that these air travel emissions are from air travel trips taken by residents regardless of airport.

**Figure 13: Full Breakdown of Clark County's 2022 Consumption Emissions**



## Full Breakdown of Emissions: Urban and Rural

Figure 14 below provides a full breakdown of **urban unincorporated** Clark County's 2022 GHG emissions.

**Figure 14: Full Breakdown of Clark County's 2022 Urban Unincorporated Emissions**

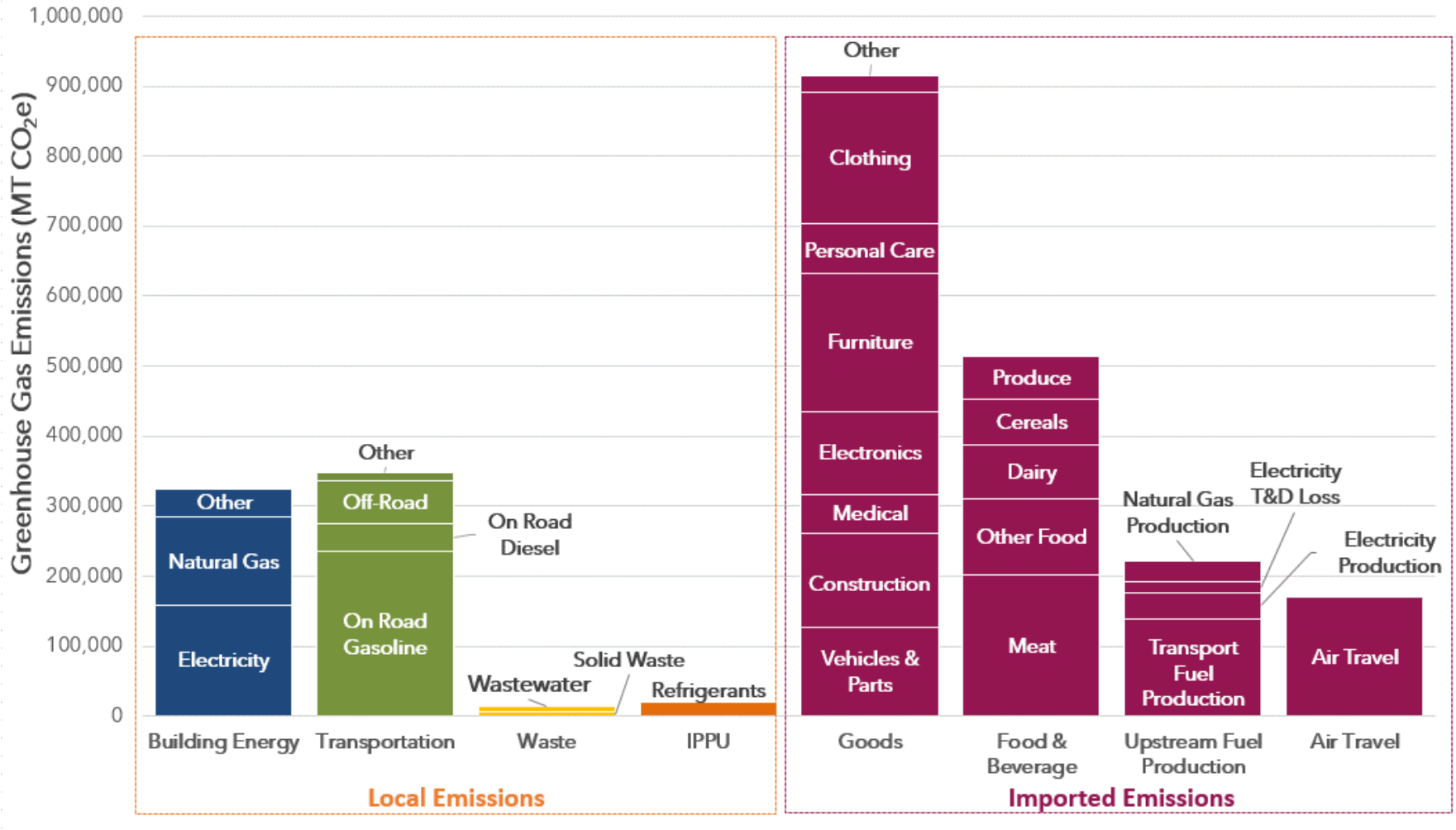
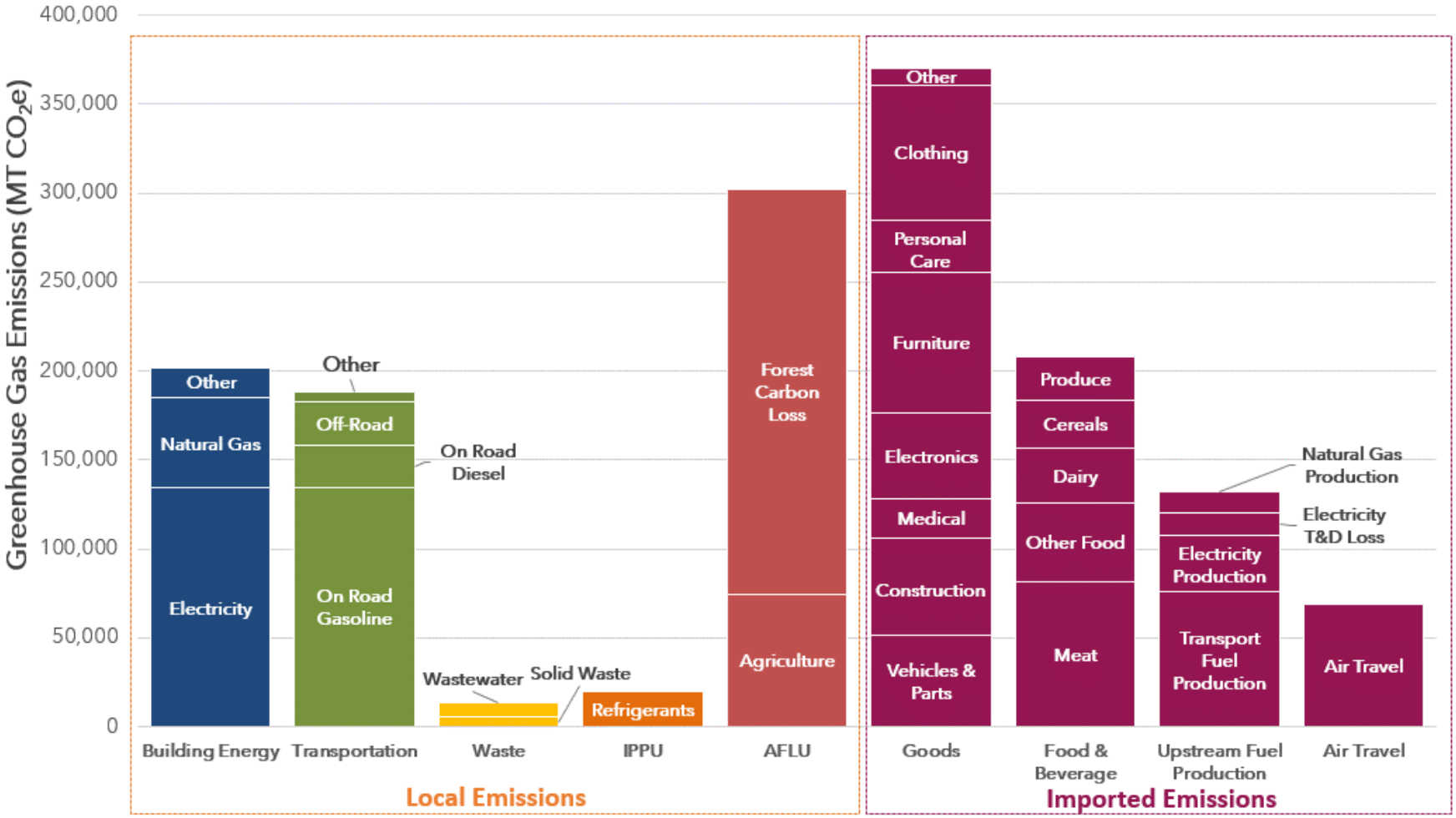


