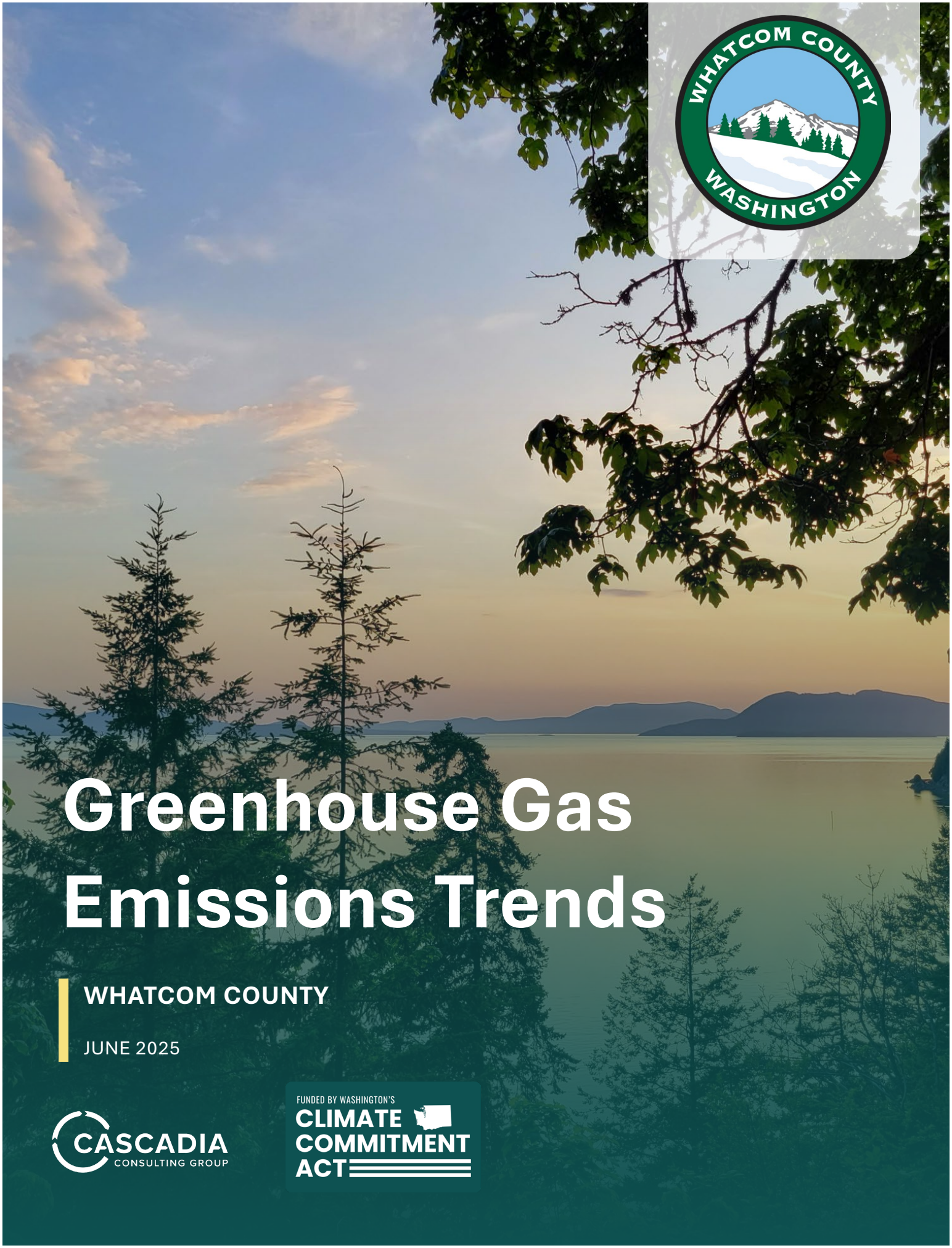

Greenhouse Gas Emissions Trends

WHATCOM COUNTY

JUNE 2025

CASCADIA CONSULTING GROUP

FUNDED BY WASHINGTON'S CLIMATE COMMITMENT ACT

Funding Acknowledgment

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Contents

Executive Summary

This *Greenhouse Gas Emissions Trends* report provides a summary of past and current communitywide and County government operations greenhouse gas (GHG) emissions for Whatcom County from 2017-2022. Outcomes from this analysis will inform development of the County's Climate Element as part of its comprehensive plan update, in compliance with Washington State House Bill (HB) 1181 requirements.

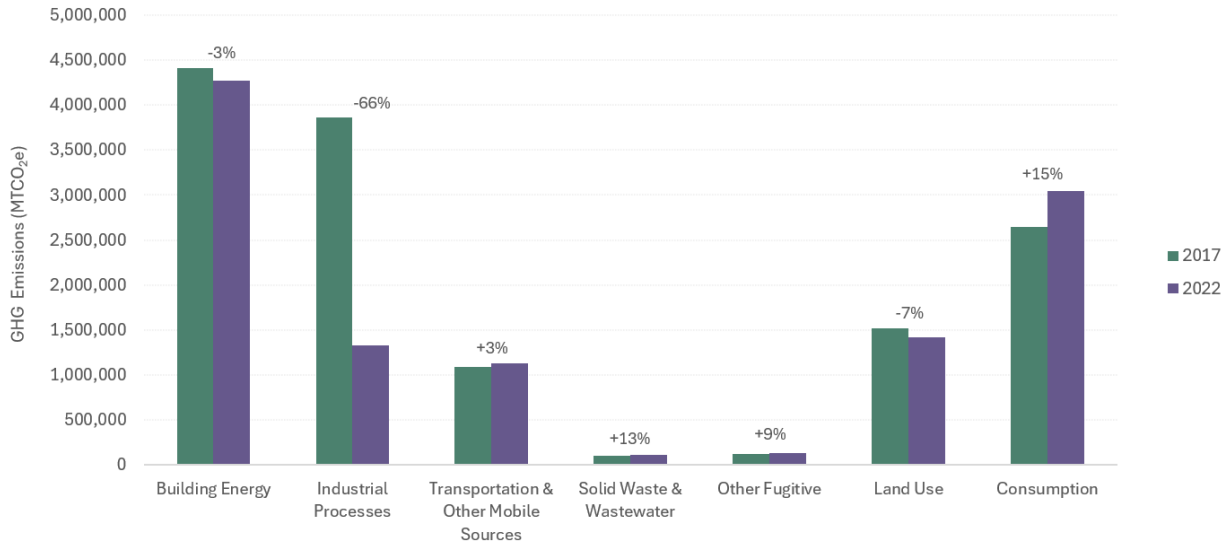
Methodology

Whatcom County's GHG 2017 and 2022 emissions inventories aligned with the standard protocols: the *U.S. Community Protocol for Accounting and Reporting of GHG Emissions* (USCP) for the communitywide inventory and the *Local Government Operations Protocol for the Quantification and Reporting of GHG Emissions Inventories* (LGOP) for the County government operations inventory. Both inventories included key recommended emissions sources from these protocols, including buildings, transportation, solid waste, wastewater, land use, and refrigerants. Emissions are reported for the 2017 and 2022 calendar years (the 2017 inventory was retroactively updated to ensure consistency and comparability with the updated 2022 inventory).

Communitywide GHG Emissions

In 2022, the Whatcom County community produced an estimated 11,417,541 $MTCO_2e$—equivalent to approximately 49.3 $MTCO_2e$ per capita. The community's largest sources of emissions were from the built environment (37%), consumption of goods and services (27%), land use (12%), and industrial processes (12%). Overall communitywide emissions have decreased 17% since 2017—primarily due to reductions in industrial process and electricity emissions.

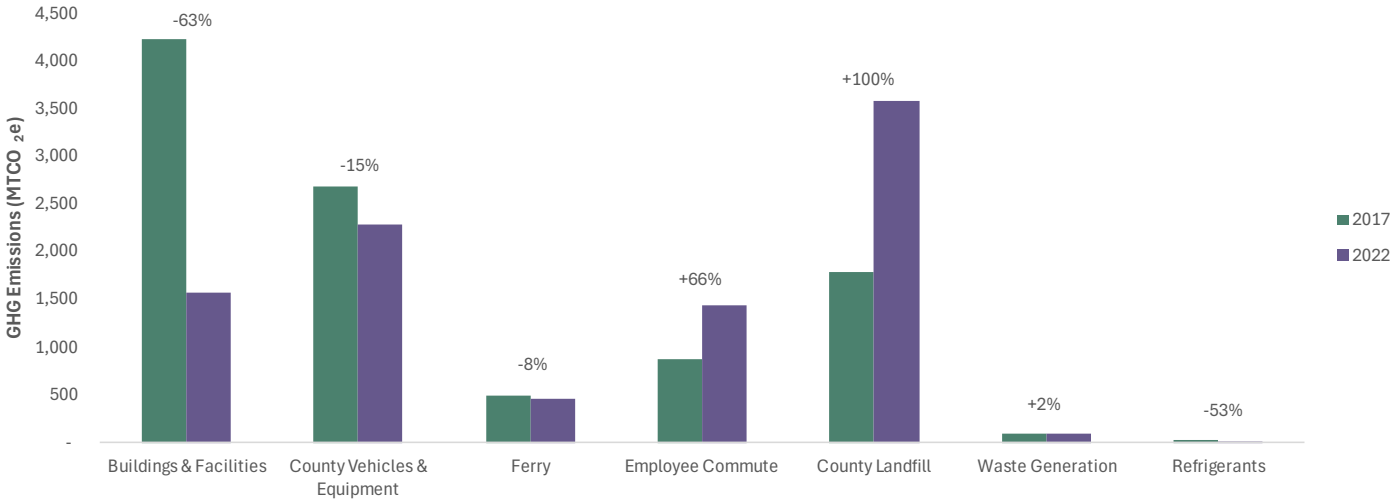
Figure 1. Communitywide GHG emissions trends.



Government Operations GHG Emissions

In 2022, Whatcom County's operations produced an estimated 9,476 $MTCO_2e$—about 0.1% of total communitywide GHG emissions that year. The County's largest sources of emissions came from County fleet vehicles/equipment and County-owned landfills, contributing 24% and 38% of total County operations GHG emissions, respectively (Figure 2). Overall County government operations emissions have decreased 7% since 2017, largely due to reductions in electricity emissions.

Figure 2. County government operations GHG emissions trends.



Introduction

Washington State House Bill (HB) 1181, signed into law in 2023, requires Washington cities and counties to address climate change in local comprehensive plan updates. Assessing Whatcom County's past, current, and future greenhouse gas (GHG) emissions is a critical step in meeting this requirement—understanding where Whatcom County's largest sources of emissions are occurring and where there are opportunities for emissions reduction. Greenhouse gas analyses allow jurisdictions to better understand current and future greenhouse gas emissions trends and develop effective strategies to reduce climate-changing GHG emissions.

This *Greenhouse Gas Emissions Trends* report provides a summary of past and current communitywide and County government operations emissions for Whatcom County from 2017-2022. A separate *Greenhouse Gas Emissions Projections & Scenarios* report will build on these findings to characterize projected future GHG emissions and reduction scenarios. Outcomes from these assessments will inform development of the County's Climate Element as part of its 2025 comprehensive plan update.

Objectives

The GHG analyses described in this report sought to achieve the following objectives:

- **Assess GHG emissions trends and drivers**, including how emissions are changing over time and what could be driving those changes.
- **Assess climate action progress** to monitor, evaluate, and adjust the County's climate action programs and initiatives as needed to ensure communitywide progress toward goals set in the County's Climate Action Plan.
- **Inform policy development** as the County embarks on an update of its comprehensive plan and develops a new Climate Element as part of that planning process.

This report summarizes the outcomes from two Whatcom County GHG emissions inventories:

- A **communitywide GHG emissions inventory** that quantifies GHG emissions from all activities within the county, including from Whatcom County residents, visitors, businesses, and government. This communitywide inventory accounts for emissions from buildings, transportation, land use, and solid waste generation and disposal.
- A **government operations GHG emissions inventory** that only quantifies GHG emissions from County government activities and facilities, including from County facilities, fleet vehicles, County employee commuting, and County operations waste generation and disposal.

Outcomes from these GHG emission inventories will be used to inform a future GHG emissions forecast, assessment of potential emissions reduction scenarios, GHG emission reduction targets and metrics, and GHG emission reduction goals and policies for Whatcom County's comprehensive plan update.

Methodology

In determining the methodology used to complete Whatcom County's GHG analyses, the project team used the following guided principles:

- **Replicability** and **transparency**, to ensure that analyses can be conducted in future years.
- **Consistency** with past county GHG analyses and available data.
- **Accuracy**, including through inclusion of all relevant sectors, use of locally specific data, and alignment with industry best practices.

Whatcom County's GHG emissions inventories aligned with the following standard protocols:

- Whatcom County's communitywide inventory was performed using guidance from both ICLEI's *U.S. Community Protocol for Accounting and Reporting of GHG Emissions* (USCP)[1] and The Greenhouse Gas Protocol's *Global Protocol for Community-Scale Greenhouse Gas Inventories* (GPC)[2]. These protocols are the industry standards for quantifying emissions from community activities.[3]
- Whatcom County's operational inventory was performed using guidance from ICLEI's *Local Government Operations Protocol for the Quantification and Reporting of GHG Emissions Inventories* (LGOP).[4] This protocol outlines a standardized method for local governments to estimate operational emissions.

Sources included in the Whatcom County GHG emissions inventories, detailed in Table 1 below, included buildings, transportation, solid waste, wastewater, land use, refrigerants, and consumption. These sectors are aligned with recommended protocols and industry best practices.

[1] US Community Protocol | ICLEI USA

[2] Global Protocol for Community-Scale GHG Inventories (GPC) | GHG Protocol.

[3] These two protocols have different geographic specificities (e.g., the GPC is more global, while the US Community Protocol has more of a US focus). Both share the same basic GHG accounting principles.

[4] Local Government Operations (LGO) Protocol | ICLEI USA

Table 1. Sources included for the 2022 Whatcom County GHG inventories.

Source	Communitywide	County Operations
Buildings	Electricity Natural gas Propane Fuel oil Industrial processes	Electricity Natural gas Propane Fuel oil
Transportation	On-road vehicles Off-road equipment Aviation Public transit	County fleet vehicles & equipment County employee commute County business travel
Solid waste	Landfilled waste generation & disposal Compost generation & disposal	Landfilled waste generation & disposal Compost generation & disposal County landfills
Wastewater	Treatment processes Septic systems	Treatment processes
Land Use	Agriculture Forests & land use change	N/A
Refrigerants	Refrigerants	Refrigerants
Consumption	Food Goods Services	N/A

GHG emissions inventories are calculated by multiplying activity data by emissions factors:

- **Activity data** quantify levels of activity that generate GHG emissions, such as vehicle miles traveled, and kWh of electricity consumed.
- **Emission factors** (EFs) translate activity levels into greenhouse gas emitted per unit (e.g., MTCO2e per kWh).

Whatcom County's communitywide and operational emissions were quantified for the 2022 calendar year, chosen as the most recent year with complete data at the time of this study and the baseline recommended by the Department of Commerce Climate Planning Intermediate Guidance. Where applicable, this analysis also included retroactive updates of some 2017 GHG inventory sectors to ensure consistency and comparability across inventory years. Analyses were performed in Microsoft Excel and the ICLEI ClearPath tool.[5]

Detailed methodologies and data considerations for each emissions source are provided in Appendix A.

[5] https://icleiusa.org/clearpath/

Policy Implications

Outputs from Whatcom County's GHG emissions inventory and resulting emissions trends support the identification and development of county-specific local policy options. For example:

- **Understanding the current emissions context** provides insight into the County's highest emissions sources, which should be prioritized for policy development to meet GHG emission reduction targets.
- **Understanding historic emissions trends** can provide insights into focus areas for the County climate program and needs for adaptive management of County climate programs and policies to meet changing needs and external factors. Note that the County does not have direct influence or control over all emissions sectors, so emissions trends may not necessarily reflect County program effectiveness or needs. However, for core emissions sources over which the County has more influence (e.g., buildings, passenger vehicle VMT), emissions trends can reveal the following insights:
    - **Emissions increases** in particular sectors indicate areas where more action or regional coordination is needed, or current actions need to be expanded or changed for broader impact.
    - **Emissions decreases** in particular sectors could indicate areas where the County or regional partners have been successful in reducing emissions, and thus should focus its policies and programming on continuing current initiatives or shifting focus to other higher-emitting sectors.

A forthcoming report on Whatcom County's future GHG emissions forecast, and scenarios will provide additional insight regarding potential policy solutions and their projected impact in the context of current and projected state and federal policies.

Inventory Findings & Trends

Communitywide GHG Emissions

In 2022, the Whatcom County community produced an estimated 11,417,541 MTCO2e. The community's largest sources of emissions were from the built environment (37%), consumption of goods and services (27%), land use (12%), and industrial processes (12%; see Figure 3 and Table 2). Overall communitywide emissions have decreased 20% since 2017—primarily due to reductions in industrial process and electricity emissions.

In addition to the comprehensive GHG emissions summary, Table 2 also presents Whatcom County's "core" emissions—emissions produced by sectors most commonly included in community greenhouse gas inventories and over which County governments often have the most influence (e.g., through local policy mechanisms such as local codes/regulations). Core emissions sources in this inventory include on-road vehicles, solid waste generation and disposal, wastewater treatment processes, and residential and commercial electricity and natural gas.

Figure 3. Whatcom County communitywide 2022 GHG emissions profile ($MTCO_2e$).

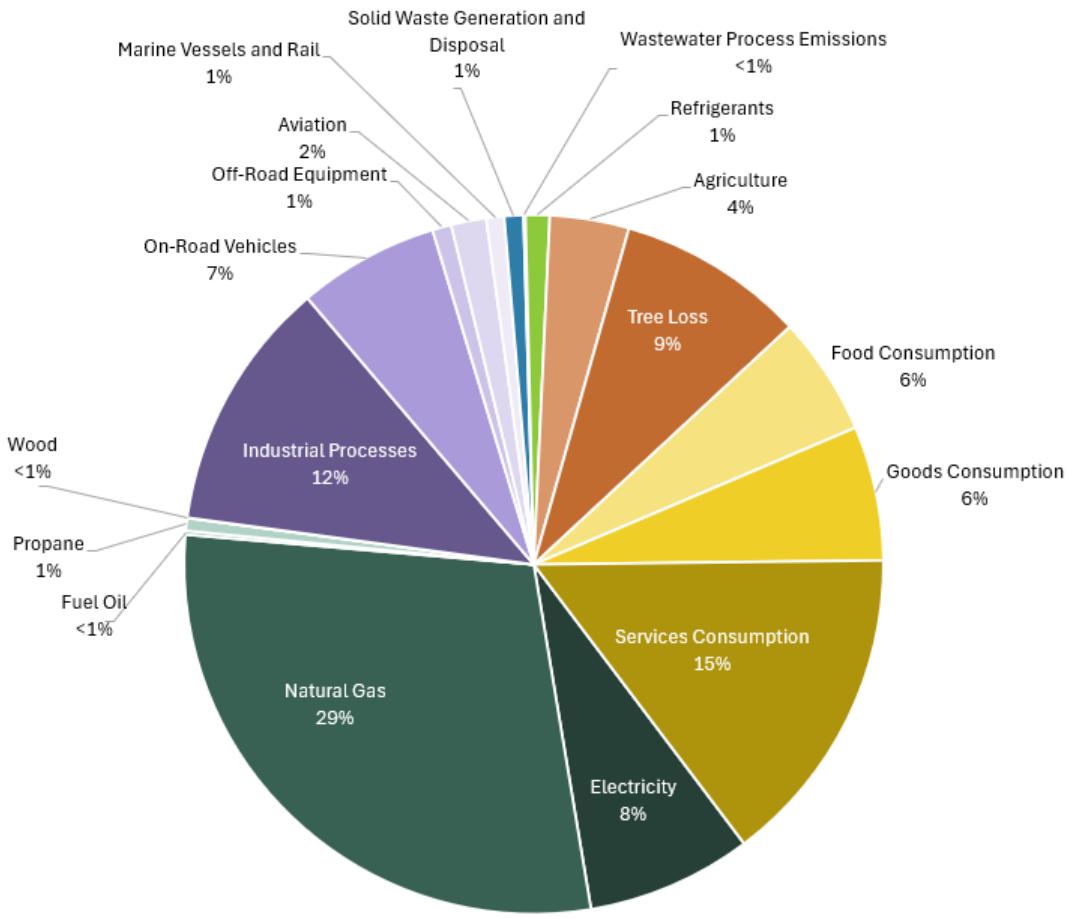
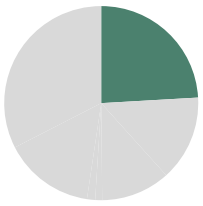


Table 2. Total and per-capita communitywide GHG emissions, by sector ($MTCO_2e$).