Figure 15 below provides a full breakdown of **rural unincorporated** Clark County's 2022 GHG emissions.

**Figure 15: Full Breakdown of Clark County's 2022 Rural Unincorporated Emissions**



# Appendix A: Glossary of Terms

**Carbon (or GHG) footprint**

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 CO2e (carbon dioxide equivalent).

**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 ($CO_2$) 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. 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 ($CO_2e$). 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.[5]

### 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 (GCP), 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.

[5] 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.

**MT**

Short for metric ton, which equals about 2,200 pounds. 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 $CO_2e$). 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**

| Clark County Emissions Sector / Sub-Sector *Using market-based accounting for electricity* | 2022 Emissions | | | Per Capita | | |
|---|---|---|---|---|---|---|
| | Urban | Rural | Total | Urban | Rural | Total |
| **Building Energy** | **326,007** | **202,107** | **528,115** | **1.9** | **2.9** | **2.2** |
| Residential Buildings | | | | | | |
| Electricity | 106,988 | 117,018 | 224,006 | 0.6 | 1.7 | 0.9 |
| Natural Gas | 94,829 | 38,393 | 133,221 | 0.6 | 0.6 | 0.6 |
| Other Fuels & Emissions | 21,918 | 9,008 | 30,926 | 0.1 | 0.1 | 0.1 |
| Commercial Buildings | | | | | | |
| Electricity | 36,291 | 14,139 | 50,430 | 0.2 | 0.2 | 0.2 |
| Natural Gas | 26,469 | 10,716 | 37,186 | 0.2 | 0.2 | 0.2 |
| Other Fuels & Emissions | 20,080 | 8,128 | 28,208 | 0.1 | 0.1 | 0.1 |
| Industrial Facilities | | | | | | |
| Electricity | 15,053 | 2,937 | 17,989 | <.1 | <.1 | <.1 |
| Natural Gas | 4,288 | 1,736 | 6,024 | <.1 | <.1 | <.1 |
| Other Fuels & Emissions | 92 | 32 | 124 | <.1 | <.1 | <.1 |
| **Transportation** | **348,541** | **188,115** | **536,656** | **2.0** | **2.7** | **2.2** |
| Passenger cars | 235,364 | 134,403 | 369,767 | 1.4 | 1.9 | 1.5 |
| Freight | 39,990 | 23,407 | 63,398 | 0.2 | 0.3 | 0.3 |
| Transit | 3,097 | 1,254 | 4,350 | <.1 | <.1 | <.1 |
| Off-road | 61,777 | 25,011 | 86,788 | 0.4 | 0.4 | 0.4 |
| Rail | 7,268 | 2,942 | 10,210 | <.1 | <.1 | <.1 |
| Electric Vehicles | 1,045 | 596 | 1,641 | <.1 | <.1 | <.1 |
| Local Aviation | N/A | 501 | 501 | N/A | <.1 | <.1 |
| **Solid Waste & Wastewater** | **19,906** | **13,737** | **33,643** | **0.1** | **0.2** | **0.1** |
| Solid Waste Landfill | 13,138 | 5,319 | 18,457 | <.1 | <.1 | <.1 |
| Wastewater Treatment & Septic Systems | 6,769 | 8,418 | 15,187 | <.1 | 0.1 | <.1 |
| **Industrial Process & Product Use** | **48,556** | **19,659** | **68,215** | **0.3** | **0.3** | **0.3** |
| Refrigerants | 48,556 | 19,659 | 68,215 | 0.3 | 0.3 | 0.3 |
| **Agriculture, Forestry, & Land Use** | | **301,743** | **301,743** | | **4.4** | **1.3** |
| Agricultural Soil Amendments | N/A | 8,067 | 8,067 | N/A | 0.1 | <.1 |
| Livestock | N/A | 66,676 | 66,676 | N/A | 1.0 | 0.3 |
| Land Use Emissions | N/A | 1,390,000 | 1,390,000 | N/A | 20.1 | 5.8 |
| Land Use Sequestration | N/A | -1,163,000 | -1,163,000 | N/A | <.1 | <.1 |
| **Imported Emissions** | **1,810,221** | **772,265** | **2,582,486** | **10.6** | **11.1** | **10.7** |
| Household Consumption | | | | | | |
| Goods | 914,721 | 370,355 | 1,285,075 | 5.3 | 5.3 | 5.3 |
| Food | 513,192 | 207,784 | 720,976 | 3.0 | 3.0 | 3.0 |
| Air Travel | 169,279 | 68,538 | 237,816 | 1.0 | 1.0 | 1.0 |
| Upstream Energy Production | 213,030 | 125,588 | 338,618 | 1.2 | 1.8 | 1.4 |
| **Negative Emissions** | **-2,871** | **-1,162** | **-4,033** | **-0.02** | **-0.02** | **-0.02** |
| Purchased Offsets | -2,871 | -1,162 | -4,033 | -0.02 | -0.02 | -0.02 |
| Local Emissions | 743,011 | 725,360 | 1,468,371 | 4.3 | 10.5 | 6.1 |
| Local + Imported | 2,553,232 | 1,497,625 | 4,050,857 | 14.9 | 21.6 | 16.8 |

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

| Clark County Emissions Sector / Sub-Sector<br>*Using location-based accounting for electricity* | 2022 Emissions | | | Per Capita | | |
|---|---|---|---|---|---|---|
| | Urban | Rural | Total | Urban | Rural | Total |
| **Building Energy** | **475,879** | **328,836** | **804,715** | **2.8** | **4.7** | **3.3** |
| Residential Buildings | | | | | | |
| Electricity | 208,259 | 227,609 | 435,868 | 1.2 | 3.3 | 1.8 |
| Natural Gas | 94,829 | 38,393 | 133,221 | 0.6 | 0.6 | 0.6 |
| Other Fuels & Emissions | 21,918 | 9,008 | 30,926 | 0.1 | 0.1 | 0.1 |
| Commercial Buildings | | | | | | |
| Electricity | 70,643 | 27,502 | 98,145 | 0.4 | 0.4 | 0.4 |
| Natural Gas | 26,469 | 10,716 | 37,186 | 0.2 | 0.2 | 0.2 |
| Other Fuels & Emissions | 20,080 | 8,128 | 28,208 | 0.1 | 0.1 | 0.1 |
| Industrial Facilities | | | | | | |
| Electricity | 29,301 | 5,712 | 35,013 | 0.2 | <.1 | 0.1 |
| Natural Gas | 4,288 | 1,736 | 6,024 | <.1 | <.1 | <.1 |
| Other Fuels & Emissions | 92 | 32 | 124 | <.1 | <.1 | <.1 |
| **Transportation** | **349,527** | **188,678** | **538,205** | **2.0** | **2.7** | **2.2** |
| Passenger cars | 235,364 | 134,403 | 369,767 | 1.4 | 1.9 | 1.5 |
| Freight | 39,990 | 23,407 | 63,398 | 0.2 | 0.3 | 0.3 |
| Transit | 3,097 | 1,254 | 4,350 | <.1 | <.1 | <.1 |
| Off-road | 61,777 | 25,011 | 86,788 | 0.4 | 0.4 | 0.4 |
| Rail | 7,268 | 2,942 | 10,210 | <.1 | <.1 | <.1 |
| Electric Vehicles | 2,031 | 1,159 | 3,190 | <.1 | <.1 | <.1 |
| Local Aviation | N/A | 501 | 501 | N/A | <.1 | <.1 |
| **Solid Waste & Wastewater** | **19,906** | **13,737** | **33,643** | **0.1** | **0.2** | **0.1** |
| Solid Waste Landfill | 13,138 | 5,319 | 18,457 | <.1 | <.1 | <.1 |
| Wastewater Treatment & Septic Systems | 6,769 | 8,418 | 15,187 | <.1 | 0.1 | <.1 |
| **Industrial Process & Product Use** | **48,556** | **19,659** | **68,215** | **0.3** | **0.3** | **0.3** |
| Refrigerants | 48,556 | 19,659 | 68,215 | 0.3 | 0.3 | 0.3 |
| **Agriculture, Forestry, & Land Use** | | **301,743** | **301,743** | | **4.4** | **1.3** |
| Agricultural Soil Amendments | N/A | 8,067 | 8,067 | N/A | 0.1 | <.1 |
| Livestock | N/A | 66,676 | 66,676 | N/A | 1.0 | 0.3 |
| Land Use Emissions | N/A | 1,390,000 | 1,390,000 | N/A | 20.1 | 5.8 |
| Land Use Sequestration | N/A | -1,163,000 | -1,163,000 | N/A | <.1 | <.1 |
| **Imported Emissions** | **1,853,143** | **808,564** | **2,661,707** | **10.8** | **11.7** | **11.1** |
| Household Consumption | | | | | | |
| Goods | 914,721 | 370,355 | 1,285,075 | 5.3 | 5.3 | 5.3 |
| Food | 513,192 | 207,784 | 720,976 | 3.0 | 3.0 | 3.0 |
| Air Travel | 169,279 | 68,538 | 237,816 | 1.0 | 1.0 | 1.0 |
| Upstream Energy Production | 255,951 | 161,888 | 417,839 | 1.5 | 2.3 | 1.7 |
| **Negative Emissions** | **-2,871** | **-1,162** | **-4,033** | **-0.02** | **-0.02** | **-0.02** |
| Purchased Offsets | -2,871 | -1,162 | -4,033 | -0.02 | -0.02 | -0.02 |
| Local Emissions | 893,868 | 852,652 | 1,746,521 | 5.2 | 12.3 | 7.3 |
| Local + Imported | 2,747,011 | 1,661,216 | 4,408,227 | 16.1 | 24.0 | 18.3 |