GHG Emissions Sector	2017 Total Emissions (MTCO2e)	2022 Total Emissions (MTCO2e)	% Change	2022 % of Total	2022 Per-Capita (MTCO2e)
Building Energy	**4,417,738**	**4,272,328**	**-3%**	**37%**	**18.4**
Electricity	**1,627,014**	**874,247**	**-46%**	**8%**	**3.8**
Residential	541,241	449,247	-17%	4%	1.9
Commercial	458,183	333,667	-27%	3%	1.4
Industrial	627,590	91,334	-85%	1%	0.4
Natural Gas	**2,711,814**	**3,309,779**	**22%**	**29%**	**14.3**
Residential	239,626	256,082	7%	2%	1.1
Commercial	174,193	180,951	4%	2%	0.8
Industrial	2,297,996	2,872,746	25%	25%	12.4
Propane	**63,597**	**66,741**	**5%**	**1%**	**0.3**
Residential	57,023	55,626	-2%	0%	0.2
Commercial	6,574	11,115	69%	0%	<0.1
Fuel Oil	**13,793**	**19,793**	**43%**	**0%**	**0.1**
Residential	5,905	2,998	-49%	0%	< 0.1
Commercial	7,888	16,795	113%	0%	0.1
Wood	**1,521**	**1,769**	**16%**	**0%**	**0.0**
Residential	1,521	1,769	16%	0%	< 0.1
Industrial Processes	**3,862,349**	**1,330,442**	**-66%**	**12%**	**5.7**
Industrial Processes	**3,862,349**	**1,330,442**	**-66%**	12%	**5.7**
Transportation	**1,089,709**	**1,125,418**	**3%**	**10%**	**4.9**
On-Road Vehicles	**792,053**	**739,762**	**-7%**	**6%**	**3.2**
Passenger	588,049	526,514	-10%	5%	2.3
Freight	204,005	213,248	5%	2%	0.9
Public Transit	**5,884**	**5,747**	**-2%**	**0%**	**0.0**
Off-Road Equipment	**93,672**	**100,758**	**8%**	**1%**	**0.4**
Aviation	**123,218**	**184,931**	**50%**	**2%**	**0.8**
Marine & Rail	**74,881**	**94,221**	**26%**	**1%**	**0.4**
Solid Waste & Wastewater	**97,826**	**110,681**	**13%**	**1%**	**0.5**
Generation & Disposal	**88,631**	**100,740**	**14%**	**1%**	**0.4**
Wastewater Processes	**9,195**	**9,941**	**8%**	**0.1%**	**0.0**
Other Fugitive Emissions	**116,567**	**127,219**	**9%**	**1%**	**0.5**
Refrigerants	**115,774**	**126,483**	**9%**	**1%**	**0.5**
SF6	**793**	**736**	**-7%**	**0.01%**	**0.0**
Land Use	**1,511,086**	**1,411,099**	**-7%**	**12%**	**6.1**
Agriculture	**465,852**	**417,908**	**-10%**	**4%**	**1.8**
Tree Loss	**1,045,234**	**993,191**	**-5%**	**9%**	**4.3**
Consumption	**2,643,472**	**3,040,354**	**15%**	**27%**	**13.1**
Food	**388,584**	**628,306**	**62%**	**6%**	**2.7**
Goods	**663,563**	**709,825**	**7%**	**6%**	**3.1**
Services	**1,591,324**	**1,702,223**	**7%**	**15%**	**7.3**
Total Emissions	**13,738,746**	**11,417,541**	**-17%**	**100%**	**49.3**
Core Emissions	**2,309,006**	**2,076,135**	**-10%**		**9.0**

Building Energy

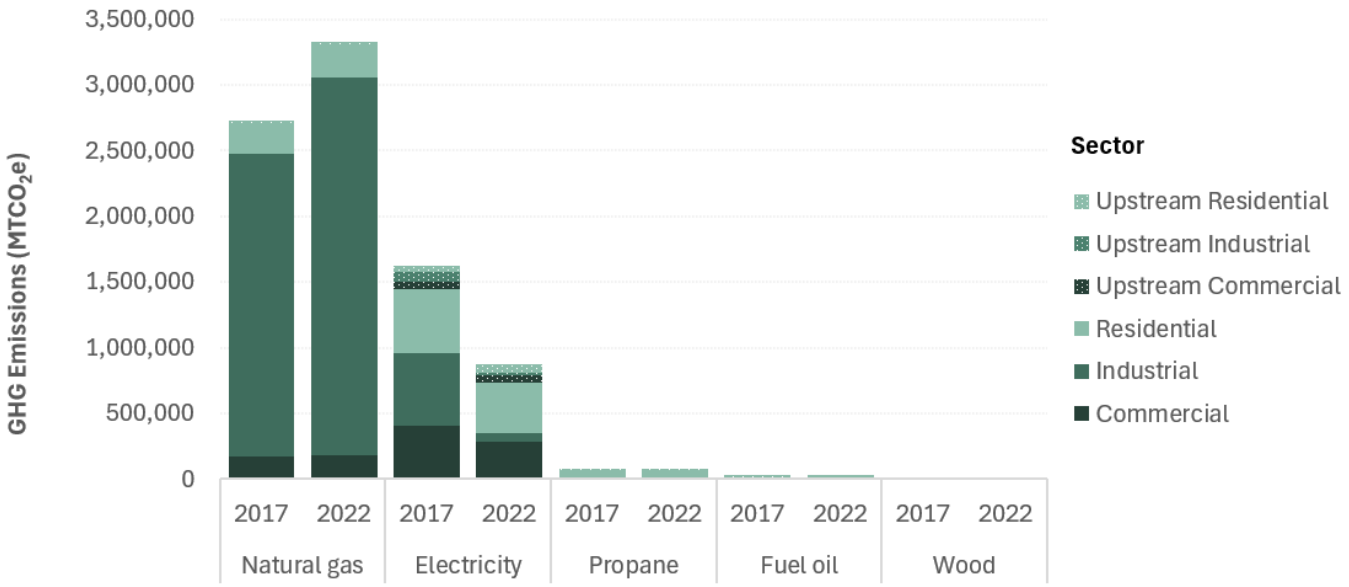


The building energy sector includes emissions from the consumption of **electricity, natural gas,** and **other sources (fuel oil and propane)** within residential, commercial, and industrial buildings. Figure 4 provides a summary of emissions trends from this sector, including emissions from on-site fuel combustion, as well as upstream emissions generated during fuel extraction, production, and transport. A detailed overview of emissions from these sources is provided below.

SUMMARY

- In 2022, building energy emissions accounted for approximately 37% of communitywide emissions.
- Since 2017, building energy emissions have decreased by an estimated 3%, primarily due to reductions in industrial electricity consumption and reductions in the carbon intensity of electricity generation.
- The largest sources of building energy emissions are from electricity and natural gas, which accounted for 8% and 29% of 2022 total communitywide emissions, respectively.
- Since 2017, electricity emissions have decreased by 46%, while natural gas emissions have increased 22% (primarily in the industrial sector, where natural gas consumption increased from 2,297,996 to 2,872,746 therms).
- Other building energy sources make up about 1% of total communitywide emissions.

Figure 4. Building energy GHG emissions trends, by source and sector.



ELECTRICITY

Whatcom County's electricity is delivered through Puget Sound Energy (PSE), City of Blaine, City of Sumas, and Whatcom PUD-1. Electricity accounted for 9% of Whatcom County's total communitywide GHG emissions in 2022. Communitywide electricity emissions have decreased 46% since 2017—primarily due to reductions in industrial electricity consumption and the carbon intensity of electricity generation.

Electricity emissions account for both direct and upstream emissions generated during the processes of extracting, producing, and transporting electricity. Figure 5 shows electricity emission trends between 2017 and 2022, by sector, including both direct (combustion) and upstream sources. Electricity emissions saw decreases in both direct and upstream emissions in all three sectors. As indicated in Figure 6 and Figure 7, these changes in electricity emissions can be attributed to a decrease in industrial electricity consumption and reductions in the carbon intensity of electricity production (i.e., transition to more clean, renewable electricity sources).

Electricity consumption decreased by approximately 25% since 2017. Electricity consumption in the industrial sector saw the largest decrease in consumption at approximately 68% since 2017 (Figure 7). The largest contributor to the decrease in electricity emissions is the reduction of industrial electricity consumption, due to the closure of the Intalco smelter.

Figure 5. Electricity emission trends, by sector.

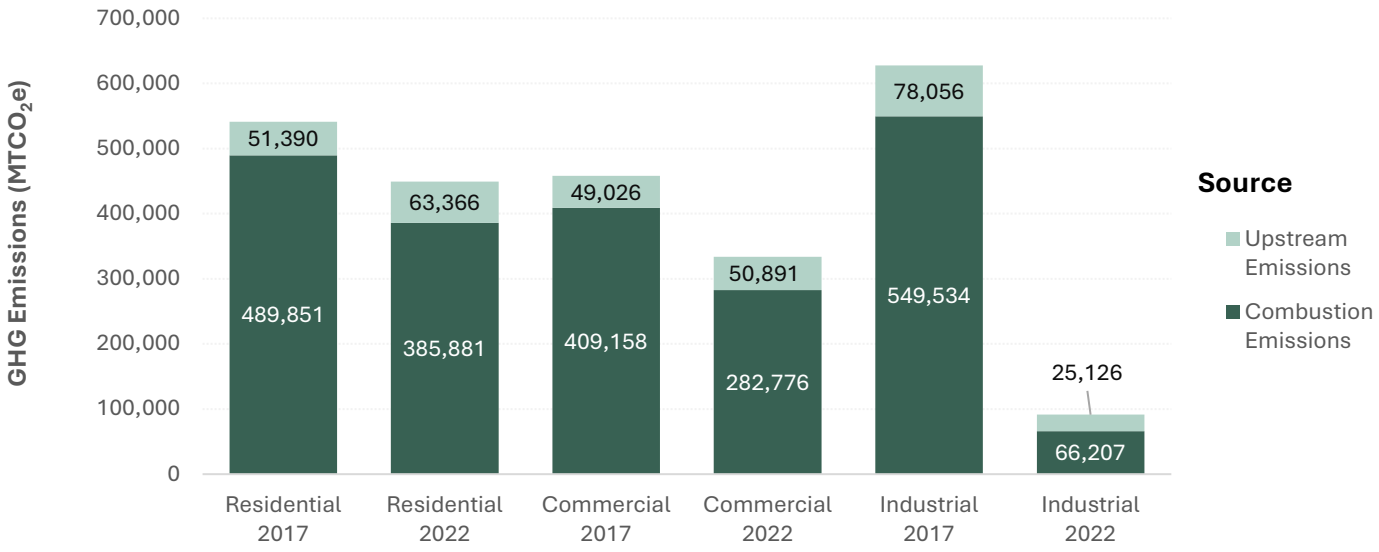


Figure 6. Electricity carbon intensity trends, by sector.

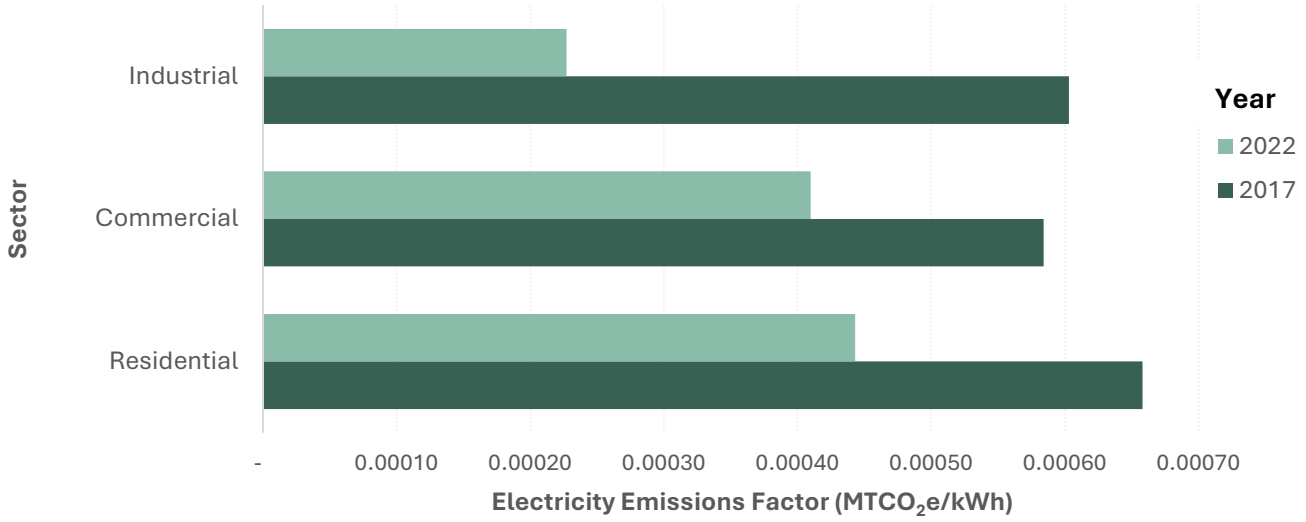
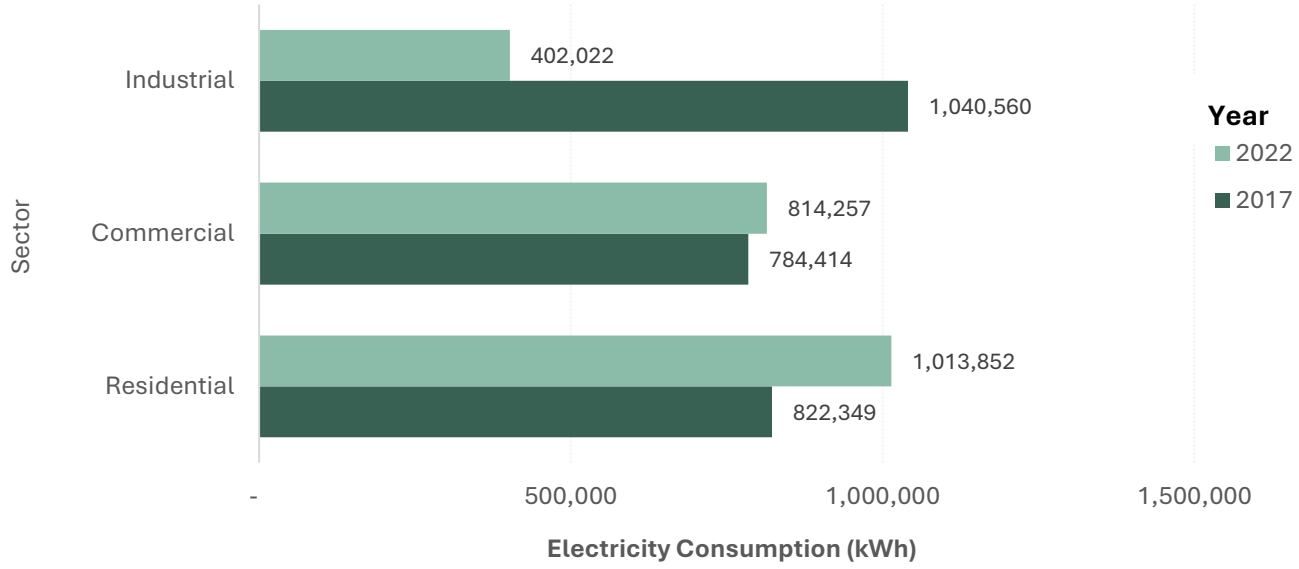


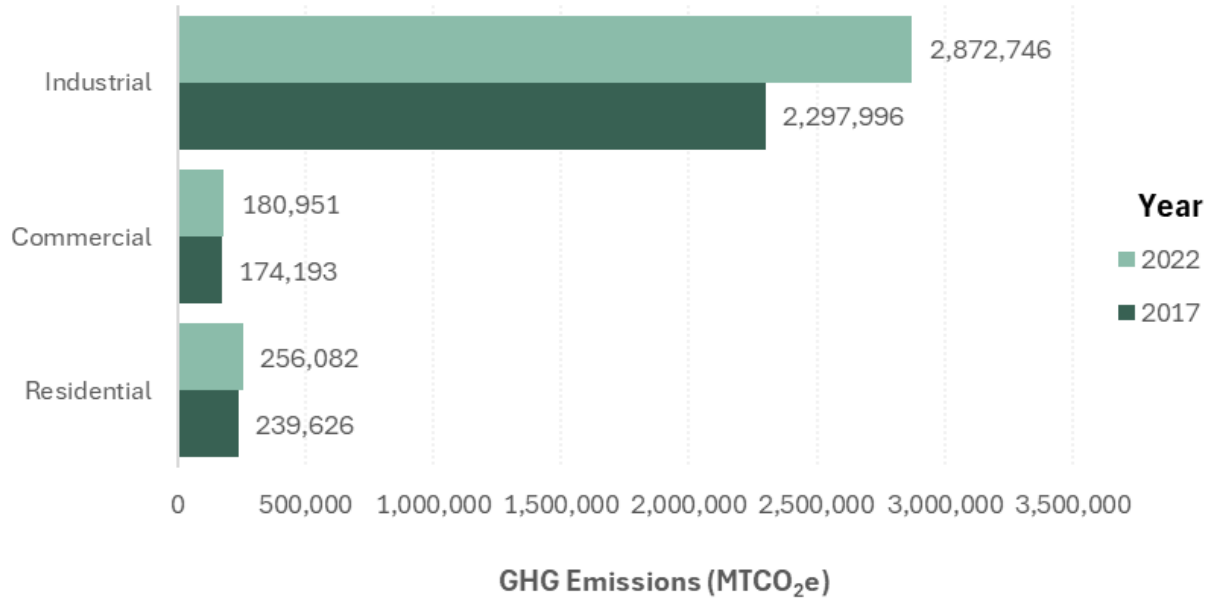
Figure 7. Electricity consumption trends, by sector.



Natural Gas

Whatcom County's natural gas is delivered by Cascade Natural Gas. Natural gas accounted for 29% of Whatcom County's total communitywide GHG emissions in 2022. Natural gas emissions include combustion emissions from all sectors—residential, commercial, and industrial—as well as upstream emissions produced during the extraction, processing, and transportation of natural gas prior to its delivery to consumers. Natural gas emissions in 2022 increased by approximately 22% compared to 2017—largely driven by an increase in industrial natural gas use (Figure 8).

Figure 8. Natural gas emissions trends, by sector.



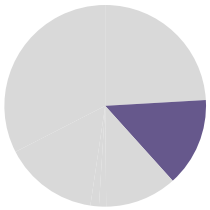
OTHER SOURCES

Other sources of emissions from building energy include direct and upstream emissions from fuel oil, propane, and wood consumption. These other fuel sources accounted for 1% of 2022 communitywide emissions in Whatcom County.

Fuel oil emissions in 2022 increased by 43% compared to 2017, largely due to increased statewide consumption within the commercial sector (scaled to the county level based on the number of commercial employees in Whatcom County).[6] Propane consumption has remained relatively steady (5% increase since 2017).

[6] Whatcom County employees were classified into commercial vs. industrial employees based on employment industry subsector NAICS codes (e.g., manufacturing, retail, professional services).

Industrial Processes

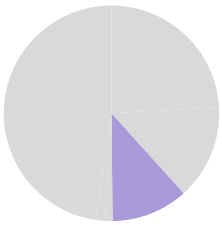


Industrial processes refer to GHG emissions within the industrial sector that are not accounted for through metered natural gas and electricity utilities, such as in industrial manufacturing and processing. Industrial sources within Whatcom County include oil refineries, which comprise the majority of emissions in this sector, as well as an aluminum manufacturing facility. Facilities, electric power entities (EPEs), and fuel suppliers who produce over 25,000 MTO_2e of GHG emissions a year are required to report their emissions to the US EPA annually.

SUMMARY

- In 2022, industrial emissions account for approximately 12% of communitywide emissions in Whatcom County.
- The largest point source of GHG emissions in 2022 in Whatcom County was the BP Cherry Point Refinery, which emitted over 1 million $MTCO_2e$ in 2022.
- Industrial processes have decreased 66% since 2017—largely driven by reduced emissions from the closure of the Intalco aluminum manufacturing facility. While not included in the industrial processes total to avoid double counting with the building energy sector, it is important to note that a couple Puget Sound Energy generating stations saw notable increases in emissions from 2017 and 2022.

Transportation

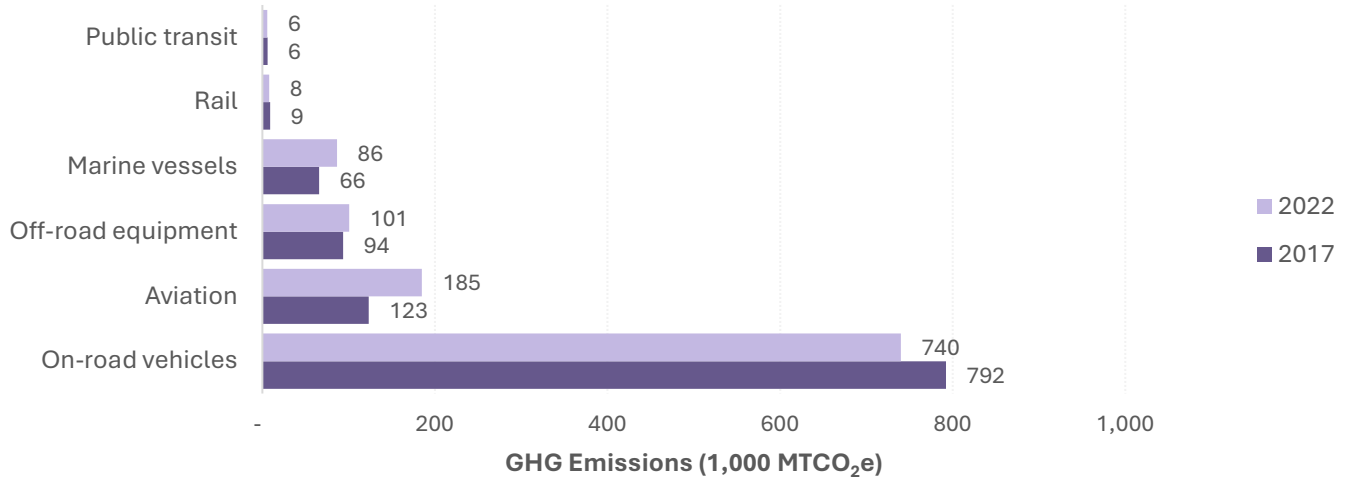


The transportation sector includes emissions from communitywide transportation mobile sources including **on-road vehicles, off-road equipment, aviation, marine vessels, and rail vehicles**. The transportation sector made up 10% of Whatcom County's 2022 communitywide emissions.

SUMMARY

- Transportation emissions have increased 3% since 2017, with reductions in some sectors (on-road vehicles) and increases in others (aviation, offroad equipment, marine/rail; see Figure 9).
- On-road emissions are the largest source of emissions in the transportation sector, representing 6% of overall 2022 communitywide Whatcom County emissions.

Figure 9. Transportation emissions trends.



ON-ROAD VEHICLES

On-road vehicles emissions include emissions from passenger vehicles and freight and service vehicles (heavy, medium, and light vehicles). Most on-road vehicle emissions are from passenger vehicles. Passenger vehicle emissions have declined 10% since 2017, due to both a 9% reduction in vehicle miles traveled as well as a 1% reduction in the carbon intensity of vehicles ($MTCO_2e$/mile; see Figure 10 and Figure 11).

Figure 10. On-road vehicle emissions trends.

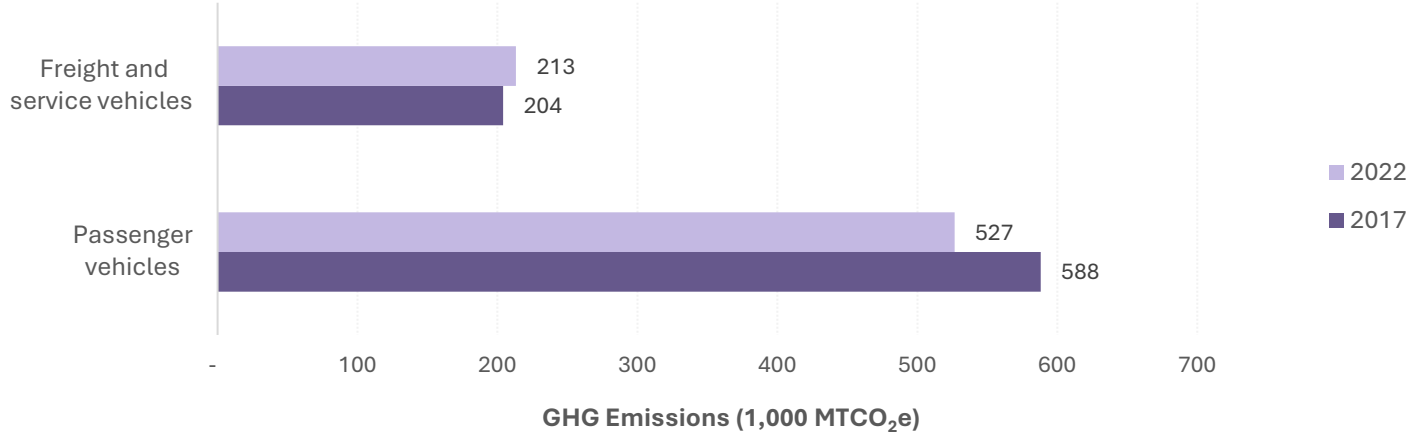


Figure 11. On-road vehicle miles traveled trends.

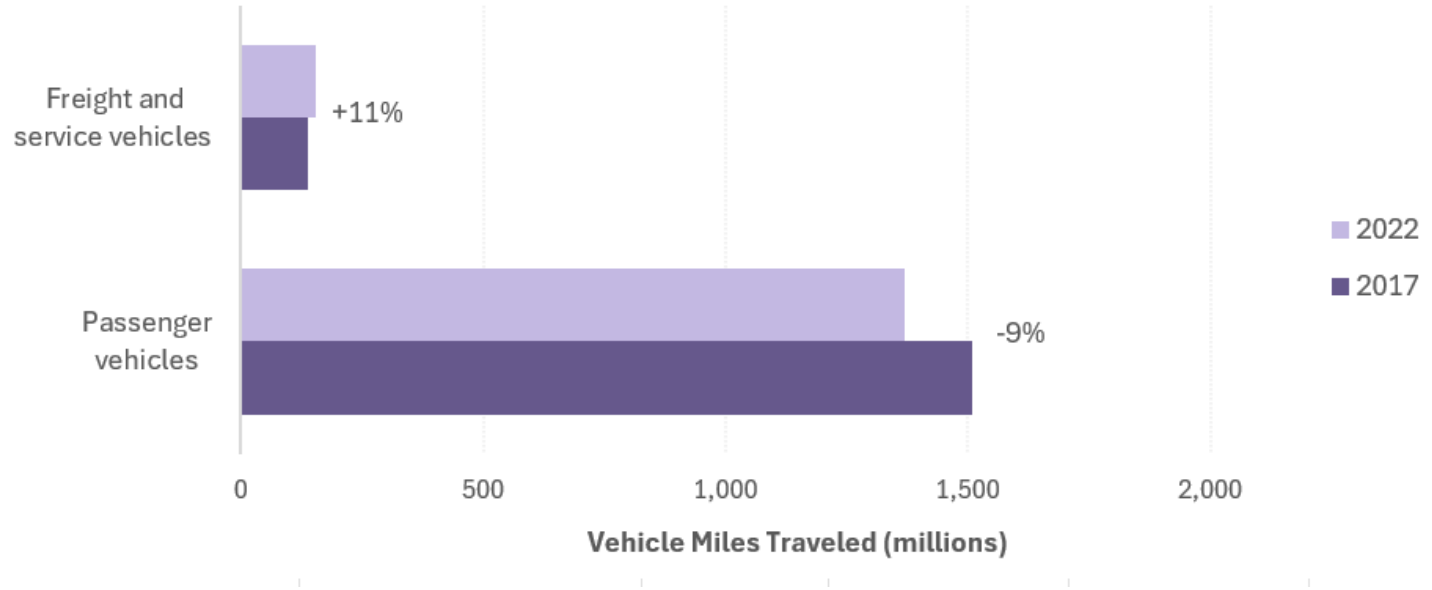
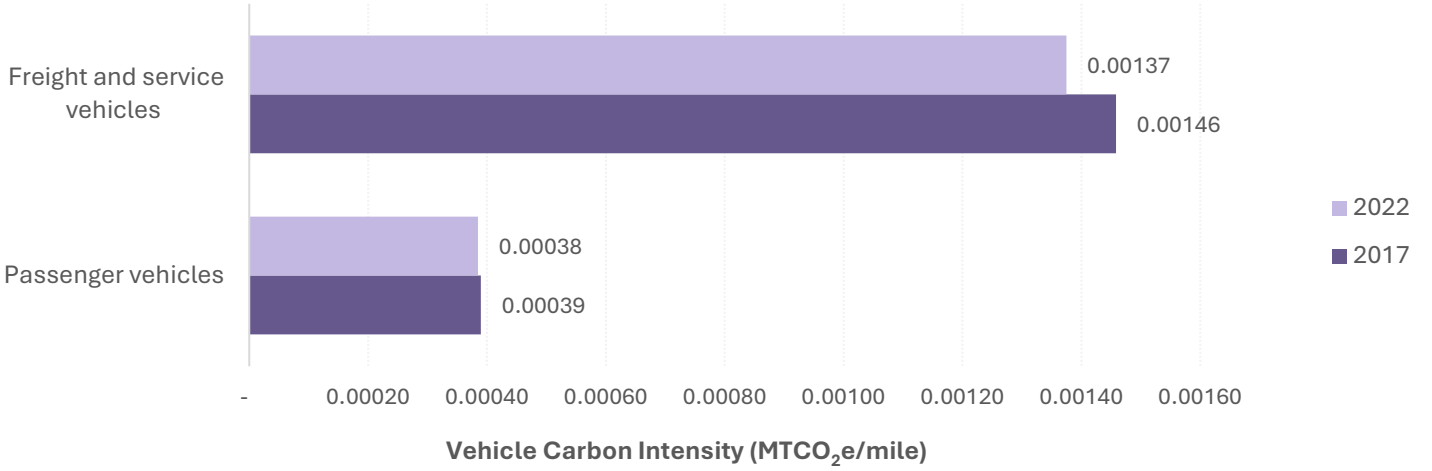


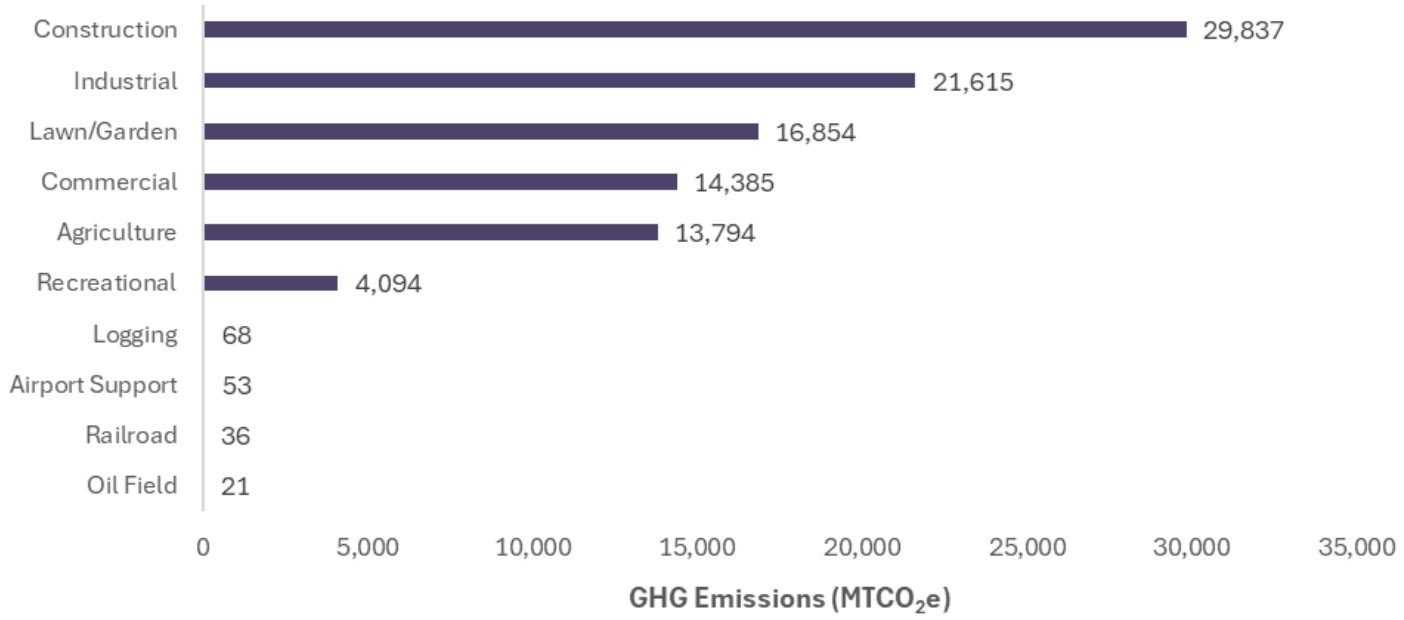
Figure 12. On-road vehicle carbon intensity trends.



OFF-ROAD EQUIPMENT

Off-road equipment—which includes recreational, construction, industrial, lawn/garden, agriculture, commercial, logging, airport support, oil field, pleasure craft, and railroad related equipment—made up 1% of Whatcom County's 2022 communitywide GHG emissions. The largest source of off-road emissions is construction equipment, making up 30% of off-road equipment emissions (Figure 13).

Figure 13. Off-road vehicle emissions by source.



AVIATION

Aviation emissions account for fuel used by aircraft local airports (including Bellingham International Airport, BLI) and estimated fuel consumption from Seattle-Tacoma International Airport (SEA) by Whatcom County residents and visitors. This sector accounted for 2% of total 2022 communitywide GHG emissions within Whatcom County. Most of these emissions are from Whatcom County resident and visitor air travel through SEA.

MARINE VESSELS AND RAIL

Marine vessels and rail emissions include emissions from commercial marine vessels, passenger ferries, and freight rail (BNSF). Marine vessel and rail emissions accounted for 1% of communitywide transportation emissions in Whatcom County. Emissions from this sector have increased 26% since 2017—largely due to estimated increases in commercial marine vessel emissions over that period.

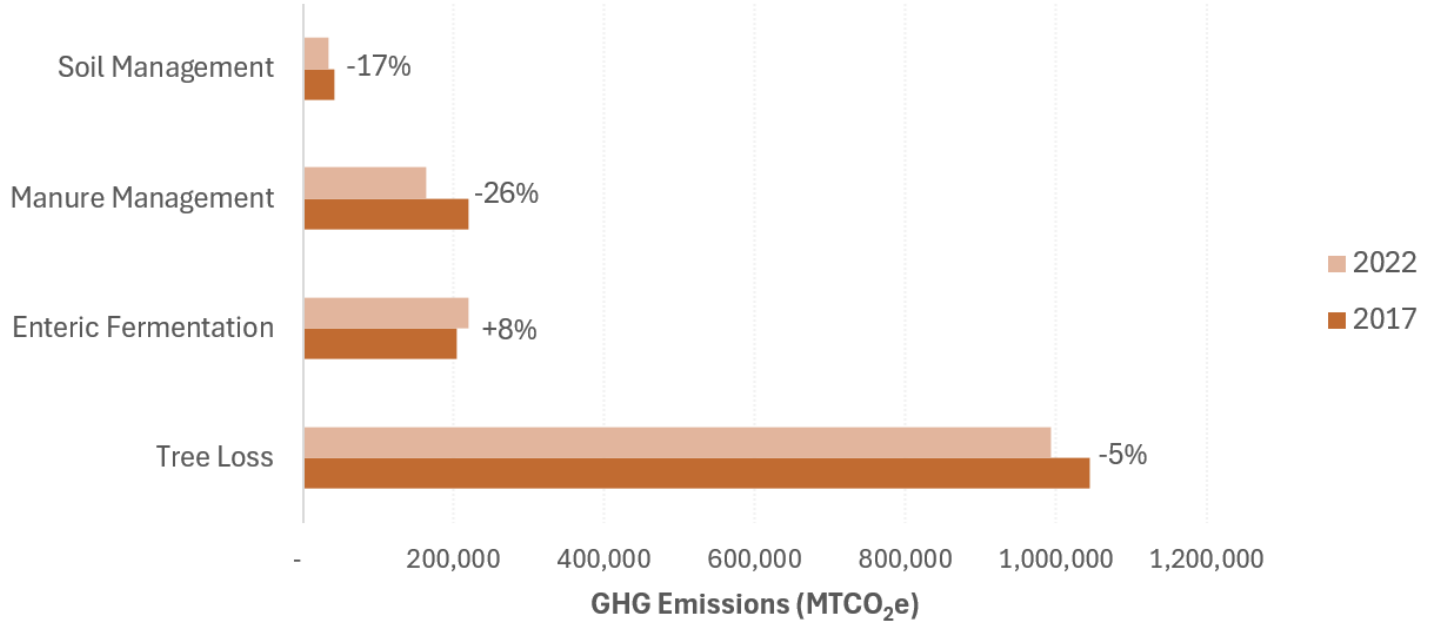
Land Use

The land use sector includes emissions from tree loss and agricultural activities, such as soil management and manure management and digestive processes in livestock. Emissions from land use made up an estimated 15% of Whatcom County's 2022 communitywide emissions. Note that estimated emissions from this sector are less precise, as it is based on assumed agricultural practices on County agricultural lands and uses satellite imagery over an extended period of time utilized to estimate tree loss.

SUMMARY

- Tree loss and agricultural activities accounted for 9% and 4% of total 2022 communitywide GHG emissions, respectively.
- Land use emissions have decreased an estimated 7% since 2017—driven by declines in both tree loss and agricultural emissions. Agricultural emissions have declined 10% since 2017, largely driven by estimated reductions in emissions from manure management (due to an estimated 26% reduction in number of dairy cows) (Figure 14).
- The largest source of emissions in the agricultural sector is from livestock manure management and enteric fermentation (digestive processes).
- The total estimated acres of cropland declined 14% from 2017 to 2022, resulting in a corresponding decline in estimated soil management GHG emissions.[7]

Figure 14. Land use emissions trends.

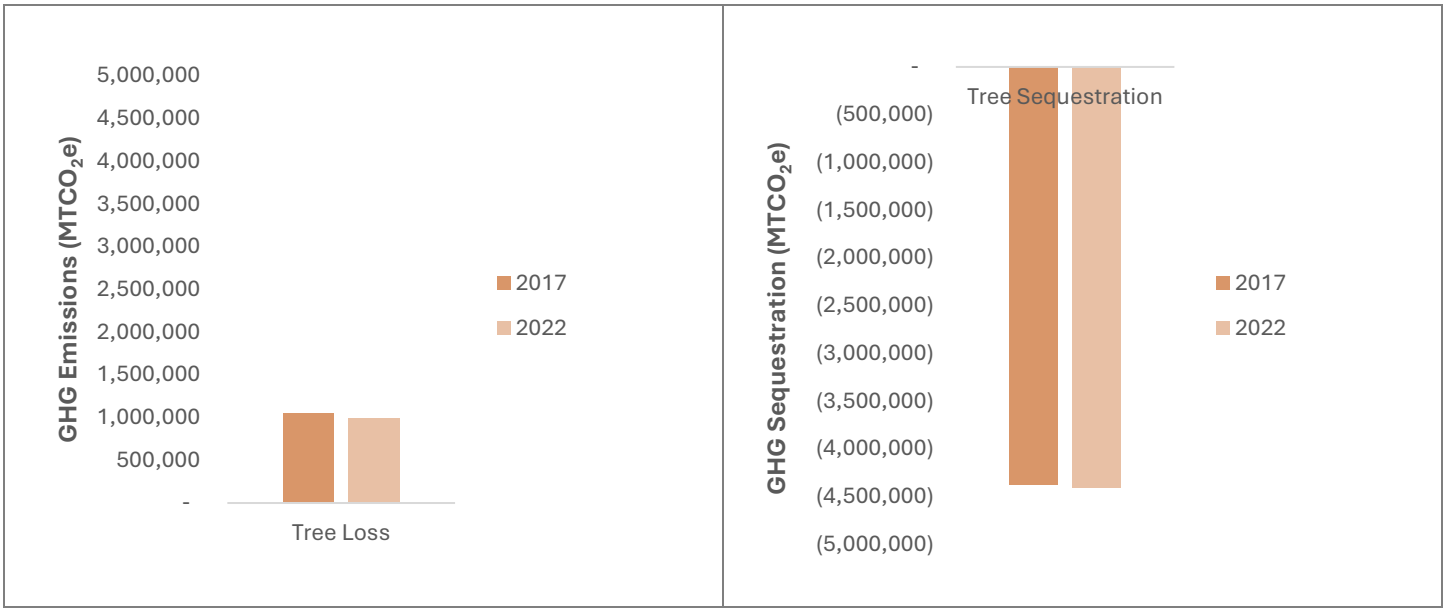


[7] Data sources for estimating cropland acres and other agriculture-related activity data are detailed in the "Agriculture" section of Appendix A.

TREE COVER EMISSIONS & SEQUESTRATION

Emissions from land use include emissions from tree cover loss within Whatcom County, stemming from activities that result in conversion of tree covered land into settlements, grasslands, or other non-forested land types. Carbon sequestration refers to the removal of carbon dioxide from the atmosphere. Sequestration amount is dependent on factors such as tree types, forest age, and tree health. Tree loss emissions have declined over time while tree cover sequestration has increased. Tree loss emissions stem primarily from forest conversion to other land uses and from forest harvesting. Emissions from tree cover loss should be reported separately from emissions sequestered according to GHG accounting protocols.

Figure 15. Tree cover emissions and sequestration.



Solid Waste & Wastewater

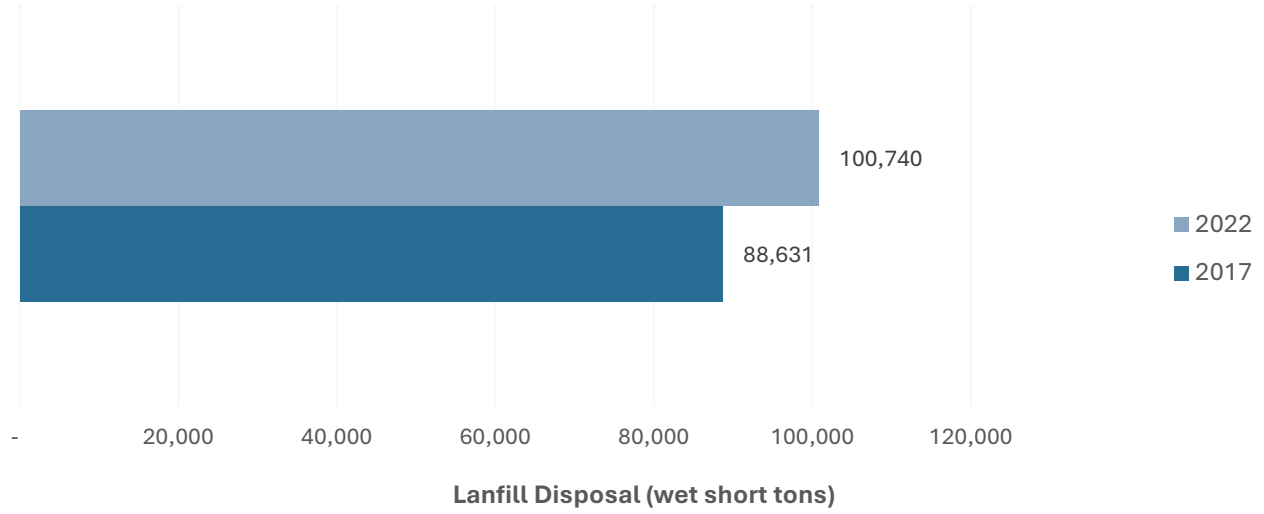
Emissions from the solid waste and wastewater sector include emissions produced from the generation, transportation, and disposal of solid waste into landfills and from the treatment of wastewater produced within Whatcom County. Emissions from wastewater are generated by the biological processing of organic wastewater at treatment facilities, as well as from septic systems within the community. Wastewater treatment plants within Whatcom County also produce emissions through energy used to power wastewater treatment processes; these emissions are accounted for in the commercial energy sector to avoid double-counting between sectors.

SUMMARY

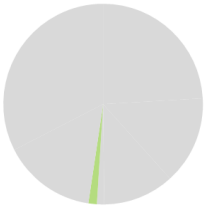
- Emissions from solid waste and wastewater made up 1% of Whatcom County's 2022 communitywide emissions. The majority of these emissions are from solid waste—wastewater emissions comprised only 0.1% of total communitywide emissions in 2022.
- Solid waste emissions have increased 14% since 2017, driven by an increase in the amount of waste disposed to landfills outside Whatcom County (10% increase) and changes in the estimated waste composition (Figure 16).

- Wastewater emissions have increased 8% since 2017—largely due to population growth.

Figure 16. Solid waste disposal trends.