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

# 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 $CO_2e$). 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), sulfur hexafluoride ($SF_6$), 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).

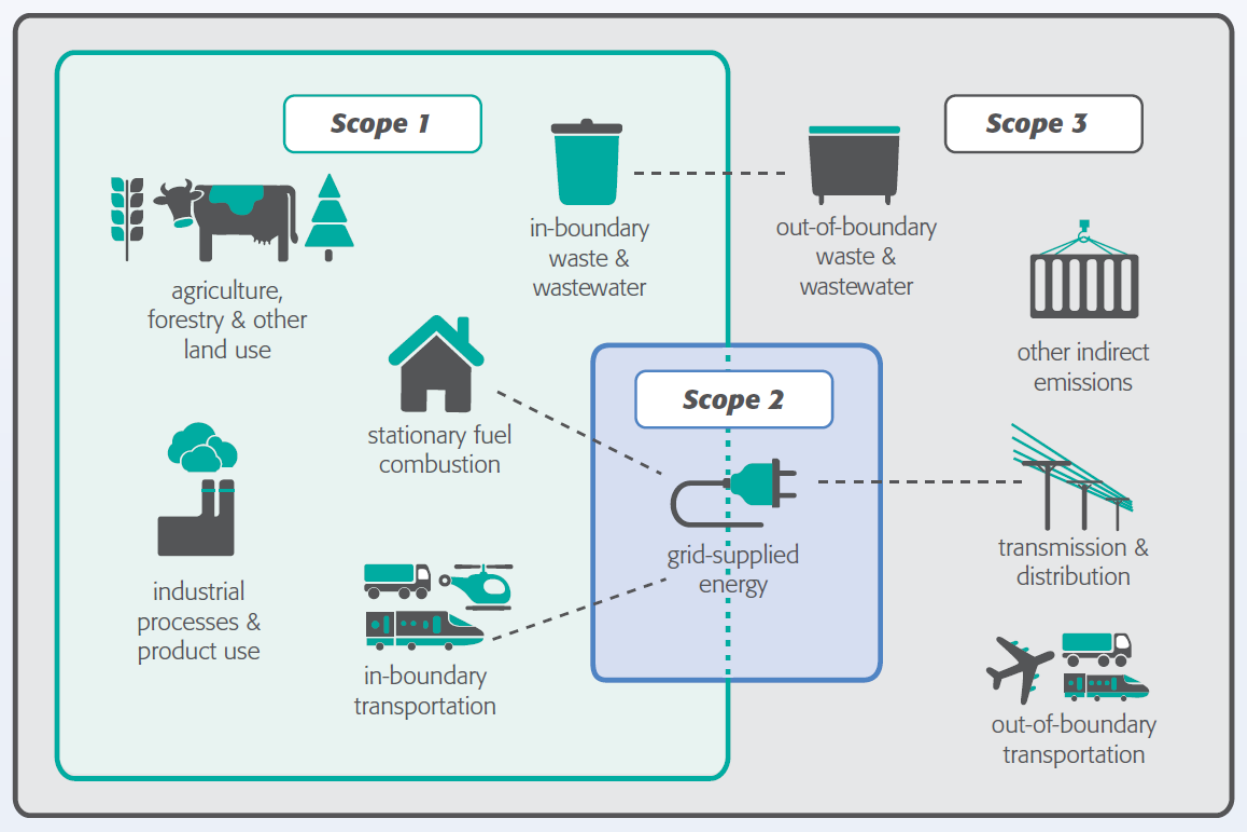
## Scopes

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 16 (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. 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 16: Graphical Illustration of Scopes[6]**