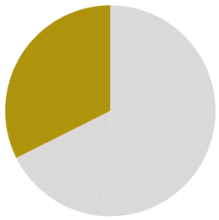


Other Fugitive Emissions



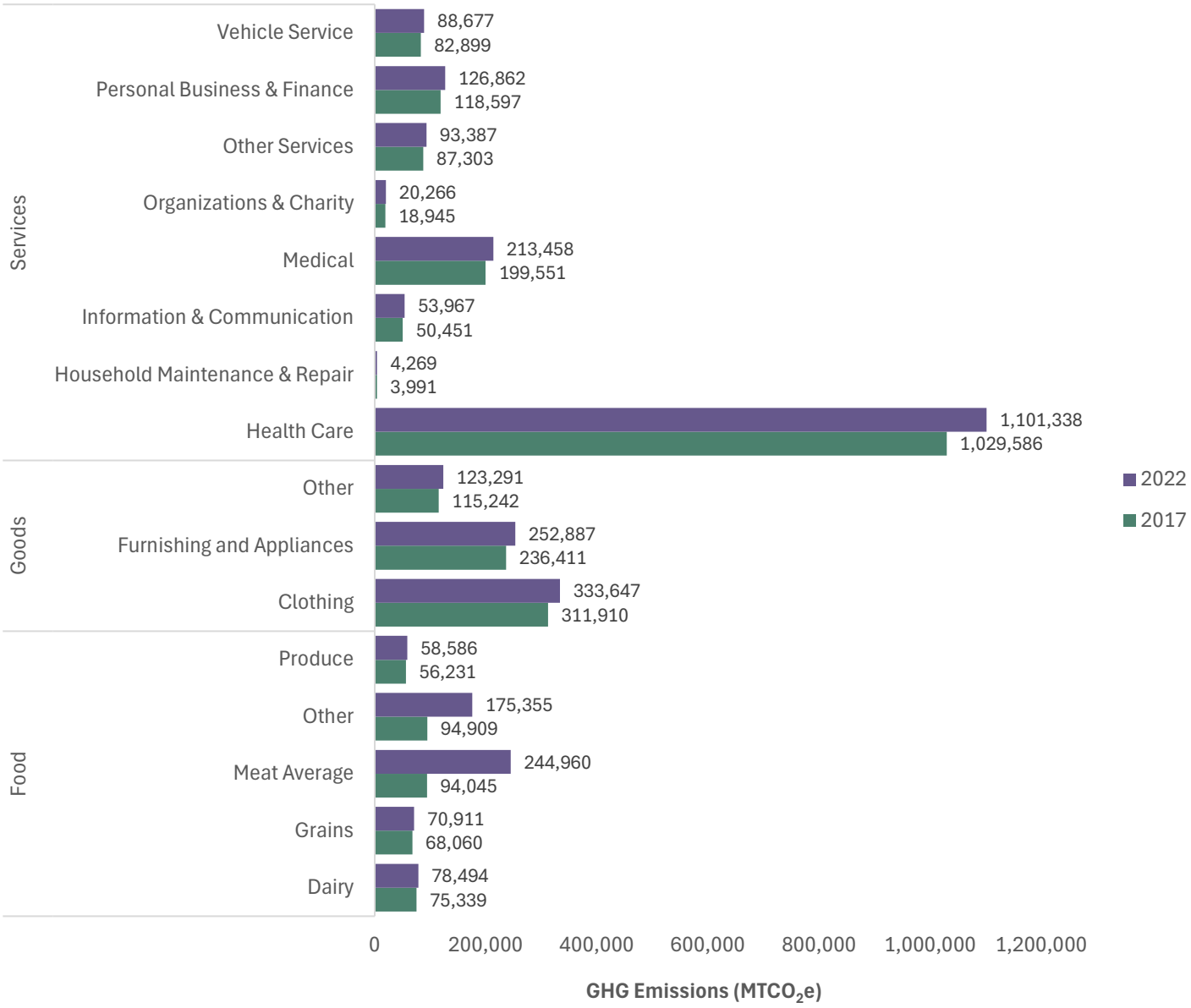
Greenhouse gas emissions can also steam from leaks from contained sources, such as from refrigeration and industrial equipment. This inventory estimated emissions from leakage of potent greenhouse gases from both refrigerants used in buildings and vehicles and SF_6 (used for insulation of electricity transmission lines). This source made up an estimated 1% of 2022 communitywide emissions in Whatcom County—from leakage of hydrofluorocarbons (HFCs) and HFC substitutes used for cooling and refrigeration.

Consumption



New to this 2022 GHG emissions inventory update, emissions associated with consumption account for the upstream emissions associated with the manufacturing, transport, use, and disposal of goods and services consumed by the community. Emissions from this source are estimated based on United States average consumption of various products and Whatcom County population and income data. Based on these estimates, consumption accounted for almost one third (27%) of county communitywide GHG emissions in 2022. The largest consumption emissions sources are from healthcare and medical services, clothing, furniture/appliances, and meat consumption (Figure 17).

Figure 17. Consumption emission trends.



Government Operations GHG Emissions

The County operations GHG emissions inventory summarizes emissions produced by Whatcom County government activities, including from County owned and operated facilities, vehicles, and equipment. In 2022, Whatcom County's operations produced an estimated 9,476 $MTCO_2e$—about 0.1% of total communitywide GHG emissions that year. The County's largest sources of emissions came from County fleet vehicles/equipment and County-owned closed landfills, contributing 24% and 38% of total County operations GHG emissions, respectively (Figure 18). Overall County government operations emissions have decreased 7% since 2017, largely due to reductions in electricity emissions.

Figure 18. Whatcom County government operations 2022 GHG emissions profile ($MTCO_2e$).

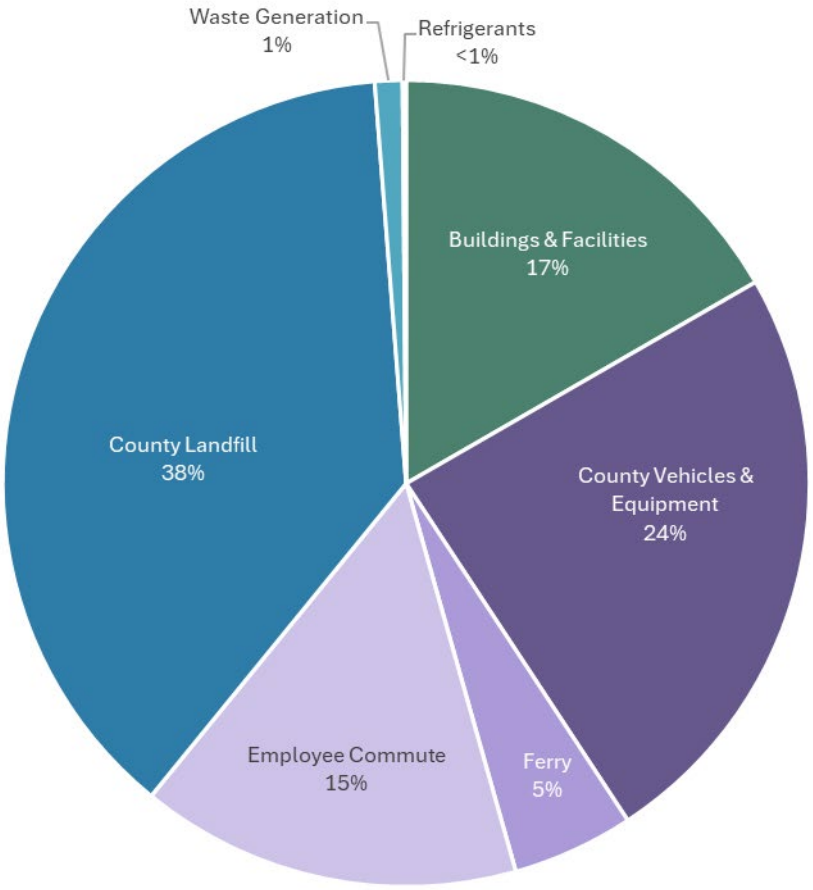
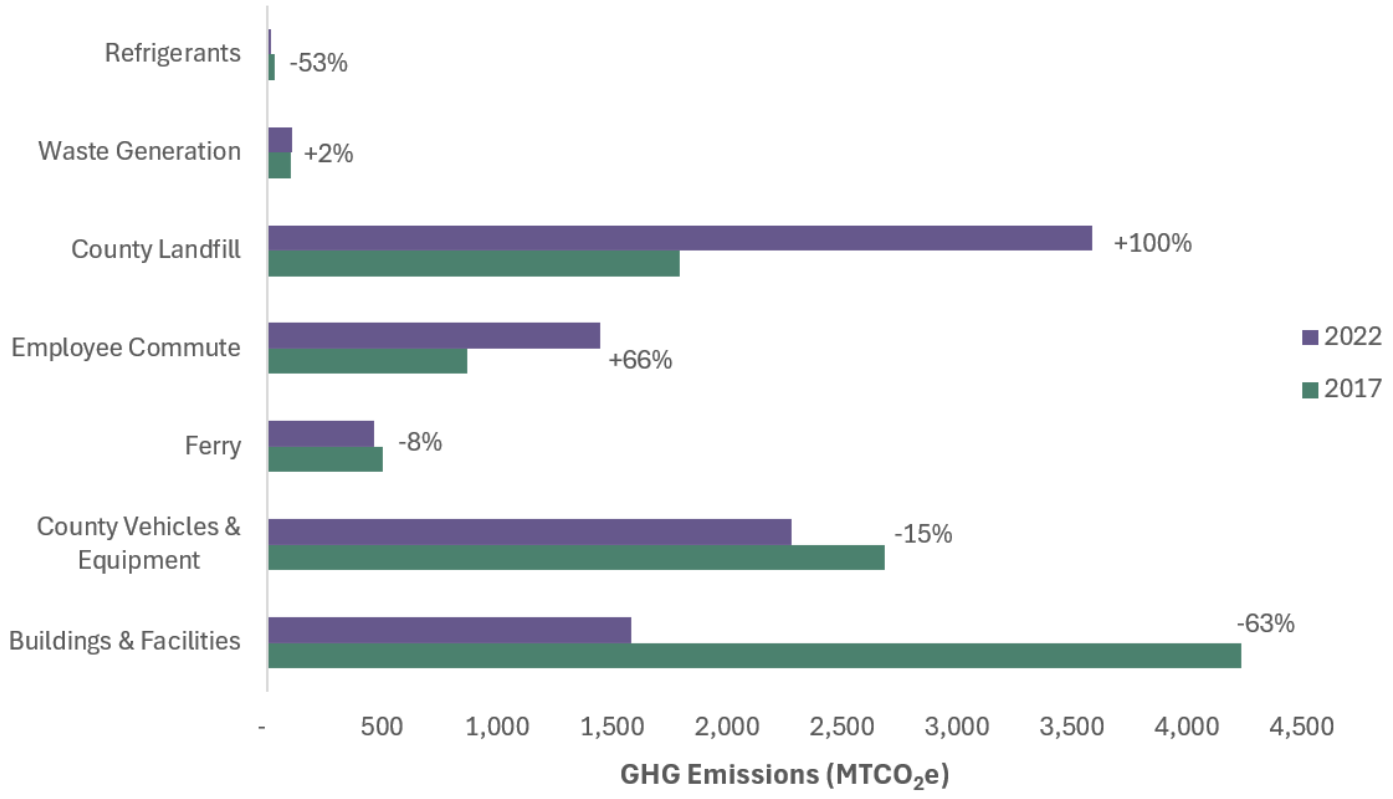


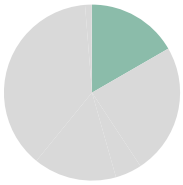
Table 3. Total county operations GHG emissions, by sector.

GHG Emissions Sector	2017 Total Emissions (MTCO2e)	2022 Total Emissions (MTCO2e)	Change	% Change	2022 % of Total
Buildings & Facilities	**4,236**	**1,580**	**(2,656)**	**-63%**	**17%**
Electricity	3,117	604	(2,513)	-81%	6%
Natural Gas	1,119	976	(143)	-13%	10%
Transportation	**4,056**	**4,189**	**537**	**13%**	**44%**
County Vehicles & Equipment	2,684	2,280	537	20%	24%
Ferry	503	462	(41)	-8%	5%
Employee Commute	870	1,447	577	66%	15%
Solid Waste	**1,896**	**3,692**	**1,796**	**95%**	**39%**
County Landfill	1,793	3,587	1,794	100%	38%
Waste Generation	103	105	2	2%	1%
Refrigerants	**33**	**15**	**(20)**	**-53%**	**0.2%**
Refrigerant Leakage	33	15	(18)	-53%	0.2%
Total Emissions	**10,221**	**9,476**	**(747)**	**-7%**	**100%**

Figure 19. County government operations GHG emissions trends.



Buildings & Facilities

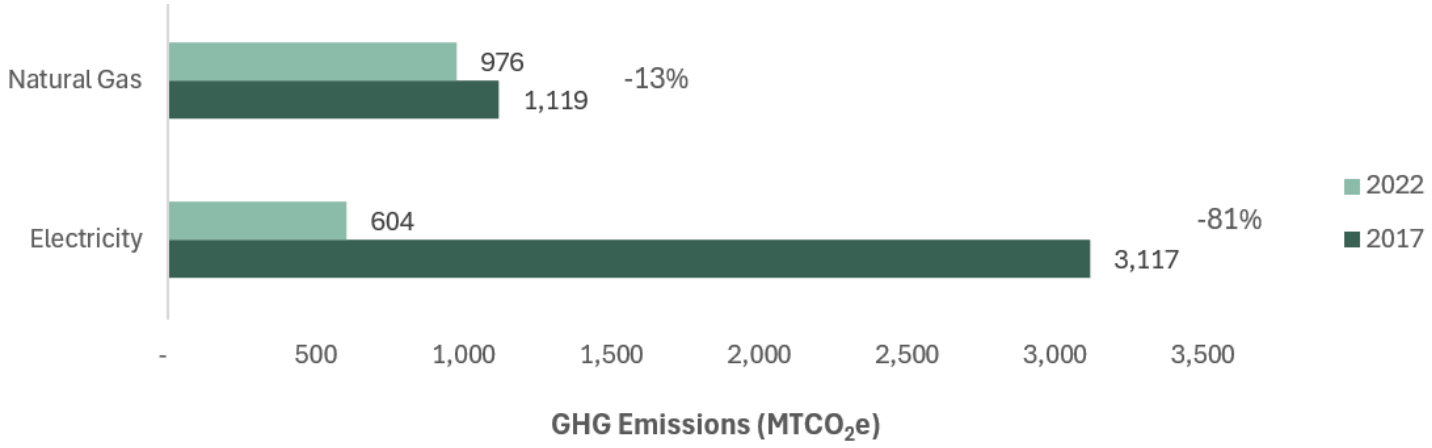


The buildings & facilities sector includes emissions from the use of electricity, natural gas, propane, and fuel oil in County buildings and facilities.

SUMMARY

- In 2022, energy consumption from Whatcom County government buildings and facilities accounted for 17% of government operations emissions.
- Building and facility emissions decreased 63% between 2017 and 2022. Primary contributors to this change include reductions in facility natural gas consumption and a lower carbon intensity (emissions per unit of energy produced) of PSE's electricity fuel mix in 2022. Whatcom County also purchases off-site renewable energy through a Voluntary Long -Term Renewable Energy Service Agreement.
- County operations electricity emissions decreased approximately 80% since 2017, while natural gas emissions decreased ~10% over that period.

Figure 20. Government operations building & facility emissions, by fuel type.



ELECTRICITY

Whatcom County facilities' electricity is delivered through Puget Sound Energy (PSE). Electricity accounted for 6% of Whatcom County's total government operations GHG emissions in 2022. Electricity emissions have declined by approximately 81% since 2017, despite a 19% increase in electricity consumption (Figure 21). These emission reductions are due to the utility's transition to clean, renewable electricity fuel sources, despite an increase in consumption.

Figure 21. Whatcom County facility electricity consumption trends.

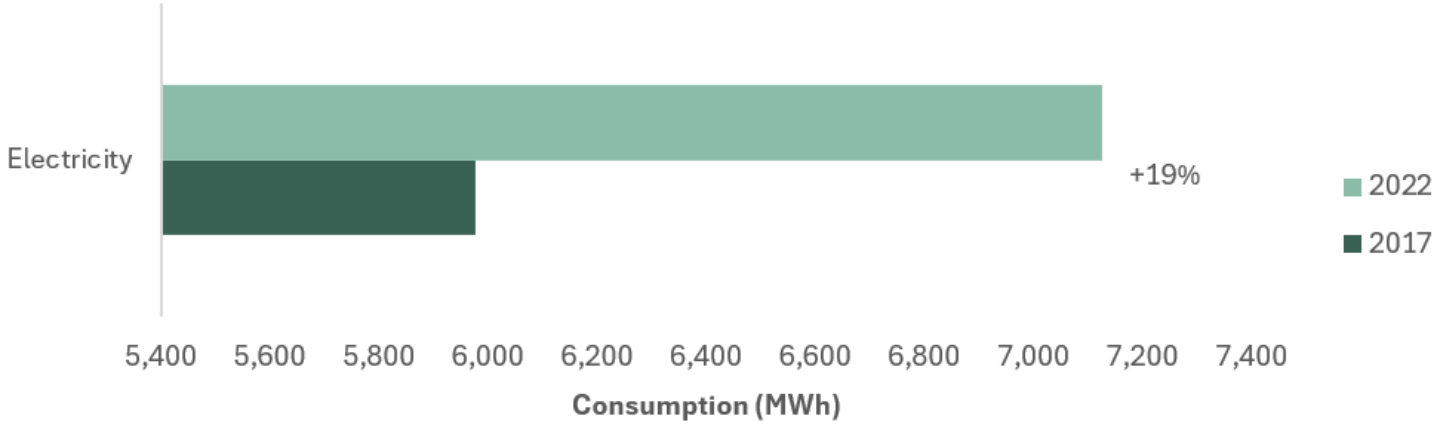
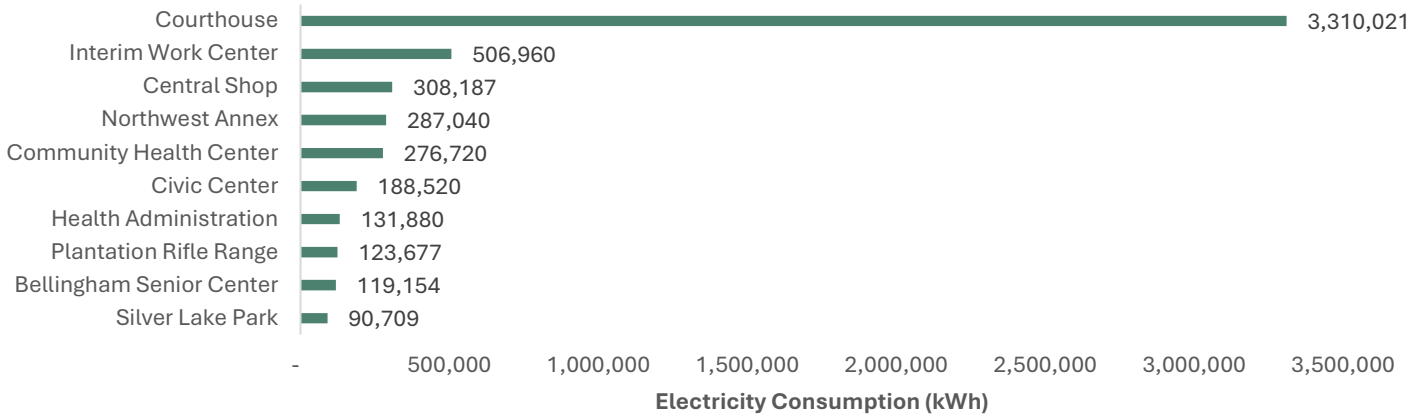


Figure 22. Top electricity-consuming Whatcom County government facilities in 2017.



NATURAL GAS

Whatcom County's natural gas is delivered by Cascade Natural Gas (CNG). Natural gas accounted for 10% of Whatcom County's total government operations GHG emissions in 2022. County facility natural gas consumption has declined 13% since 2017 (Figure 23). The largest consumer of natural gas is the County Courthouse (Figure 24).

Figure 23. County facility natural gas consumption trends.

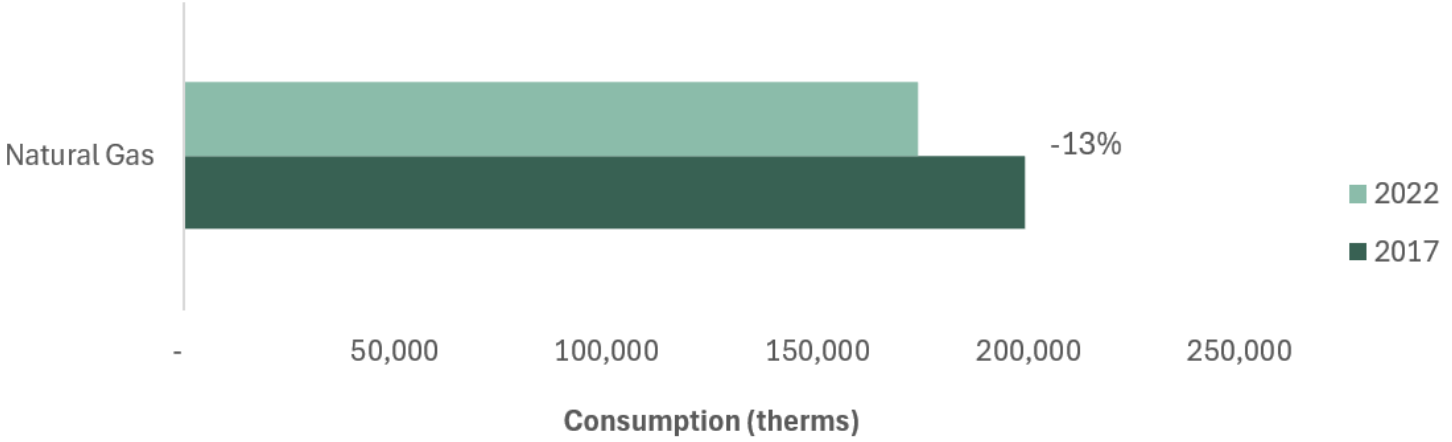
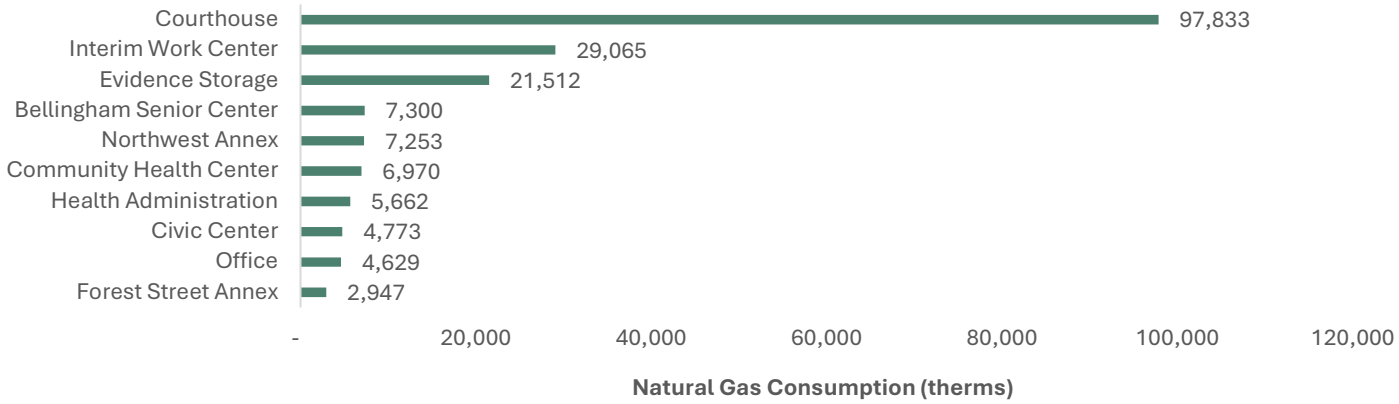
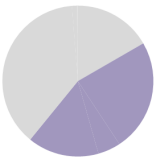


Figure 24. Top natural gas-consuming Whatcom County government facilities in 2017.