[6] 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 |
|---|---|---|---|
| **Building Energy** | | | |
| Residential Buildings | ✓ | ✓ | |
| Commercial Buildings | ✓ | ✓ | |
| Industrial Facilities | ✓ | ✓ | |
| Fugitive Emissions from Natural Gas Systems | ✓ | | |
| Fugitive Sulfur Hexafluoride | ✓ | | |
| **Transportation** | | | |
| On-Road Passenger Vehicles | ✓ | ✓ | |
| On-Road Heavy-Duty and Freight | ✓ | ✓ | |
| Transit Vehicles | ✓ | | |
| Off-Road Vehicles and Equipment | ✓ | | |
| Rail | ✓ | | |
| Local Aviation | ✓ | | |
| **Waste & Wastewater** | | | |
| Landfill Waste | ✓ | | |
| Central Wastewater Treatment | ✓ | | |
| Septic Systems | ✓ | | |
| **Industrial Process & Product Use** | | | |
| Refrigerants | ✓ | | |
| Industrial Process Emissions | ✓ | | |
| **Agriculture, Forestry, & Land Use** | | | |
| Agricultural Soil Amendments | ✓ | | |
| Livestock | ✓ | | |
| Land Use Emissions | ✓ | | |
| Land Use Sequestration (annual growth) | ✓ | | |
| **Imported Emissions** | | | |
| Household Consumption | | | ✓ |
| Air Travel | | | ✓ |
| Upstream Energy Production | | | ✓ |
| **Negative Emissions** | | | |
| Purchased carbon offsets | ✓ | | |
| Other emissions activities not listed above do not occur within the boundary - see list of exclusions. | | | |

## Inventory Exclusions

**Table 5: Summary of Inventory Exclusions**

| Inventory Exclusions by Emissions Sector | | | |
|---|---|---|---|
| **GPC Terminology** | **Report Terminology** | **Notation Key** | **Description** |
| **Stationary Energy** | **Building Energy** | | |
| 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 from agriculture, forestry, and fishing facilities (such as farms, logging sites, etc.) 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 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. |
| 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. |
| **Transportation** | | | |
| On-road | On-road passenger vehicles | Included | |
| | On-road heavy-duty freight | Included | |
| | Transit vehicles | Included | |
| Railways | Rail | Included | |

| | | | |
|---|---|---|---|
| Waterborne navigation | | NO | The major local source of these emissions comes from the Port of Vancouver which is outside of the inventory 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 | |
| **Waste** | **Solid Waste and Wastewater** | | |
| 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 | Included | |
| **Industrial Process and Product Use (IPPU)** | | | |
| Industrial Processes | Industrial Process Emissions | NO | No activity identified within Clark County's geographic boundary. All industrial emissions visible in state and federal reporting are limited to building energy emissions. |
| Product Use | Refrigerants | Included | |
| **Agriculture, Forestry, & Other Land Use** | **Agriculture, Forestry, & Land Use** | | |
| Livestock | Livestock | Included | Assumed to be in rural geography only. |
| Land | Land Use Emissions | Included | |
| | Land Use Sequestration (annual growth) | Included | |
| Aggregate sources and non-$CO_2$ emission sources on land | Agricultural Soil Amendments | Included | |

| Other Scope 3 | Imported Emissions | | |
|---|---|---|---|
| | 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.

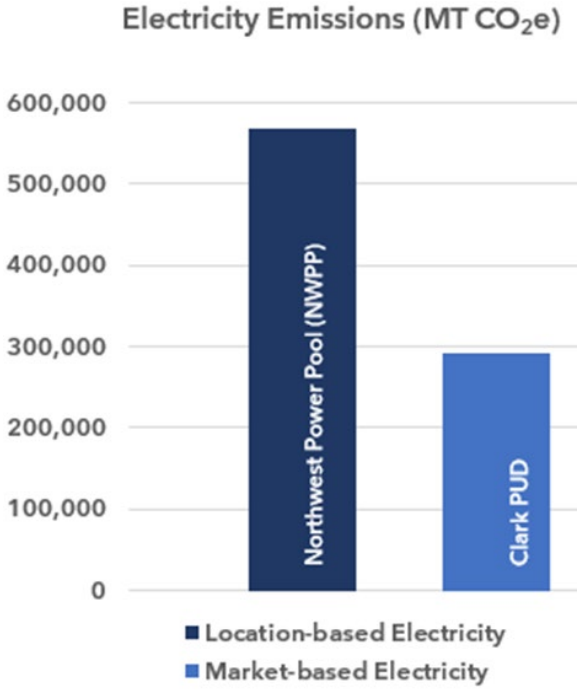
## Electricity Accounting

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.[7] **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. As shown in Figure 17, market-based accounting shows emissions as far less than location-based as it accounts for the local renewables feeding into the energy system.