Transportation

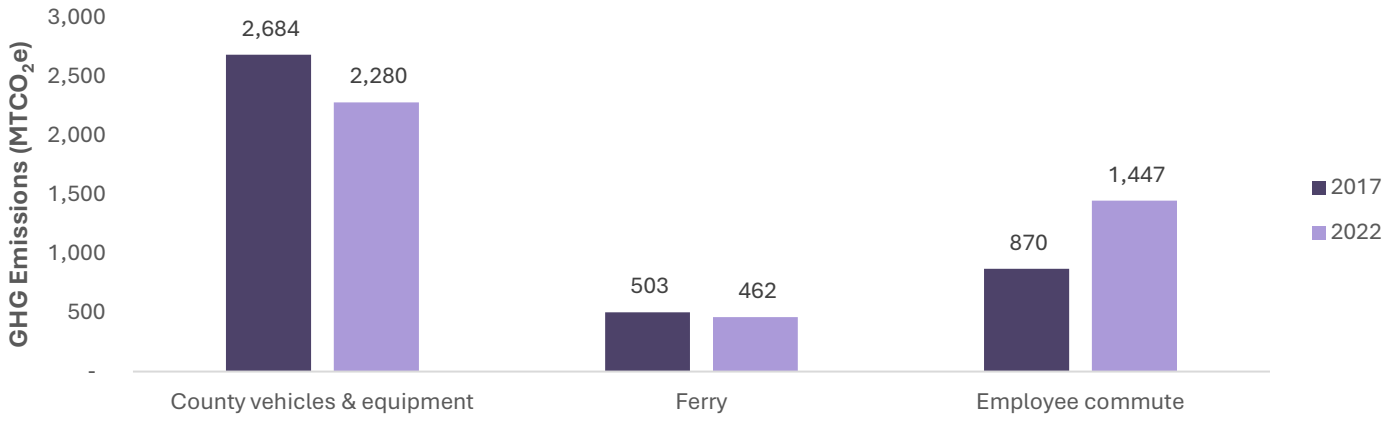


Emissions within the transportation sector of the government operations GHG inventory include emissions from fuel consumed by County-owned vehicle fleet and equipment, the ferry, and employee commuting. Emissions from this sector accounted for 44% of Whatcom County's estimated 2022 government operations emissions.

SUMMARY

- The largest source of emissions in this sector is from County vehicles and equipment, which made up 24% of the total government operations emissions in 2022. Emissions from County vehicles and equipment have decreased 15% since 2017 due to reductions in vehicle use and a transition to more fuel-efficient vehicles.
- Emissions from employee commuting, which made up an estimated 15% of total government operations emissions in 2022, have increased an estimated 66% since 2017 due to an increase in the number of employees estimated to drive to work in a gasoline or diesel fueled vehicle.
- Ferry emissions made up 5% of total government operations emissions in 2022 and have declined approximately 8% since 2017.

Figure 25. County operations transportation emissions trends.



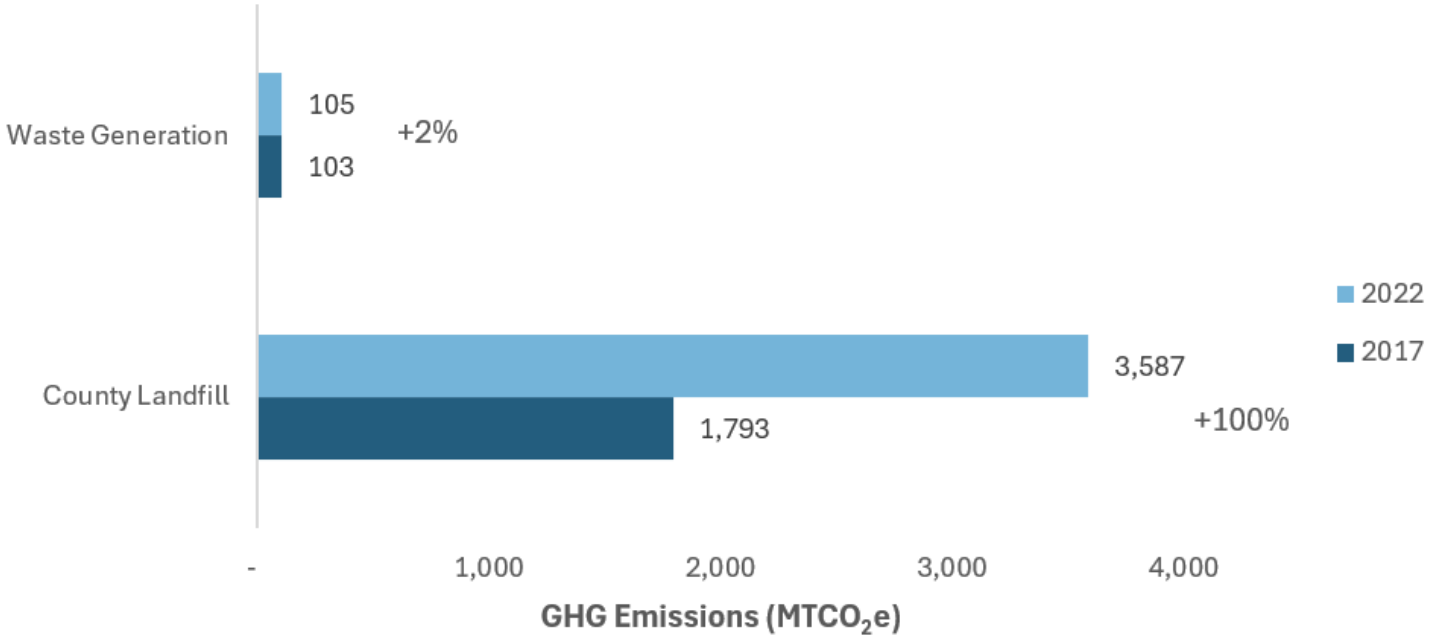
Solid Waste

Government operations solid waste emissions stem from waste generation by County staff and activities as well as methane emissions from closed County-owned landfills. Emissions from these solid waste sources made up 39% of 2022 Whatcom County government operations emissions—from closed County-owned landfills.

SUMMARY

- Emissions from County-owned landfills are shown to have increased 100% since 2017; however, these changes are attributable to updates in the EPA model used to estimate emissions from closed landfills. The number of landfills and the amount of waste in place did not change between 2017 and 2022.
- Emissions from County staff and activity waste generation are estimated to have remained relatively constant since 2017.

Figure 26. Solid waste government operations emissions trends.



Refrigerants

Emissions from refrigerants in the government operations GHG emissions inventory includes emissions from the use, leakage, and disposal of stationary refrigerants in County facilities, as well as mobile refrigerant use in County fleet vehicles and equipment. Based on available data, emissions from County refrigerant leakage made up less than 1% of government operations emissions in 2022 and are estimated to have declined 53% since 2017.

Appendix A: Detailed Methodology

Methodology and Data Sources

Calculating Whatcom County's GHG inventories involved identifying and applying emissions factors to activity data, summarized in Table 4 and detailed in the following sections:

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

Table 4. Key data sources for Whatcom County communitywide GHG emissions inventories.

Sector	Activity Data	Emissions Factors (EFs)
Transportation		
On-road vehicles	Vehicle miles traveled data from Washington State Department of Transportation (WSDOT) Highway Performance Monitoring System (HPMS)	US Environmental Protection Agency (EPA) Emission Factor Hub vehicle EFs (by vehicle & fuel type)
Off-road equipment	EPA Motor Vehicle Emission Simulator (MOVES) model outputs, by county	N/A (data reported in emissions)
Public transit	Reported transit vehicle miles traveled by fuel type for each transit agency from the National Transit Database (NTD)	US EPA Emission Factor Hub vehicle EFs (by vehicle & fuel type)
Aviation	Two approaches, depending on data availability: 1) Volume of fuel (jet-A and aviation gasoline) loaded onto all planes departing from airports within county; volume of all fuel used in helicopters, light aircraft operating within county boundaries (e.g., police, sightseeing, training) 2) Number of landing and takeoff cycles that could be used to estimate fuel based on similar airports Attributed emissions from County resident/visitor Seattle-Tacoma International Airport (SEA) use via Approach 1 (described above), in combination with passenger survey data, population, and household income data from the U.S. Census	USEPA EF Hub average emission factors, by fuel type
Marine	Puget Sound Maritime Emissions Inventory (from EPA MOVES) Lummi Island Ferry fuel consumption from County staff	USEPA EF Hub average emission factors, by fuel type
Rail	Puget Sound Maritime Air Emissions Inventory (for BNSF)	N/A (data reported in emissions)

Sector	Activity Data	Emissions Factors (EFs)
	Passenger rail not included due to lack of passenger data from Amtrak.	
Building Energy		
Electricity	County-wide consumption provided by utilities	1) Utility-specific emission factors (from Department of Ecology Clean Fuel Standard program utility-specific electricity calculations) 2) Emissions & Generation Resource Integrated Database (eGRID) EFs (for informational purposes only)
Natural gas	County-wide consumption provided by utilities	US EPA EF Hub average EF
Fuel Oil	WA fuel oil consumption by sector from U.S. Energy Information Administration (EIA)	U.S. EPA EF Hub average EFs
Propane	WA propane consumption by sector from U.S. EIA	US EPA EF Hub average EFs
Wood	U.S. West regional average household wood energy consumption from U.S. EIA	ClearPath default EF
Industrial processes	EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT)	N/A - data reported in terms of emissions
Solid Waste & Wastewater		
Solid waste generation & disposal	County-wide tonnage from WA Department of Ecology Waste characterization for Northwest WA from WA Department of Ecology	EPA Waste Reduction Model (WARM) EFs, customized for landfill attributes
Wastewater treatment processes	Wastewater treatment data by wastewater treatment facilities (including gallons processed)	U.S. Community Protocol default EFs, customized for wastewater treatment facility process specifications
Septic systems	Number of reported septic systems	U.S. Community Protocol default EFs
Other Fugitive Emissions		
Refrigerants	EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022	N/A - reported in terms of emissions
SF6	SF6 emissions reported by Puget Sound Energy, downscaled by Whatcom County customer count	N/A - reported in terms of emissions
Land Use		
Agriculture	County-specific acres of cropland and number of livestock (from U.S. Department of Agriculture Census of Agriculture)	U.S. Community Protocol defaults by animal / management scenario
Tree Loss	ICLEI Land Emissions and Removals Calculator - reported in terms of emissions	
Consumption		
Food, Goods, Services Consumption	Population/households from U.S. Census Average per-household consumption from UC Berkeley CoolClimate Calculator	ICLEI ClearPath default EFs

Table 5. Key data sources for Whatcom County government operations GHG emissions inventories.

Sector	Activity Data	Emissions Factors (EFs)
Transportation		
County vehicles & equipment	Fuel consumption data for County vehicles and equipment	US Environmental Protection Agency (EPA) Emission Factor Hub vehicle EFs (by vehicle & fuel type)
Ferry	Lummi Island Ferry fuel consumption from County staff	USEPA EF Hub average emission factors, by fuel type
Employee commute		
Buildings & Facilities		
Electricity	Consumption by County facilities	Utility-specific emission factors (from Department of Ecology Clean Fuel Standard program utility-specific electricity calculations)
Natural gas	Consumption by County facilities	US EPA EF Hub average EF
Solid Waste		
Solid waste generation & disposal	Estimated tonnage based on waste hauler invoices (container size and pickup frequency) Assumed waste characterization consistent with community commercial sector	EPA Waste Reduction Model (WARM) EFs, customized for landfill attributes
County landfills	Tons of waste in place	Landfill-specific methane capture scenario & location Emissions estimates from California Air Resources Board's First-Order Decay Model tool (based on IPCC methodology)
Refrigerants		
Refrigerants	County-reported refrigerant use	IPCC Sixth Assessment Report (AR6) Global Warming Potentials (GWP)7F8

Note that, in some cases, these data sources and approaches were updated from the 2017 GHG inventory to ensure inventories are comparable, accurate, and reflect the latest protocols and best practices.

The following sections detail the methodology used for the communitywide GHG inventories.

[8] https://ghgprotocol.org/sites/default/files/2024-08/Global-Warming-Potential-Values%20%28August%202024%29.pdf

Transportation

ON-ROAD

On-road emissions were developed using annual vehicle-miles-traveled activity data from WSDOT's Highway Performance Monitoring System (HPMS), which provides estimated annual VMT for all public roadways in each county. VMT for each county was split into light, medium, and heavy duty VMT based on WSDOT HPMS statewide freight percentages. For medium- and heavy-duty freight emissions, VMT was multiplied by fuel- and vehicle-specific emissions factors from the EPA Emissions Factor Hub. For light-duty vehicles, vehicle registration data from Whatcom County was used to estimate VMT by fuel type, which was then multiplied by fuel-specific emissions factors from the EPA Emissions Factor Hub. The vehicle registration data was also used to create a weighted emissions factor for light-duty gasoline vehicles, based on the split between passenger vehicles and light trucks in each county.

OFF-ROAD

Off-road emissions were acquired from EPA's Motor Vehicle Emissions Simulator (MOVES) model version 4.0. Using county-level defaults, the MOVES nonroad module was used to output daily emissions within the inventory calendar years for all available off-road sectors, including agriculture, airport support, commercial, construction, industrial, lawn and garden, logging, oil field, pleasure craft, railroad, recreational, and underground mining. The equipment included in these sectors included self-propelled vehicles, such as construction equipment, as well as handheld equipment like chainsaws. MOVES output was provided for by weekday and weekend day for each month. The results were multiplied by the appropriate number of weekdays and weekend days in each calendar year to determine annual emissions. The model produces CH_4 and CO_2 emissions per sector for gasoline, LPG, CNG, and diesel.

PUBLIC TRANSIT

Transit emissions were based on annual fuel use and vehicle-miles-traveled data for each transit agency, obtained from the National Transit Database report. Annual fuel use was multiplied by standard fuel- and vehicle-specific emissions factors from the EPA Emissions Factor Hub.

AVIATION

Aviation emissions for Bellingham International Airport were based on the fuel used by aircraft at the airport during that calendar year. Gallons of jet fuel and aviation gasoline were multiplied by standard fuel-specific emission factors from the US EIA.

Emissions from Seattle-Tacoma International Airport (SEA) were allocated to the surrounding counties to acknowledge that many travelers are residents of locations other than King County, where the airport is located. To attribute fuel consumption to the Puget Sound counties, total jet fuel used in 2022 was multiplied by the percentage of passengers whose journey began or ended at SEA—rather than connecting through SEA—based on passenger survey data provided by the airport. Using passenger survey data that identified the percentage of passengers who were from King County, a portion of this fuel was attributed to King County. Consistent with the Puget Sound Regional Emissions Analysis (PSREA) 2019 inventory approach, the remaining fuel allocated to the Puget Sound region was then attributed to Kitsap, Pierce, Thurston, and Snohomish counties based on an income-weighted per-capita fuel consumption average. This income-weighted per-capita consumption metric was then used to estimate commercial aviation-related GHG emissions for Whatcom County. All fuel consumption estimates were then multiplied by fuel-specific emission factors to estimate GHG emissions.

MARINE

Emissions from marine sources were estimated for ocean-going, harbor, and recreational vessels and for the Lummi Island Ferry.

The County operates the Lummi Island Ferry (Whatcom Chief), traveling between Lummi Island and the mainland. To estimate ferry emissions, annual ferry fuel consumption data (gallons of diesel) were multiplied by the U.S. EPA emissions factor for diesel fuel.

In the absence of locally sourced data, the Puget Sound Maritime Air Forum's 2016 and 2021 *Puget Sound Maritime Air Emissions Inventory* provided estimated emissions from ocean-going, harbor, and recreational vessels in Whatcom County for the 2017 and 2022 GHG inventories, respectively. The maritime emissions inventory attributed ocean-going vessel emissions to Whatcom County based on routes within the county. Harbor vessel emissions were allocated among the four Northwest Clean Air Agency (NWCAA) counties of Island, San Juan, Skagit, and Whatcom. Recreational vessel emissions were attributed to Whatcom County based on data from port-owned marinas, private marinas, and marinas of other non-port, public entities.

RAIL

In the absence of more local, updated data, rail emissions were calculated using information from Puget Sound Maritime Air Forum's 2005, 2016, and 2021 *Puget Sound Maritime Air* Emissions *Inventories* to estimate emissions from freight rail (BNSF) for Whatcom County. Passenger rail (Amtrak) data was not available at the local level and is not included in this inventory; the Lake Whatcom Railway tourist attraction also is not included.

Building Energy

ELECTRICITY

Emissions from electricity consumption were determined using the annual amount of electricity consumed in Whatcom County, multiplied by utility- and year-specific emission factors. Residential, commercial, and industrial electricity consumption data was procured directly from the utilities that provide service to Whatcom County (City of Blaine, Puget Sound Energy, PUD No1 of Whatcom County). Emissions from electricity transmission and distribution (T&D) were accounted for in the utility-specific emission factors used for these inventories, provided by the WA Department of Ecology.

NATURAL GAS

Emissions from natural gas consumption were determined by multiplying the natural gas consumed in 2022 within each county by utility- and year-specific emission factors. Residential, commercial, and industrial natural gas consumption data were procured directly from the utilities that provide service to Whatcom County (Cascade Natural Gas). Emissions from natural gas leakage were calculated using the default leakage rate provided by ClearPath, ICLEI's greenhouse gas inventory software platform (derived from the EDF User Guide for Natural Gas Leakage Rate Modeling).[9] Other defaults necessary to calculate fugitive emissions from natural gas were also sourced from ClearPath.

[9] https://www.edf.org/sites/default/files/US-Natural-Gas-Leakage-Model-User-Guide.pdf

PROPANE, FUEL OIL, & WOOD

Residential propane and fuel oil emissions were calculated using 2022 U.S. EIA residential and commercial propane and fuel oil consumption data for the state of Washington. Statewide total residential fuel sales were allocated to counties using U.S. Census American Community Survey (ACS) home heating fuel data. Commercial propane and fuel oil emissions were calculated using WA commercial fuel consumption estimates downscaled by the number of commercial employees within each county as compared to total state employment. Employment data were collected from the WA Employment Security Department, which provides data on the number of employees across industries. Propane and fuel oil emissions were both calculated using U.S. EPA emissions factors.

Emissions from the combustion of wood within the residential sector were estimated using a similar approach to residential propane and fuel oil. Regional total residential wood consumption data from the U.S. EIA (2020 and 2015 data for the 2022 and 2017 inventory years, respectively, due to data availability) were used to determine a per-household wood consumption average, which was then applied to the number of households using U.S. Census American Community Survey (ACS) home heating fuel data. Emissions were calculated using ICLEI ClearPath default emissions factors.

INDUSTRIAL PROCESSES

Emissions from industrial processes in 2022 were obtained from EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT). Data was available for download by county for large facilities (>25,000 $MTCO_2e$) required to report annual data about GHG emissions to EPA as part of the Greenhouse Gas Reporting Program. To avoid double counting with other inventory sectors such as solid waste and buildings, EPA FLIGHT data from landfill facilities and metered facility energy consumption (e.g., electricity, natural gas) were excluded.

Solid Waste and Wastewater

SOLID WASTE GENERATION AND DISPOSAL

Emissions from the generation and disposal of landfilled solid waste were estimated by multiplying the annual tons of waste generated by material type-specific emissions factors derived from the US EPA WARM v16 model. Because more locally specific tonnage data were not attainable for Whatcom County, the Washington State Department of Ecology's *Solid Waste Disposal Annual Summary, Recoverable and Non-Recoverable Wastes generated in Washington state, 1994-2021* tonnage estimates for Whatcom County were used (2021 values were used as a proxy for 2022). Because a more recent or locally specific waste characterization study was unavailable, the waste characterization percentages for northwest Washington from the *WA Statewide 2020-2021 (and 2015-2016) Waste Characterization Studies* were used to estimate the composition of waste generated in Whatcom County for 2022 and 2017, respectively. These characterization data were translated into US EPA WARM categories to estimate emissions by material type, and custom EFs were applied to estimate methane emissions based on the landfill's unique characteristics and methane capture scenario. Emissions from transportation of waste to landfills were estimated using estimated travel distance (from Google Maps) and default emission factors from the U.S. Community Protocol.

This analysis only analyzed GHG emissions from disposal of solid waste in landfills. GHG emissions from composted waste were not included due to challenges in receiving compost tonnage data.

WASTEWATER TREATMENT PROCESSES

Emissions from the treatment of wastewater produced by Whatcom County residents and businesses were estimated based on reported data from wastewater treatment plants. The analysis included the following wastewater treatment facilities:

- Birch Bay
- Everson
- Gooseberry Point
- Lummi Kwina
- Post Point
- Sandy Point
- Lighthouse Point
- Lynden

Emissions were estimated based on the type of treatment processes at a given plant—such as the use of anaerobic digestion or the use of nitrification/denitrification—as well as the population served. Based on the data reported by each facility, emissions were calculated using U.S. Community Protocol default equations. Where facilities were unable to directly provide the necessary data to estimate process emissions, service area was used to estimate population served and emissions were estimated using data from US EPA compliance reports for that wastewater treatment facility.

SEPTIC SYSTEMS

To determine emissions from septic systems, the estimated population served by septic systems was estimated using the 1) number of septic systems within each county (reported by Whatcom County Health and Community Services) and 2) average population per household in that county (as reported by the U.S. Census). Emissions were then estimated using default equations from the U.S. Community Protocol.

Other Fugitive Emissions

Emissions from refrigerant use were obtained from U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2022. Total refrigerant emissions were downscaled to Whatcom County based on the U.S.-to-county population ratio.

Emissions from SF6 were calculated using reported SF_6 emissions from Puget Sound Energy's publicly reported greenhouse gas inventories, downscaled by the number of Puget Sound Energy customers within Whatcom County.

Land Use

AGRICULTURE

Agricultural emissions were calculated following the U.S. Community Protocol methodology. Agricultural emissions stem from livestock enteric fermentation, manure management, and soil. For these calculations, the U.S. EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks* annexes provided values for the following: livestock enteric fermentation emissions factors, distribution of waste management systems, typical animal mass, daily and annual volatile solid production rates, maximum CH_4 producing capacity per pound of manure, methane conversion factors based on manure management system, daily excreted nitrogen rates, nitrous oxide emissions factors, nitrogen lost through volatilization, and nitrogen lost through runoff and leaching. The U.S. Community Protocol Appendix G provided values for volatilization and runoff/leaching emissions factors. Data on the number of animals in Whatcom County was sourced from the USDA Census of Agriculture. The U.S. EPA

Inventory and Inventory Annexes provided nationwide values for direct and indirect N_2O emissions from soils, and the total U.S. cropland acreage was provided by the USDA Census of Agriculture. This national data was used to create an emissions factor for soil, which was applied to the acres of cropland in Whatcom County.

TREE LOSS

ICLEI's Land Emissions and Removals Navigator (LEARN) tool was used to estimate GHG emissions from tree cover loss and carbon sequestration from tree cover gain and maintenance within county boundaries. The LEARN tool uses the National Land Cover Database (NLCD), produced by the United States Geological Survey (USGS) as the land cover database for this analysis. The LEARN tool requires a minimum of a 3-year analysis timeframe, which was divided by three to determine an average annual value. At the time of this analysis, the tool was available through 2019; therefore, 2016-2019 and 2013-2016 timeframes were analyzed for the 2022 and 2017 GHG emissions inventories, respectively. Default factors used to calculate emissions for the "Trees Outside Forests" category are based on data for Seattle, Washington (the tool allows for customization to major metropolitan areas; the only available Washington option is for Seattle).

Consumption

New to this 2022 GHG emissions inventory update, emissions from consumption accounted for the upstream and embodied carbon emissions associated with food, goods, and services consumed by Whatcom County residents. Emissions in this category exclude emissions already accounted for in other sectors of the inventory, such as from energy use in buildings and vehicles.

Consumption emissions are calculated using U.S. average household consumption estimates (e.g., per-capita food consumption or goods purchases) and multiplying by the number of households in Whatcom County.

Approach and Data Limitations

While the GHG inventories sought to include the most accurate, locally specific data available, in some cases data availability was limited and scaling or approximations were necessary. Notable limitations in the data and resulting approaches are summarized below.

Transportation

ON-ROAD

- No notable limitations of approach or data sources.

OFF-ROAD

- No notable limitations of approach or data sources.

PUBLIC TRANSIT

- No notable limitations of approach or data sources.

AVIATION

- Estimated County resident/visitor air travel based on passenger survey data and estimated air travel for entire Puget Sound region (downscaled by County population and income).

MARINE

- Ocean-going, harbor, and recreational vessels estimated using 2016 and 2021 data for 2017 and 2022 inventories, respectively.

RAIL

- Estimated using 2005, 2016, and 2021 data to approximate 2017 and 2022 emissions.

Building Energy

ELECTRICITY

- No notable limitations of approach or data sources.

NATURAL GAS

- No notable limitations of approach or data sources.

PROPANE, FUEL OIL, AND WOOD

- Estimated wood consumption using 2015 and 2020 western region household consumption estimates for 2017 and 2022 inventories, respectively.

INDUSTRIAL PROCESSES

- Emissions from U.S. EPA FLIGHT reporting were used to avoid potential double counting, due to lack of data granularity within WA Department of Ecology reporting. This data source only captures entities emitting over 25,000 MTCO2e annually.

Solid Waste and Wastewater

SOLID WASTE GENERATION AND DISPOSAL

- Landfill: Local tonnage and waste characterization data were unavailable, so utilized county-level estimates from WA Department of Ecology statewide studies. There are no open landfills in Whatcom County and there is a fully privatized waste collection and disposal system so estimations of waste emissions are subject to data availability. All waste in Whatcom County is transported to other counties for disposal.
- Compost: Data were unavailable; emissions from compost were excluded from this analysis.
- Government operations inventory estimated waste tonnage using hauler invoice data (container size and pickup frequency).

WASTEWATER TREATMENT PROCESSES & SEPTIC SYSTEMS

- Some wastewater treatment facilities did not provide data for 2022 and/or 2017; in those instances, U.S. EPA reporting was used to estimate treatment processes and emissions.

Other Fugitive Emissions

- Downscaled refrigerant leakage estimates from U.S. national inventory by population.

Land Use

AGRICULTURE

- Agricultural practices (per acre or head of livestock within the county) were based on national averages.
- Acres of cropland and heads of livestock were based on County-level estimations from the USDA Census of Agriculture.

TREE LOSS

- The most recent year of data available within the LEARN tool at the time of this analysis was 2019, so the tree cover analysis was performed using 2016-2019 and 2013-2016 timeframes for the 2022 and 2017 inventories, respectively, to satisfy the tool's three-year analysis time period requirement. The National Land Cover Database (NLCD) used for the LEARN tool's analysis, is updated approximately every 2-3 years.

Consumption

- Consumption emissions were calculated using U.S. average household consumption estimates.

Sensitivity to Local Conditions

Not all inventory values are based on locally derived data. Table 6 below summarizes some of the limitations and sensitivities of data used in the inventory. Note that the sensitivity of data to local conditions does not relate to the County's ability to influence emissions from that sector. For example, although fuel oil and propane values are based on scaled regional/state data, emissions from those sources could be influenced through building/energy code and local energy efficiency and electrification retrofit incentive programs.

Table 6. Summary of data sensitivity to local conditions.

Sector	Values are sensitive to local conditions	Values are sensitive to local conditions, with some exceptions	Values are based on scaled regional/state data	Values are based on scaled national data
Transportation				
On-road	✓			
Off-road			✓	
Public transit	✓			
Aviation		✓		
Marine & rail	✓			
Building Energy				
Electricity	✓			
Natural gas	✓			
Fuel oil			✓	
Propane			✓	
Wood			✓	
Industrial Processes				
Industrial processes		✓		
Solid Waste and Wastewater				
Solid waste generation & disposal		✓		
Wastewater treatment processes	✓			
Other Fugitive Emissions				
Refrigerants				✓
SF_6	✓			
Land Use				
Agriculture		✓		
Tree loss	✓			
Consumption				
Food, goods, & services				✓

Updates to Existing Inventories

The analyses presented in this report draw from the following existing GHG inventories for Whatcom County:

- The 2017 Whatcom County GHG emissions inventory prepared by Cascadia Consulting Group, summarized in the "Whatcom County Greenhouse Gas Inventory 2017" report published in 2020.
- The 2022 Whatcom County GHG emissions inventory prepared by Cascadia Consulting Group for WA Department of Commerce, summarized in the "Whatcom County 2022 Greenhouse Gas Emissions Analysis" report published in 2024.

For some GHG emissions sectors, methodologies were updated from these inventories to reflect more localized, accurate, or standard approaches. Specific updates are detailed in the tables below.

Table 7. Updates to existing communitywide inventories.

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Building Energy					
Electricity	County consumption data (provided by utilities) with utility-specific emission factors	Calculate emissions using actual consumption data and utility-specific emission factors from the Department of Ecology. Also provide eGRID emissions (for informational purposes only).	Update to use comparable emissions factors using WA fuel mix disclosure data.		x
Electricity T&D* losses	PSE/BPA grid loss factors	Factored into utility-specific emission factors from the Dept of Ecology.	Remove from 2017 inventory, factored into WA EFs		x
Natural gas	County consumption data (provided by utilities) with default EFs	Use utility-provided consumption data and utility-specific emission factors, where available. Otherwise, use EPA average EFs.	Calculate NG emissions using EPA default EF to align with past inventories.		x

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Propane	Estimated based on census home heating fuel and EIA data (residential), and estimated based on average of employment and establishments (commercial)	Estimate using Washington propane consumption data (EIA), downscale using US Census home heating source data (for residential) and WA Employment Security Department (ESD) employee counts (for commercial). Industrial sources covered under "Industrial process emissions" sector below.	Update 2017 to use employment, rather than average of employment and establishment.		x
Fuel oil	Estimated based average of employment and establishments (commercial)	Estimate using WA fuel oil consumption data (EIA), downscale using Census house heating information and WA ESD employee counts. Industrial sources covered under "Industrial process emissions" sector below.	Update 2017 to use employment, rather than average of employment and establishment.		x
Wood	Estimated based on census home heating fuel and EIA data (residential)	Not included	Add residential emissions from this source to 2022 inventory.	x	
Industrial process emissions	EPA FLIGHT tool	EPA FLIGHT Tool	N/A - no update needed		

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Transportation					
On-road vehicle	Modeled vehicle miles traveled from WCOG travel demand model	Use WSDOT HPMS VMT for each county, and split out into light, medium, and heavy duty VMT based on WSDOT's statewide freight percentages. For freight, use the fuel assumptions developed for PSREA, and apply EPA EFs. For light-duty vehicles, use vehicle registration data from each county to calculate emissions by vehicle and fuel type. Provide VMT per capita estimates for home-based VMT per resident as informational data for each county.	Update 2017 on-road emissions to use WSDOT travel demand model.		x
Transit	Used reported transit vehicle miles traveled by fuel type from Whatcom Transit	Calculate emissions using reported transit vehicle miles traveled by fuel type for each transit agency in each county.	N/A - no updates needed		
Off-road vehicle	EPA NONROAD model	County level emissions data from EPA MOVES model (e.g., off-road recreational vehicles, landscaping, and construction equipment)	Remove pleasure craft from off-road in lieu of collecting local data (as indicated in "Marine" below)		

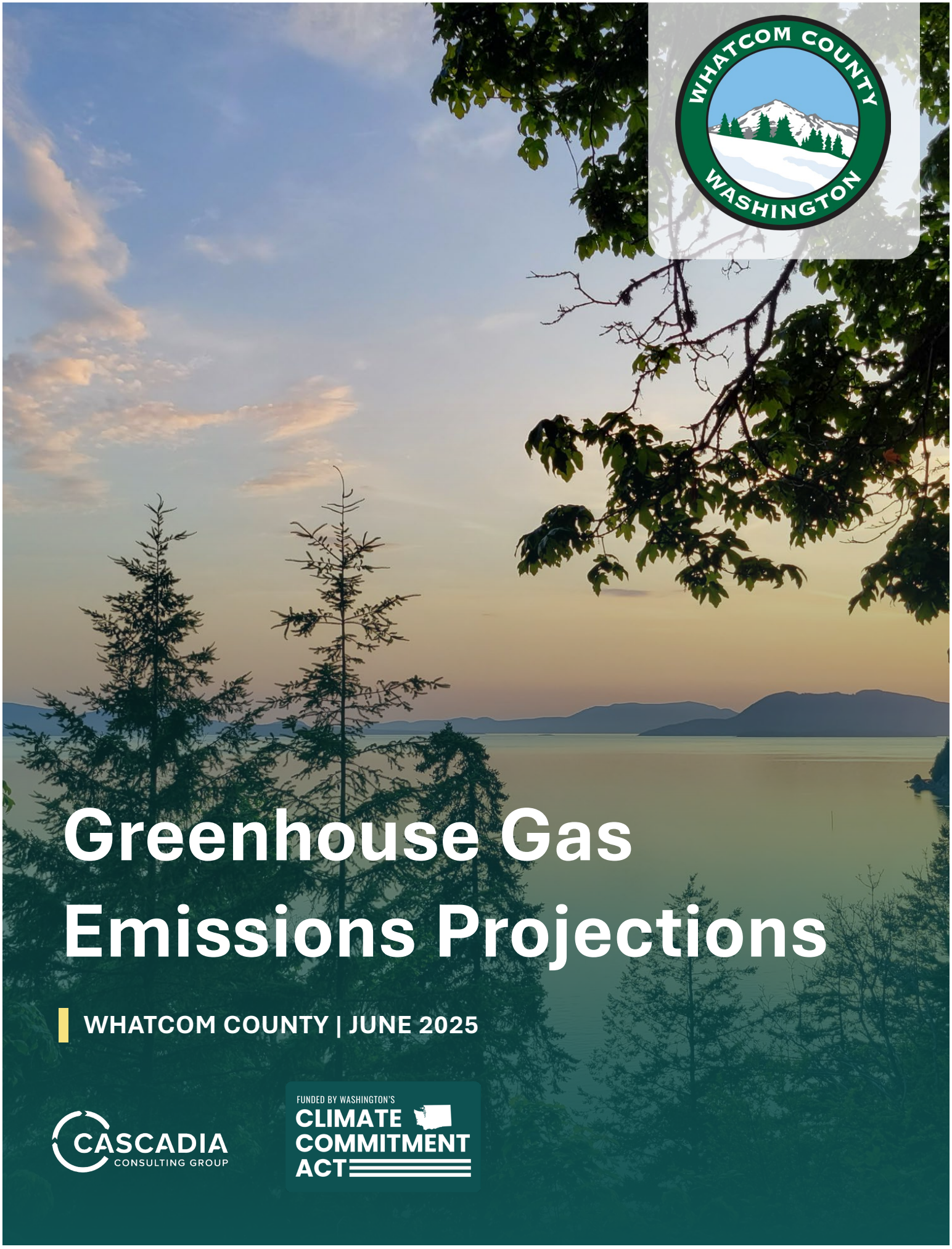
	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Aviation	Fuel usage: Port of Bellingham - Bellingham International Airport (Command Aviation and Bellingham Aviation Services); BLI Tourism Survey Report to estimate percentage of emissions attributable to local population (31%)	Follow the methodology of PSREA for SeaTac and allocate to passengers from applicable counties if supporting data is available from the airport. For regional airports, calculate emissions from all fuel loaded onto planes departing from airports within county boundaries (scope 3 per GPC); emissions from fuel used in helicopters/light aircraft operating within county boundaries (scope 1 per GPC).	Attribute Bellingham International Airport emissions based on passenger survey rather than attributing it all to Whatcom County. Either remove SeaTac emissions from Commerce, or update 2017 WC inventory to include emissions from SeaTac for consistency.		x
Marine	2016 Puget Sound Maritime Emissions Inventory + recreational vessel fuel consumption data	Use commercial marine data available from 2020 US EPA National Emissions Inventory (NEI), by county.	Update to use 2021 PSMAEI inventory to estimate emissions.	x	
Ferry	Collected fuel consumption for the Lummi Island Ferry from County staff	Not included.	Estimate emissions from LIF	x	
Rail	Freight: Puget Sound Maritime Air Forum's 2005 and 2016 Puget Sound Maritime Air Emissions Inventories to estimate emissions from freight rail (BNSF) for Whatcom County; Passenger - not included due to lack of passenger data from Amtrak	US EPA National Emissions Inventory (NEI) by county.	Update to use 2021 PSMAEI data to attribute rail emissions to Whatcom instead of NEI to align with past approaches	x	

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Solid Waste					
Landfilled waste	County-wide tonnage and local waste characterizations; EPA WARM EFs	Calculate using WARM EFs, regional waste characterizations, and best available tonnage estimates	N/A - no updates needed		
Recycling	Not included	Not included	N/A - no updates needed		
Compost	Not included	If compost is available, calculate using WARM EFs and best available tonnage estimates	N/A - no updates needed		
Processing	Estimated using waste tonnage and USCP defaults	Not included	Add to 2022 inventory.	x	
Closed Landfills	Estimated emissions from closed landfills using FOD	Not included	Add to 2022 inventory.	x	
Water & Wastewater					
Wastewater (septic)	Estimated septic system emissions based on population served	Calculate septic emissions by # of estimated systems.	N/A - no updates needed		

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Wastewater (treatment)	Used site-specific data to estimate emissions, used population based where site-specific was unavailable: - Everson Wastewater Treatment Plant - Newhalem Wastewater Treatment Plant - Lynden Wastewater Treatment Plant - Lighthouse Point Wastewater Treatment Plant -Post Point Wastewater Treatment Plant	Used site-specific data to estimate emissions, used population based where site-specific was unavailable: - Birch Bay Water and Sewer District - Everson - Lummi Kwina - Gooseberry - Post Point - Sandy Point	Update to include all WWTFs (from both 2017 and 2022 Commerce).		x
Wastewater (lagoon)	Estimated emissions from Lynden lagoon	Not included - no lagoons listed in Whatcom County per EPA lagoon inventory	N/A - no updates needed (no lagoons listed in Whatcom for 2022)		
Water/WW treatment/conveyance energy use	Not included	Calculate emissions using metered consumption data (reported by WWTF) and utility-specific emission factors (FOR INFORMATIONAL PURPOSES ONLY to avoid double counting with Electricity sector).	N/A - listed as info only so no need to remove.		
Fugitive Emissions					
Refrigerant (HFC)	EPA National Greenhouse Gas Emissions Inventory, downscaled to population	Scale EPA data based on population.	Confirm that the same/equivalent data tables are being used.		

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Electric transmission/ distribution (SF6)	Scaled from PSE GHG inventory data	Not included.	Add emissions from SF6, scaled from PSE data.	x	
Natural gas distribution	Default NG loss rate	Utility-specific natural gas loss rates, where available. If not, then use U.S. Community Protocol defaults.	N/A - no updates needed		
Land Use					
Forest/tree loss	Appendix J: Forest Land and Trees	Utilize the ICLEI LEARN tool to estimate emissions associated with land use changes (including tree loss/degradation).	Updated to reflect newest LEARN tool and corresponding analysis time period		x
Forest/tree sequestration	Appendix J: Forest Land and Trees	Utilize the ICLEI LEARN tool to estimate sequestration associated with land use changes (including tree gain/growth).	Updated to reflect newest LEARN tool and corresponding analysis time period		x
Agriculture / soil management	Number and type of livestock	County-specific acres of cropland and number of livestock, EFs from U.S. Community Protocol (defaults by animal / management scenario)	N/A - no updates needed		
Agriculture / soil management	Excluded	US acres of cropland, Whatcom acres of cropland, US emissions from soil management.	Add to 2017 inventory.		x

	Whatcom Inventory (2017)	Dept of Commerce 2022 Inventory	Updates	Update from 2022 Commerce Inventory?	Retroactive Update of 2017?
Upstream Emissions					
Upstream emissions from fuels	Not included	Not included.	Use ClearPath defaults to estimate upstream emissions from energy sources (electricity, natural gas, fuel oil, propane).	x	x
Other consumption-based emissions (food, services, goods)	Not included	Not included.	Use ClearPath defaults to estimate consumption-based emissions for these categories using County population data.	x	x



Greenhouse Gas Emissions Projections

WHATCOM COUNTY | JUNE 2025

CASCADIA CONSULTING GROUP

FUNDED BY WASHINGTON'S CLIMATE COMMITMENT ACT

Funding Acknowledgment

The Greenhouse Gas Emissions Projections Report for Whatcom County is supported with funding from Washington's Climate Commitment Act. The CCA supports Washington's climate action efforts by putting cap-and-invest dollars to work reducing climate pollution, creating jobs, and improving public health. Information about the CCA is available at www.climate.wa.gov.

Contents

Executive Summary

This *Greenhouse Gas Emissions Projections* report provides a summary of projected future communitywide greenhouse gas (GHG) emissions for Whatcom County from 2022-2050. Outcomes from this analysis will inform development of the County's Climate Element as part of its comprehensive plan update, in compliance with Washington State House Bill (HB) 1181 requirements.

Methodology

Results from the 2022 communitywide GHG inventory were used to forecast future emissions and emission reduction scenarios for Whatcom County. Specifically, the analysis forecasted Whatcom County's communitywide GHG emissions to 2050 under three forecasts, detailed in the sections below:

- **Business-as-usual (BAU)**, which assumes no action is taken and assumes projected population[1] and economic growth.
- **Adjusted business-as-usual (ABAU)**, which models estimated emissions reduction from existing federal, state, and regional policies.
- **Additional local action,** which models estimated emissions reduction from local strategies such as VMT reduction and building energy efficiency.

Within these forecasts, the report also presents three different alternatives:

- **No action:** no action at the local level to reduce emissions.
- **Alternative 1: Some local action:** incremental local emissions targets to support Washington's statewide emission reduction target, assuming a slow ramp up to realizing full local policy action potential by 2050.
- **Alternative 2: Local action to meet target:** near-term local action on key emissions sectors and additional long-term local action to ensure countywide emissions are on track to meet long-term target. Note that this alternative approaches the 2050 state target, but does not meet the carbon neutral by 2050 goal due to remaining emissions outside Whatcom County's regulatory control.

In addition to these high-level scenario models, we also modeled local emission reductions associated with more **specific local climate actions**:

- Expanded public transit
- Land carbon sequestration (avoided forest conversion, improved forest management)
- Sector-specific building energy reductions (residential, commercial, industrial)

Projections drew from available literature and data sources, including County population and employment projections, and were based on a forecasting and scenario analysis tool developed for Whatcom County by WA Department of Commerce (contracting with Cascadia Consulting Group).

[1] Washington Office of Financial Management (OFM) Growth Management Act population projections, "Middle" scenario.

Projections & Scenario Analysis Findings

A forecasting analysis of Whatcom County's communitywide emissions from 2022 to 2050 revealed the following projections under **three forecasts** (ranges represent sensitivity analyses based on a range of federal and state policy implementation scenarios):

- Under a **business-as-usual (BAU)** projection, which assumes no action is taken to reduce GHG emissions, Whatcom County's emissions will grow 22% by 2050 (compared to a 2022 baseline), as depicted by the dotted black line in Figure 1.
- The **adjusted business-as-usual (ABAU**) projection, which models estimated emissions reductions from existing federal, state, and regional policies, estimates 0% to 22% reduction in communitywide emissions by 2050 (compared to a 2022 baseline), as depicted by the pink line in Figure 1.
- The **additional local action** projection, which models estimated emission reductions from local climate actions such as reducing building energy consumption or transitioning to electric vehicles, estimates a 55% to 80% total reduction in communitywide emissions by 2050 (compared to a 2022 baseline), as shown by the local action scenario reductions in Figure 1.

These forecasts were then applied to **three alternatives** to reveal the following findings (see Figure 1 below):

- Under no local action, we estimate that Whatcom County GHG emissions will decrease 0% to 22% by 2050 compared to 2022 levels.
- Under **some local action (Alternative 1)**, we estimate that Whatcom County GHG emissions will decrease 29% to 56% by 2050 compared to 2022 levels.
- Under **local action to meet target (Alternative 2)**, we estimate that Whatcom County GHG emissions will decrease 55% to 80% by 2050 compared to 2022 levels.