**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).[8] 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 17: Electricity Emissions in MT $CO_2e$ 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.

[7] For details, visit http://www.ghgprotocol.org/scope_2_guidance.
[8] https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf

# Appendix D: Summary of Data and Emissions Factors

## Data Collection

Project consultant staff worked with Clark County's staff to collect the data required to calculate emissions. Clark 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 detail below.

| 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 was provided by Clark Public Utility District and Northwest Natural. Electricity and natural gas data included information on retail sales, transported gas, 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 Clark County's population. Emissions factors for natural gas, fuel oil, and propane are from U.S. Environmental Protection Agency'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. 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 system leakage quantity. This data is considered highly accurate. | |
| **Transportation** | |
| **On-Road Energy** | *Direct emissions from gasoline and diesel for passenger and freight transportation.* |
| Emissions from on-road energy were calculated using a combination of vehicle miles traveled (VMT) modeling approaches. First, each relevant geography (cities, unincorporated rural, and UGA areas) were mapped and uploaded to Replica software. This software 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 estimated 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.

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 each geography. Overall, WSDOT estimates were larger by about 20% but are assumed to be more accurate and the preferred data source.

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 all geographies. 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 for that location).

Due to assumptions around fuel type and fuel economy, data is considered to have medium accuracy.

Note that C-TRAN fuel use was subtracted from freight diesel outside of the model.

| **Transit** | *Direct emissions from fuels powering passenger transit transportation.* |
|---|---|

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. This data is considered highly accurate.

| **Air Travel** | *Direct emissions from local airports within the geographic boundary.* |
|---|---|

There are several airports and helipads located within the geographic boundary. The emissions associated with these were estimated through fuel sales data provided directly by airport management. Not all local airports responded to the request for data. The data that was received is considered highly accurate.

| | |
|---|---|
| **Off-Road Including Rail** | *Direct emissions from gasoline and diesel for off-road vehicles, such as construction equipment, etc.* |
| Emissions from off-road vehicles were estimated based on the state of Washington's GHG inventory (2019, used as proxy) and were downscaled by population. Off-road transportation data were available, split into air transport, marine transport, locomotives, and "other"; air and marine transport were excluded since no significant marine transport, such as ferries, exist in the community and air transport was collected separately. Data was given in carbon dioxide equivalent ($CO_2e$). This data is considered to have medium to low 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 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. This data is considered to be highly accurate. | |
| **Agriculture: Livestock** | *Direct emissions from agricultural activities, primarily from the management of animal enteric fermentation and manure management.* |
| Activity data for livestock taken from USDA's 2022 Census of Agriculture for Clark 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. | |
| **Agriculture: Soil Amendments** | *Direct emissions from fertilizer application and soil management.* |
| Agriculture soil emissions are estimated in the Washington State Greenhouse Gas Inventory in 2019 and downscaled for Clark County on a farm acreage basis. Washington state and Clark County "acres of harvested crop land" are taken from USDA's 2022 Census of Agriculture for Clark County. Emissions are considered as having medium to low accuracy. | |
| **Solid Waste & Wastewater** | |
| **Landfilled Solid Waste** | *Fugitive methane emissions from mixed solid waste generated in the community regardless of disposal location.* |
| Clark County has no active 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 Findley Butte and Wasco County landfills were downscaled based on reported short tons | |