Modeling of **specific local climate actions** revealed a range of GHG reduction potential, detailed in Table 1.

Figure 1. Forecasted GHG emissions and reductions under three alternatives.

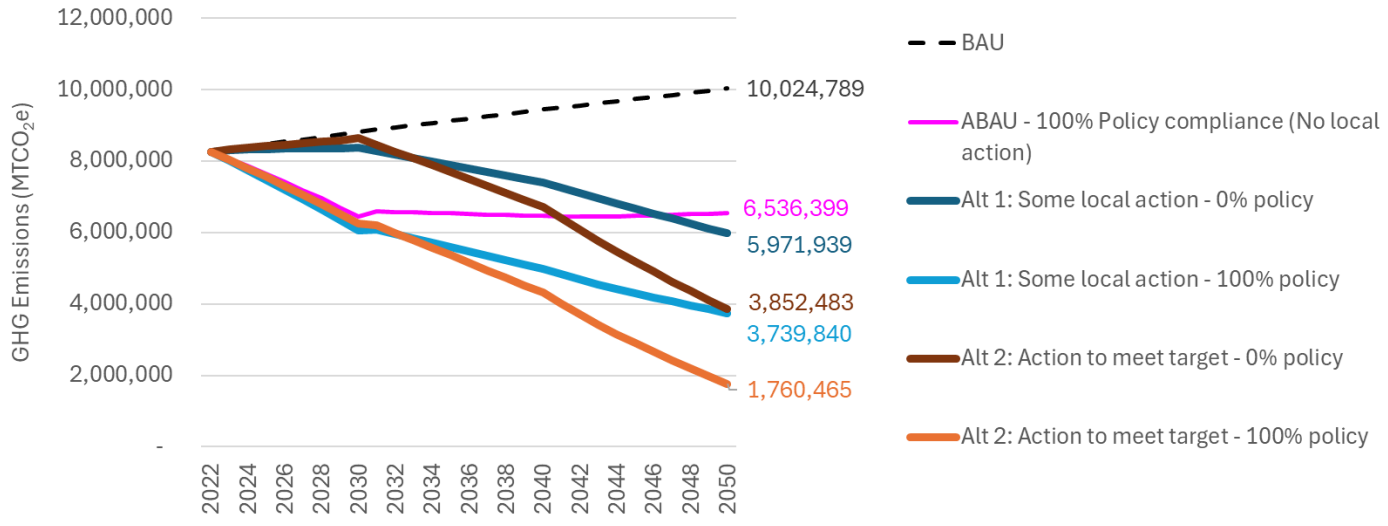


Table 1. Local action GHG emission reductions & sequestration (presented as range across scenarios).

Action	Range	GHG Emissions Reduced/Sequestered ($MTCO_2e$)			
		2030	2040	2050	Cumulative
Public Transit					
Expanded public transit	low	7,377	3,644	0	109,451
	high	12,716	31,550	34,315	614,464
Land Carbon Sequestration					
Avoided forest conversion		1,127	1,127	1,127	31,555
Improved forest management		8,400	14,000	14,000	301,000
Building Energy Reduction					
Residential	low	15,406	136,139	242,503	2,884,886
	high	34,753	314,039	549,922	6,564,941
Commercial	low	10,344	72,600	146,951	1,637,733
	high	24,781	188,775	373,509	4,212,330
Industrial	low	690	1,095,419	2,190,951	14,074,655
	high	169,869	1,360,828	2,722,865	29,612,839

Introduction

Washington State House Bill (HB) 1181, signed into law in 2023, requires Washington cities and counties to address climate change in local comprehensive plan updates. Assessing Whatcom County's past, current, and future greenhouse gas (GHG) emissions is a critical step in meeting this requirement—understanding where Whatcom County's largest sources of emissions are occurring and where there are opportunities for emissions reduction. Greenhouse gas analyses allow jurisdictions to better understand current and future greenhouse gas emissions trends and develop effective strategies to reduce climate-changing GHG emissions.

This *Greenhouse Gas Emissions Projections* report provides a summary of projected future communitywide emissions for Whatcom County from 2022-2050. This report builds from a separate *Greenhouse Gas Emissions Trends* report that details outcomes from the 2022 GHG emissions inventory update. Outcomes from these assessments will inform development of the County's Climate Element as part of its 2025 comprehensive plan update.

Objectives

The GHG analyses described in this report sought to achieve the following objectives:

- **Understand likely future GHG emissions**, including how emissions might change over time and what could drive those changes.
- **Identify overall and sector-specific emission reduction targets** to review communitywide progress toward goals set in the County's Climate Action Plan.
- **Inform policy development** as the County embarks on an update of its comprehensive plan and develops a new Climate Element as part of that planning process.

This report summarizes the outcomes from the following **forecasts**:

- **Business-as-usual (BAU)**, which assumes no action is taken and assumes projected population and economic growth.
- **Adjusted business-as-usual (ABAU)**, which models estimated emissions reduction from existing federal, state, and regional policies.
- **Additional local action**, which models estimated emissions reduction from local strategies such as VMT reduction and building energy efficiency.

Within these forecasts, the report also presents two different **alternatives**:

- **Alternative 1: Some local action:** incremental local emissions targets to support Washington's statewide emission reduction target, assuming a slow ramp up to realizing full local policy action potential by 2050.
- **Alternative 2: Local action to meet target:** near-term local action on key emissions sectors and additional long-term local action to ensure countywide emissions are on track to meet long-term target. Note that this alternative approaches the 2050 state target, but does not meet the carbon neutral by 2050 goal due to remaining emissions outside Whatcom County's regulatory control.

Within these alternatives, we also conducted a **policy sensitivity analysis** to understand how local action needs may vary under different federal/state policy compliance scenarios. Specifically, we examined alternatives under two policy scenarios:

- **0% policy compliance** (assume no state/federal policies contribute to future emissions reductions)
- **100% policy compliance** (assume all state/federal policies contribute to future emissions reductions)

In addition to these high-level scenario models, we also modeled local emission reductions associated with more **specific local climate actions**:

- Expanded public transit
- Land carbon sequestration (avoided forest conversion, improved forest management)
- Sector-specific building energy reductions (residential, commercial, industrial)

Outcomes from these GHG emission analyses will be used to inform GHG emission reduction targets and GHG emission reduction goals and policies for Whatcom County's comprehensive plan update.

Methodology

Whatcom County's GHG emissions projections and scenario analyses built from the County's 2022 communitywide GHG emissions inventory to quantitatively estimate future emissions and reduction scenarios. Emissions were modeled for every year between 2022 and 2050 using best available data and projections related to anticipated population/economic growth, policies/regulations, and local programs and initiatives. All assumptions were clearly documented and included as part of technical appendix of the report. Calculations were conducted in Microsoft Excel, building off the GHG emissions forecast and scenario analysis tool developed by Cascadia Consulting Group to support comprehensive plan updates in collaboration with Washington State Department of Commerce. The analyses projected future GHG emissions and reductions within each of the County's GHG emissions sectors, summarized in Table 2 below.

Table 2. Sources included in the GHG emissions forecast & scenario analysis.

Sector	Sources	
Buildings	Electricity Natural gas Propane	Fuel oil Industrial processes
Transportation	On-road vehicles Off-road equipment	Air travel Public transit
Solid waste	Landfilled waste generation & disposal	Compost generation & disposal
Wastewater	Treatment processes	Septic systems
Land Use	Agriculture	Tree loss & sequestration

Projections were developed by approximating anticipated changes in both activity data and emission factors over time:

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

Detailed methodologies and assumptions for each emissions scenario are provided in Appendix A: Detailed Methodology.

Policy Implications

Outputs from Whatcom County's GHG emissions forecast and scenario analysis support the development and refinement of county-specific local policy options. For example:

- **Understanding the business-as-usual context provides insight into** the scale of projected emissions growth in the absence of new policies, helping to identify the magnitude of reductions needed to meet long-term climate goals and where emissions are expected to increase most rapidly under current trends.
- **Understanding the adjusted business-as-usual context provides insight into** the emissions reductions that are already expected from state and federal policies, allowing the County to better target local actions where emissions reductions are most needed and to avoid duplicating efforts already addressed by state or federal regulations.
- **Quantifying the GHG emission impact of local actions helps to** prioritize policies and investments based on their relative effectiveness and alignment with equity and resilience goals—ensuring that Whatcom County's strategies complement broader decarbonization efforts while addressing local sources and community priorities.

Scenario & Alternatives Analysis Findings

Summary

Results from the 2022 communitywide GHG inventory were used to forecast future emissions and emission reduction scenarios for Whatcom County. Specifically, the analysis forecasted Whatcom County's communitywide GHG emissions to 2050 under **three scenarios**:

- Under a **business-as-usual (BAU)** scenario, which assumes no action is taken to reduce GHG emissions, Whatcom County's emissions will grow 22% by 2050 (compared to a 2022 baseline), as depicted by the dotted black line in Figure 2.
- The **adjusted business-as-usual (ABAU**) scenario, which models estimated emissions reductions from existing federal, state, and regional policies, estimates 22% reduction in communitywide emissions by 2050 (compared to a 2022 baseline), as depicted by the pink line in Figure 2.
- The **additional local action** scenario, which models estimated emission reductions from local climate actions such as reducing building energy consumption or transitioning to electric vehicles, estimates a 55% to 80% total reduction in communitywide emissions by 2050 (compared to a 2022 baseline), as shown by the local action scenario reductions in Figure 2.

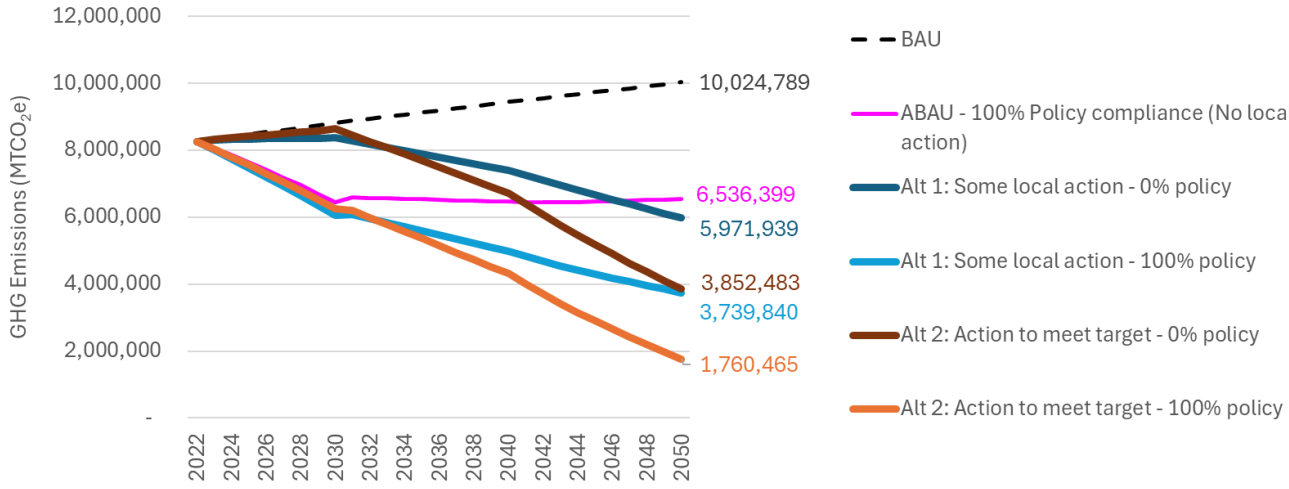
Within these forecasts, the report also presents two different **alternatives** under a range of policy implementation scenarios:

- Under **some local action (Alternative 1)**, we estimate that Whatcom County GHG emissions will decrease 29% to 56% by 2050 compared to 2022 levels.
- Under **local action to meet target (Alternative 2)**, we estimate that Whatcom County GHG emissions will decrease 55% to 80% by 2050 compared to 2022 levels.

Modeling of **specific local climate actions** revealed a range of GHG potential reductions, with cumulative 2022-2050 reductions ranging from 31,555 to 29,612,839 $MTCO_2e$. The most impactful modeled local actions were sector-specific building energy reduction (residential, commercial, industrial) and expanded public transit.

Detailed findings of these scenarios, alternatives, and local actions are provided in the sections below.

Figure 2. GHG emissions projections & scenario analysis summary



Forecasts

Business-As-Usual

The BAU projects emissions based on a "no-action future" that assumes no federal, state, regional, or local policies or actions influence future emissions. Future emissions under the BAU are modeled based on estimated population and economic growth. Population and economic growth estimates can be found in Table 4. The BAU projects a 22% growth in total emissions by 2050.

Table 3. Demographic projections for Whatcom County.

Demographic	2022	2030	2040	2050
Population	231,650	254,158	280,275	304,836
Employment	123,937	135,979	149,952	163,093

Adjusted Business-As-Usual

The ABAU estimates emissions reductions resulting from established federal, state, and regional policies. Together, the implementation of identified policies results in an estimated 21% reduction in communitywide GHG emissions by 2050 compared to 2022 levels.

The ABAU scenario considered the following federal, state, and regional policies (Appendix A: Detailed Methodology provides additional information regarding policy interpretation and assumptions):

- Washington State Energy Code (SB 5854)
- Washington Clean Buildings Act (HB 1257)
- Federal Vehicle Regulations (CAFE)
- WA Clean Fuel Standard (HB 1091)
- WA Clean Vehicle Program (SB 5974)
- WA Hydrofluorocarbon Policies (HB 1112 & HB 1050)
- WA Clean Energy Transformation Act (CETA)
- WA Climate Commitment Act (E2SSB 5126)

Note that to avoid double-counting, the analysis sequentially models each policy, so the order of modeling influences a policy's indicated GHG emission reductions.

Table 4. Projected emission and emissions reduction under the ABAU scenario.

Scenario/Policy	Greenhouse Gas Emissions/Reductions ($MTCO_2e$)		
	2030	2040	2050
BAU Projection	**8,813,523**	**9,437,751**	**10,024,789**
WA State Energy Code	-143,046	-475,740	-788,612
WA Clean Buildings Act*	-	-	-
WA Clean Energy Transformation Act (CETA)	-935,580	- 817,614	-846,202
WA Climate Commitment Act (SB 5126)	-1,104,512	-1,061,048	-1,061,340

Scenario/Policy	Greenhouse Gas Emissions/Reductions ($MTCO_2e$)		
	2030	2040	2050
Federal Corporate Average Fuel Economy (CAFE) Standards	-63,289	-143,015	-222,142
WA Clean Fuel Standard (HB 1091)	-40,489	-124,643	-158,002
WA Clean Vehicle Program (SB 5974)	-81,495	-350,457	-412,092
Aviation industry commitments	-31,847	-75,311	-121,142
Marine industry goals/commitments	-53,685	-82,086	-118,773
WA Hydrofluorocarbon Policies (HB1112 & 1050)**	-	-	-
ABAU Projection	**6,445,112**	**6,465,234**	**6,536,399**
Total ABAU Reduction	**-2,368,411**	**-2,972,517**	**-3,488,390**

** WA State Energy Code was applied first in the model and resulted in more substantial energy savings than Clean Buildings Act, therefore Clean Buildings Act does not show emissions savings.*

*** Shows as zero because refrigerant emissions were not included in the forecast and scenario planning model.*

Alternatives

Alternative 1: Some Local Action

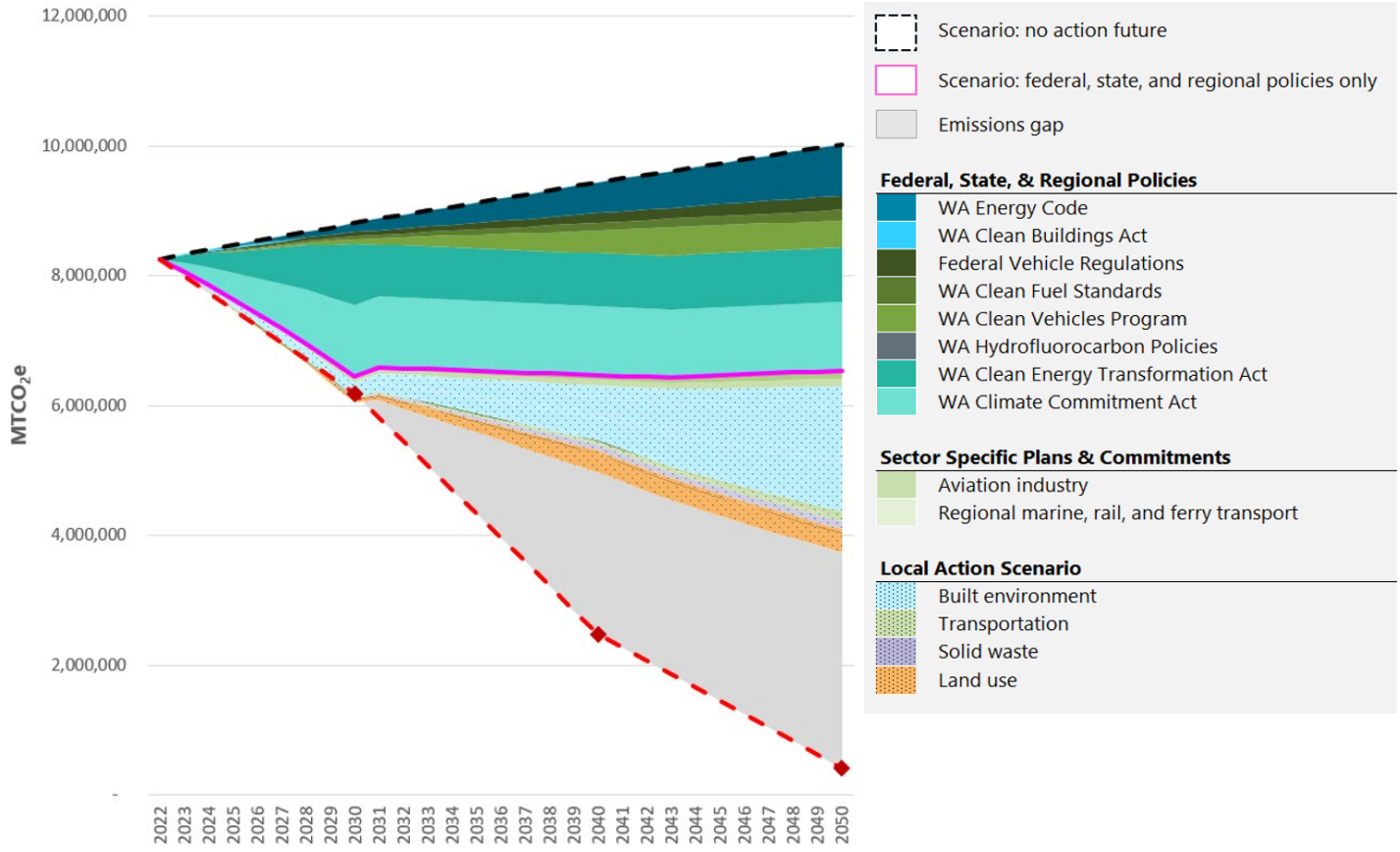
Alternative 1 (some local action) presents incremental local emissions targets to support Washington's statewide emission reduction target, assuming a slow ramp up to realizing full local policy action potential by 2050. Under some local action (Alternative 1), we estimate that Whatcom County GHG emissions will decrease 29% to 56% by 2050 compared to 2022 levels. Local action assumptions under this alternative are shown in Table 5. The most impactful local strategies in this scenario address emissions from the built environment and tree loss: 1) Electrify existing industrial buildings and 2) reducing tree loss (Figure 3).

Table 5. Local action assumptions under Alternative 1 (some local action).

Strategy	2030	2040	2050
Electrify new residential buildings (% fossil fuel use converted to elect.)	25%	50%	100%
Electrify new commercial buildings (% fossil fuel use converted to elect.)	5%	50%	75%
Electrify new industrial buildings (% fossil fuel use converted to elect.)	5%	25%	50%
Reduce energy use in existing residential buildings (% reduction in energy use)	3%	30%	50%
Reduce energy use in existing commercial buildings (% reduction in energy use)	3%	25%	50%
Reduce energy use in existing industrial buildings (% reduction in energy use)	3%	10%	30%
Electrify existing residential buildings (% fossil fuel use converted to elect.)	3%	30%	80%
Electrify existing commercial buildings (% fossil fuel use converted to elect.)	3%	20%	60%
Electrify existing industrial buildings (% fossil fuel use converted to elect.)	3%	15%	40%
Increase local solar (total new MW)	5	50	100
Reduce industrial emissions (% reduction in emissions) *	3%	5%	10%
Reduce passenger vehicle travel (% reduction in per-capita VMT) *	5%	10%	15%
Electrify passenger vehicles (% new vehicles sold that are EV) *	25%	25%	25%
Electrify freight/service vehicles (% new vehicles sold that are EV) *	5%	50%	100%
Electrify transit vehicles (% new vehicles sold that are EV) *	20%	25%	50%

Strategy	2030	2040	2050
Decarbonize offroad equipment (% reduction in emissions) *	5%	35%	50%
Decarbonize aviation fuels (% reduction in fuel carbon intensity) *	0%	0%	0%
Reduce air travel & increase efficiency (% reduction in aviation fuel use)	0%	0%	0%
Divert C&D materials (% of C&D waste diverted)	25%	75%	75%
Divert other recyclable and compostable materials (% reduction in landfilled waste)	40%	75%	90%
Improve soil management (% reduction in emissions from soil management)	5%	20%	30%
Reduce tree loss (% reduction in tree loss)	5%	30%	30%
Protect land carbon sinks (% of current sinks protected)**	50%	80%	80%

Figure 3. GHG emission reductions under Alternative 1 (some local action).



Alternative 2: Local Action to Meet Target

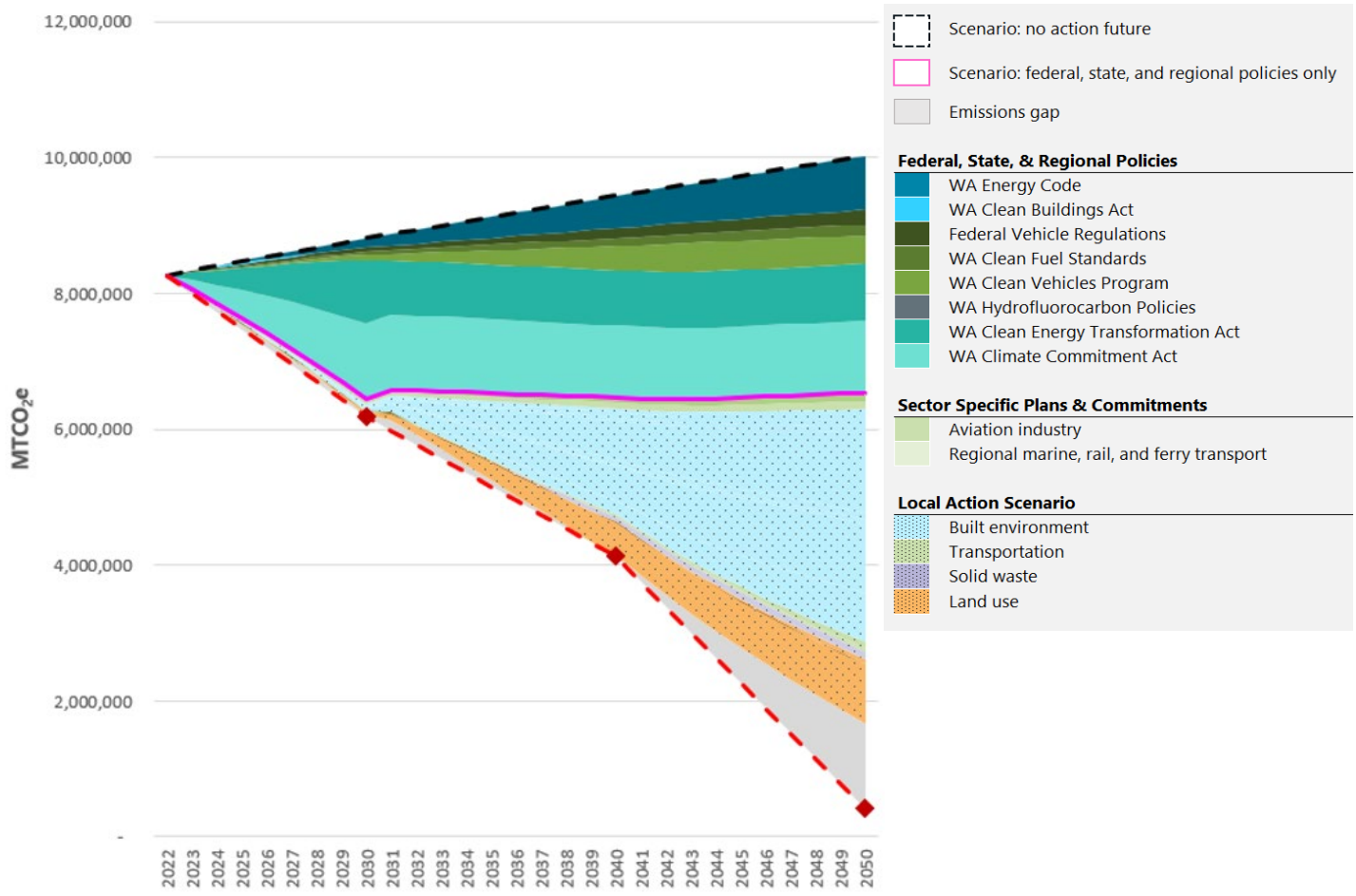
Alternative 2 (actions to meet target) focuses near-term local action on key emissions sectors and includes additional long-term local action to ensure countywide emissions are on track to meet long-term target. Note that this alternative approaches the 2050 state target, but does not meet the carbon neutral by 2050 goal due to remaining emissions outside Whatcom County's regulatory control. Under local actions to meet targets (Alternative 2) and assumed 100% federal/state policy implementation, we estimate that Whatcom County GHG emissions will decrease 55% to 80% by 2050 compared to 2022 levels. Local action assumptions under this alternative are shown in Table 6 (values in red represent more aggressive local action than in Alternative 1). The

most impactful local strategies in this scenario address emissions from the built environment and tree loss: 1) Electrify existing industrial buildings and 2) reducing tree loss (Figure 3).

Table 6. Local action assumptions under Alternative 2 (local action to meet target).

Strategy	2030	2040	2050
Electrify new residential buildings (% fossil fuel use converted to elect.)	25%	50%	100%
Electrify new commercial buildings (% fossil fuel use converted to elect.)	5%	50%	75%
Electrify new industrial buildings (% fossil fuel use converted to elect.)			
Reduce energy use in existing residential buildings (% reduction in energy use)	3%	30%	50%
Reduce energy use in existing commercial buildings (% reduction in energy use)	3%	25%	50%
Reduce energy use in existing industrial buildings (% reduction in energy use)		25%	50%
Electrify existing residential buildings (% fossil fuel use converted to elect.)	3%	30%	80%
Electrify existing commercial buildings (% fossil fuel use converted to elect.)	3%	20%	60%
Electrify existing industrial buildings (% fossil fuel use converted to elect.)		30%	90%
Increase local solar (total new MW)			
Reduce industrial emissions (% reduction in emissions) *	3%	20%	70%
Reduce passenger vehicle travel (% reduction in per-capita VMT) *	5%	10%	10%
Electrify passenger vehicles (% new vehicles sold that are EV) *			
Electrify freight/service vehicles (% new vehicles sold that are EV) *		50%	100%
Electrify transit vehicles (% new vehicles sold that are EV) *			50%
Decarbonize offroad equipment (% reduction in emissions) *			50%
Decarbonize aviation fuels (% reduction in fuel carbon intensity) *			
Reduce air travel & increase efficiency (% reduction in aviation fuel use)			
Divert C&D materials (% of C&D waste diverted)			75%
Divert other recyclable and compostable materials (% reduction in landfilled waste)		75%	90%
Improve soil management (% reduction in emissions from soil management)			30%
Reduce tree loss (% reduction in tree loss)	5%	50%	90%
Protect land carbon sinks (% of current sinks protected)**		80%	80%

Figure 4. GHG emission reductions under Alternative 2 (local actions to meet target).



Local Actions

In addition to high-level scenario models, we also modeled local emission reductions associated with the following more **specific local climate actions**:

- Expanded public transit
- Land carbon sequestration (avoided forest conversion, improved forest management)
- Sector-specific building energy reductions (residential, commercial, industrial)

Modeling of **specific local climate actions** revealed a range of GHG reduction potential, with cumulative 2022-2050 reductions ranging from 31,555 to 29,612,839 $MTCO_2e$ (Table 7). The most impactful modeled local actions were sector-specific building energy reduction (residential, commercial, industrial) and expanded public transit.

Table 7. Local action GHG emission reductions & sequestration (presented as range across scenarios).

Action	Range	GHG Emissions Reduced/Sequestered ($MTCO_2e$)			
		2030	2040	2050	Cumulative
Public Transit					
Expanded public transit	low	7,377	3,644	0	109,451
	high	12,716	31,550	34,315	614,464
Land Carbon Sequestration					
Avoided forest conversion		1,127	1,127	1,127	31,555
Improved forest management		8,400	14,000	14,000	301,000
Building Energy Reduction					
Residential	low	15,406	136,139	242,503	2,884,886
	high	34,753	314,039	549,922	6,564,941
Commercial	low	10,344	72,600	146,951	1,637,733
	high	24,781	188,775	373,509	4,212,330
Industrial	low	690	1,095,419	2,190,951	14,074,655
	high	169,869	1,360,828	2,722,865	29,612,839

Expanded Public Transit

The expanded public transit local action estimated passenger VMT reductions from Whatcom Transportation Authority (WTA) 2040, WTA's long-range transit plan. This plan provides the guidance and framework for WTA to adapt and grow service over the next twenty years to fulfill its mission to the community. The plan includes the "2040 Service Network", the result of the WTA 2040 planning process, and the "Expanded Service Network", which is an option WTA could pursue if demand significantly increased and additional funding became available, for example through a local sales tax.

This local action summarizes VMT and resulting GHG emissions savings from the anticipated increase in WTA revenue hours under WTA 2040. VMT reductions were estimated using California Air Pollution Control Officers Association (CAPCOA) 2021 guidance for quantifying GHG mitigation measures (T-24 Extend Transit Network Coverage or Hours and T-25 Increase Transit Service Frequency).[2] Specific assumptions for quantifying this action include:

- 85% increase in passenger miles
- 5% baseline transit mode share
- 12% increase in transit frequency

Implementation of this action resulted in cumulative GHG emission reductions ranging from 109,451 to 614,464 $MTCO_2e$, depending on the degree of additional related local action and federal/state policy implementation.

[2] CAPCOA. *Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity*. 2021. https://www.airquality.org/ClimateChange/Documents/Handbook%20Public%20Draft_2021-Aug.pdf

Land Carbon Sequestration

The avoided conversion action assessed the conversion of forested land under a business-as-usual scenario compared to local action to reduce tree loss. Data on the total acres of forested land for each zoning designation were compiled using GIS, and an annual loss rate of ~2% was applied to estimate annual conversion under the current zoning regulations. Emission factors from ICLEI's Land Emissions And Removals Navigator (LEARN) tool were used to estimate emissions.

The improved forest management action estimated emission reductions from forest management practices i.e., combining extended harvest rotations, increasing harvest residues collected and reused (e.g., for bioenergy), and increasing forest productivity. Assumptions include:

- 12.6% net mitigation potential[3]
- 10% increase in forestry acres participation per year
- Implementation of these actions resulted in cumulative GHG emission reductions of 332,555 $MTCO_2e$.

Building Energy Reduction

The building energy reduction action examined potential GHG emission reductions associated with targeted local buildings strategies for the residential, commercial, and industrial sectors. Assumptions for these strategies, depicted in Table 8, were determined using available resources and literature on the energy savings potential specific to each sector. Example consulted sources include the following:

- National Renewable Energy Laboratory's (NREL) *Energy Efficiency Potential in the U.S. Single Family Housing Stock* (2014).
- American Council for an Energy-Efficient Economy's (ACEEE) *Moving the Needle on Comprehensive Commercial Retrofits* (2022).
- Lawrence Berkeley National Laboratory's *Emerging Energy-Efficient Technologies for Industry*.

Table 8. Local action assumptions for residential, commercial, and industrial energy reduction under Alternative 1: some local action.

Year	2030			2040			2050		
Sector	Res	Com	Ind	Res	Com	Ind	Res	Com	Ind
Electrify new buildings (% fossil fuel use converted to elect.)	25%	5%	5%	50%	50%	25%	100%	75%	50%
Reduce energy use in existing buildings (% reduction in energy use)	3%	3%	3%	30%	25%	10%	50%	50%	30%
Electrify existing buildings (% fossil fuel converted to elect.)	3%	3%	3%	30%	20%	15%	80%	60%	40%

[3] USDA. *What can forest managers do to increase carbon storage and mitigate climate change?* 2021. https://www.climatehubs.usda.gov/sites/default/files/forestcarbon2021_Final_032321_508.pdf

Implementation of this action resulted in cumulative GHG emission reductions ranging from 1,637,733 to 29,612,839 $MTCO_2e$, depending on the degree of additional related local action and federal/state policy implementation. The highest savings were from actions in the industrial sector: 1) reduce energy use in existing industrial buildings and 2) electrify existing industrial buildings.

Target & Policy Implications

Greenhouse gas (GHG) scenario analysis is a key tool for establishing informed and achievable emissions reduction policies and targets in Whatcom County. By projecting how emissions may change under different assumptions—such as continued growth, implementation of existing state and federal policies, or the addition of local actions—scenario analysis clarifies the scale of reductions needed to meet specific climate goals. This approach enables the County to set science-based or policy-aligned targets grounded in a clear understanding of baseline trends and the expected impact of external policies. In turn, it supports the development of local strategies that are tailored, measurable, and aligned with both County priorities and state-level decarbonization requirements.

Key Performance Indicators & Targets

Outcomes from this analysis suggest a set of key performance indicators (KPIs) to monitor and track local climate action progress over time, detailed in Table 8 below.[4]

Table 9. Key performance indicators for monitoring local climate action progress

Key Performance Indicator	2022	2030	2040	2050
Overall community GHG emissions ($MTCO_2e$)	8,248,652	6,188,874	3,978,551	1,598,612
Residential natural gas consumption (therms)	45,492,378	45,779,119	45,779,119	45,779,119
Commercial natural gas consumption (therms)	32,145,443	31,449,041	21,019,253	8,343,684
Industrial natural gas consumption (therms)	510,336,473	538,456,780	306,619,388	67,861,928
Industrial process emissions ($MTCO_2e$)	1,330,442	989,172	815,812	305,930
Per-capita passenger VMT (vehicle miles)	5,908	5,612	5,317	5,317
Agriculture emissions ($MTCO_2e$)	415,205	415,205	415,205	415,205
Tree loss emissions ($MTCO_2e$)	993,191	943,531	496,596	99,319

Goals

Draft goals within Whatcom County's draft climate element that support advancement of the key performance indicators include the following:

- **Electricity and Buildings:** Goal 12.2- Decarbonize buildings by promoting the transition to renewable energy sources, implementing green building standards, and retrofitting existing buildings to be more energy efficient.
- **Industry:** Goal 12.4- Support the development of a local economic system that fosters business opportunities associated with climate action.
- **Transportation:** Goal 12.8- Support decarbonization of the transportation system by adopting new technologies, expanding infrastructure, improving connectivity, and increasing access to low-carbon transportation options. Land Use: Goal 12.11- Implement dense, mixed-use, and transit-oriented

[4] Represents outcomes from the *Alternative 2: Local action to meet target* scenario.

development in UGAs, where appropriate, and land preservation policies in rural areas to reduce greenhouse emissions.

- **Agriculture:** Promote adoption of climate smart farm management practices that maximize soil carbon storage and increase water and nutrient availability. Reduce agriculture emissions and increase renewable energy, while providing farmers with new income opportunities.

Appendix A: Detailed Methodology

Adjusted Business-As-Usual Assumptions

The adjusted business-as-usual (ABAU) scenario included consideration of the following federal, state, and regional policies:

- Washington State Energy Code (SB 5854)
- Washington Clean Buildings Act (HB 1257)
- Federal Vehicle Regulations (CAFE)
- WA Clean Fuel Standard (HB 1091)
- WA Clean Vehicles Program (SB 5974)
- WA Hydrofluorocarbon Policies (HB 1112 & HB 1050)
- WA Clean Energy Transformation Act (CETA)
- WA Climate Commitment Act (E2SSB 5126)

Additional information regarding policy interpretation and assumptions are provided below.

WA Energy Code (SB 5854)

Interpretation: SB 5854 requires residential and nonresidential construction permitted under the 2031 state energy code to achieve a 70% reduction in annual net energy consumption (compared to a 2006 baseline). State energy codes will be adopted from 2013-2031 to incrementally move towards achieving the 70% reduction by 2031.

Modeling Assumptions: New construction in 2031 and beyond will consume 70% less energy than the 2006 baseline. Scaled 2022 data to 2006 to use a 2006 baseline for this policy analysis. Assumed this baseline applies to all jurisdictions. Using 2022 energy consumption rates, modeled a straight-line reduction in energy consumption rate from 2022 to 2031 to achieve the 70% reduction from baseline (in new buildings only). Assume that any additional energy consumption under BAU compared to 2022 is from new buildings. All new commercial buildings must use electric heat pumps for space heating and electric water heating for 50% of water (reflects updates to the 2021 WA State Energy Code).

- Assume commercial water heating accounts for 9% of building energy use; assume space heating accounts for 23% of building energy use (total = 32%; Source: EIA 2015).
- Assume 75% of current commercial buildings use fossil fuel space/water heating.

WA Clean Buildings Act (HB 1257)

Interpretation: Requires all new and existing commercial buildings over 50,000 square feet to reduce their energy use intensity by 15%, compared to the 2009–2018 average.

- Buildings greater than 220,000 square feet must comply by June 1, 2026
- Buildings greater than 90,000 square feet must comply by June 1, 2027
- Buildings greater than 50,000 square feet must comply by June 1, 2028

Modeling Assumptions: Using 2022 county level commercial energy consumption data, calculated energy consumed per sq ft of commercial building space to arrive at average energy use intensity (EUI: energy consumed per sq ft). Scaled 2022 data to 2019 as a proxy for 2009-2018 baseline. Modeled a straight-line reduction in energy use intensity (up to 15%) for Bins 1–3 below for 2023 through respective compliance dates.

- Bin 1: >220K sq ft
- Bin 2: > 90K sq ft
- Bin 3: > 50K sq ft
- Bin 4: 50K sq ft and under (rule does not apply)

Federal Vehicle Regulations (CAFE)

Interpretation: Corporate Average Fuel Economy (CAFE) standards are regulated by the DOT and supported by the EPA, calculates average fuel economy levels for manufacturers and sets related GHG standards. Passenger cars and light trucks require an industry-wide fleet average of approximately 49 mpg for passenger cars and light trucks in model year 2026, increasing fuel efficiency 8% annually for model years 2024–2025 and 10% annually for model year 2026. This will also increase the estimated fleetwide average by nearly 10 miles per gallon for model year 2026, relative to model year 2021.

Modeling Assumptions: Based on PSRC Vision 2050 modeling, scaling 2022 data to 2018 for these assumptions, assumed the following changes in vehicle emissions intensity (g CO_2e/mile):

- Light duty vehicles: 33% reduction from 2018 to 2050.
- Heavy duty vehicles: 26% reduction from 2018 to 2050.

WA Clean Fuel Standard (HB 1091)

Interpretation: The Clean Fuel Standard requires a 20% reduction in the carbon intensity of transportation fuels by 2038, compared to a 2017 baseline level. Reductions in carbon intensity may be achieved through cleaner fuels or by purchasing clean fuel credits from cleaner producers such as those providing electricity as fuel. Boats, trains, aircraft, and military vehicles & equipment are excluded.

Modeling Assumptions: Model assumes the 2022 transportation fuel emissions factors are applicable for 2017–2023 (2017 is policy baseline year). Overall, policy calls for 20% reduction in carbon intensity of transportation fuels by 2038.

EV/fuel contributions: Since there are concerns with WA's short-term ability to scale up low carbon fuels, for 2030 the split of clean fuel/EV is closer to 35%/65%, compared to 50%/50% by 2038.

Therefore, compared to baseline, we modeled the following for fuel carbon intensities:

- 3.5% reduction in per-gallon gasoline & diesel vehicle (passenger, heavy duty, transit) emissions from cleaner fuels (NOT EVs) by 2030.
- 10% reduction in per-gallon gasoline & diesel vehicle (passenger, heavy duty, transit) emissions from cleaner fuels (NOT EVs) by 2040.
- Maintain 10% reduction levels to 2050.

Given Clean Cars Program, compared to baseline, we will model the following for EV use:

- 6.5% transition of gasoline/diesel passenger vehicles to EV by 2030.

- 10% transition of gasoline/diesel passenger vehicles to EV by 2040.
- Maintain 10% reduction levels to 2050.

WA Zero Emission Vehicle Standards (SB 5974)

Interpretation: Adopts standards that require a percentage of vehicles sold in Washington to be zero emission, starting with the 2025 model year.

Modeling Assumptions: As part of Move Ahead Washington program, WA would require a minimum percentages of passenger vehicles to be zero-emission starting in 2025. For ZEV standards, assuming a 15-year vehicle turnover rate:

- 25% by 2026
- 65% by 2030
- 100% by 2035
- Maintained by 100% thereafter

WA Hydrofluorocarbon Policies (HB 1112 & HB 1050)

Interpretation: HB 1112 requires that new equipment be manufactured without HFCs or using refrigerants with a lower global warming potential (GWP) in a phased approach through 2024. Equipment covered by the law are being phased in each year, starting with 2020, and penalties apply for non-compliance. In 2021, HB 1050 applied Clean Air Act provisions for ozone depleting substances to HFCs and extended restrictions on higher GWP HFCs to new equipment such as ice rinks and stationary air conditioning.

Modeling Assumptions: Aligned model assumptions with state modeling, scaling 2022 data to 2019 to align with modeling.

WA Clean Energy Transformation Act (CETA)

Interpretation: CETA applies to all electric utilities serving retail customers in Washington and sets specific milestones: By 2025, utilities must eliminate coal-fired electricity from their state portfolios; by 2030, utilities must be greenhouse gas neutral, with flexibility to use limited amounts of electricity from natural gas if it is offset by other actions; by 2045, utilities must supply Washington customers with electricity that is 100% renewable or non-emitting, with no provision for offsets.

Modeling Assumptions: Electricity will be GHG neutral (electricity emissions factor equals zero) in 2030 and beyond with a straight-line emissions factor reduction from 2022 to 2030. For utilities that rely on coal for electricity generation, additionally model straight-line reduction to 0% coal by December 31, 2025. Assume coal is replaced by renewables. This action impacts electricity emissions factors (reduces emissions per unit of energy consumed).

WA Climate Commitment Act (E2SSB 5126)

Interpretation: The Climate Commitment Act (known as Cap and Invest) places an economy-wide cap on carbon to meet state GHG reduction targets and remain consistent with best available science, while minimizing the use of offsets to meet those targets. Every polluting facility covered under the program needs to hold one allowance for every ton of greenhouse gas that it emits. Based on an environmental justice review, 35–40% of investments

must be made in overburdened communities to reduce health disparities and create environmental benefits, with an additional 10% allocated for tribal programs and projects.

Modeling Assumptions: State estimates that CCA will account for 26.2 million $MTCO_2e$ in statewide reductions by 2030. 2018 total emissions = 99.57 million $MTCO_2e$. Scaled 2022 data to 2018 to obtain a proxy baseline.

Key regulated CCA sectors relevant to the geographic inventory include:

- Natural gas (however, this sector will receive directly allocated no-cost allowances).
- Industrial processes (however, Emissions-Intensive Trade-Exposed facilities will receive directly allocated no-cost allowances).
- Transportation fuels (however, already covered to some extent by Clean Fuels Standard).

Therefore, assume the following for CCA:

- Assume CETA addresses emissions reductions in electricity sector.
- Apply -10% emissions factor adjustment to natural gas (assuming increase in hydrogen or RNG in fuel mix) to 2030.
- Apply -15% emissions reduction estimate (consider applying a reduction factor) to industrial process emissions to 2030.
- Apply -23.5% fuel emissions factor reduction estimate (consider applying a reduction factor) to transportation emissions to 2030 and -30% to 2040 (includes reductions from CFS).