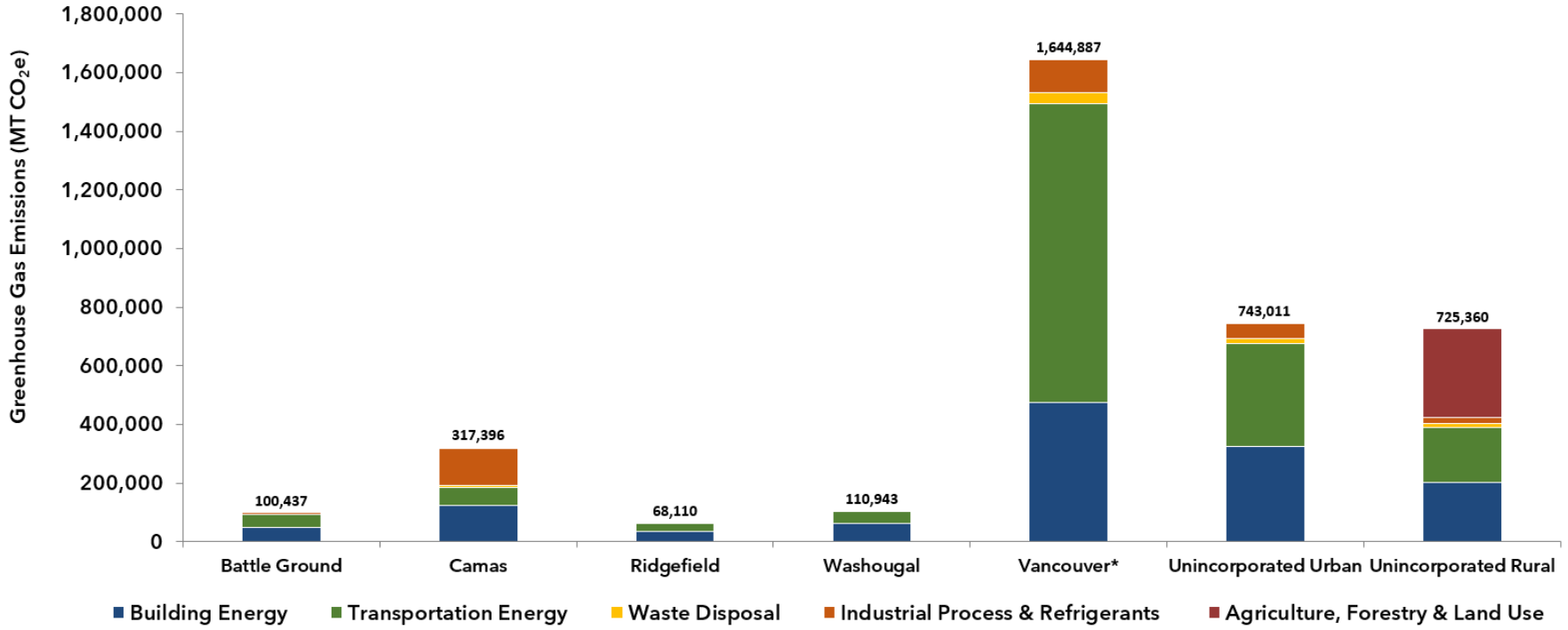
| | |
|---|---|
| from Clark County customers. Then, the total emissions were downscaled for each geography by population. This methodology follows IPCC's first order decay model and is designated by EPA as EE-6 calculations. This activity data is considered highly accurate. | |
| **Wastewater Treatment 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 Clark Regional Wastewater District staff. 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 system emissions were estimated based on subtracting service population data from central wastewater treatment plants in Clark County from the county population and applying a per capita emissions factor. This activity data is considered moderately accurate. | |
| **Industrial Process & Product Use** | |
| **Product Use (Refrigerants)** | *Fugitive loss of refrigerants and other high global warming potential (GWP) gases from building and vehicle air conditioning systems.* |
| 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. | |
| **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.* |
| **Air Travel** | *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 Berkeley Cool Climate Calculator was used to estimate emissions based on the county'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. | |
| **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. 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.<br><br>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 NWN 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. | |

# Appendix E: Sub-Jurisdictions GHG Emissions

Figure 18 below displays emissions by each sub-jurisdiction within Clark County. La Center, Yacolt, and Woodland have been excluded because they are exempt from the GHG emissions reduction requirement of the Growth Management Act.

**Figure 18: Total GHG Emissions by Sub-jurisdiction, Including Cities and Unincorporated Clark County**




| | Battle Ground | Camas | Ridgefield | Washougal | Vancouver | Unincorporated Urban | Unincorporated Rural |
|---|---|---|---|---|---|---|---|
| **Population** | 21,780 | 27,250 | 13,640 | 17,390 | 184,463 | 171,130 | 69,284 |
| **Local Emissions Per Capita** | 4.6 | 11.6 | 5.0 | 6.4 | 8.9 | 4.3 | 10.5 |

**Note that Vancouver's inventory was completed for calendar year 2019 before the scope of this project and by a different consulting firm, so the boundaries and methodology vary from the other four jurisdictions and Clark County's inventory.*