Snohomish County

2018 Greenhouse Gas Emissions Inventory for County Government Operations

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Snohomish County

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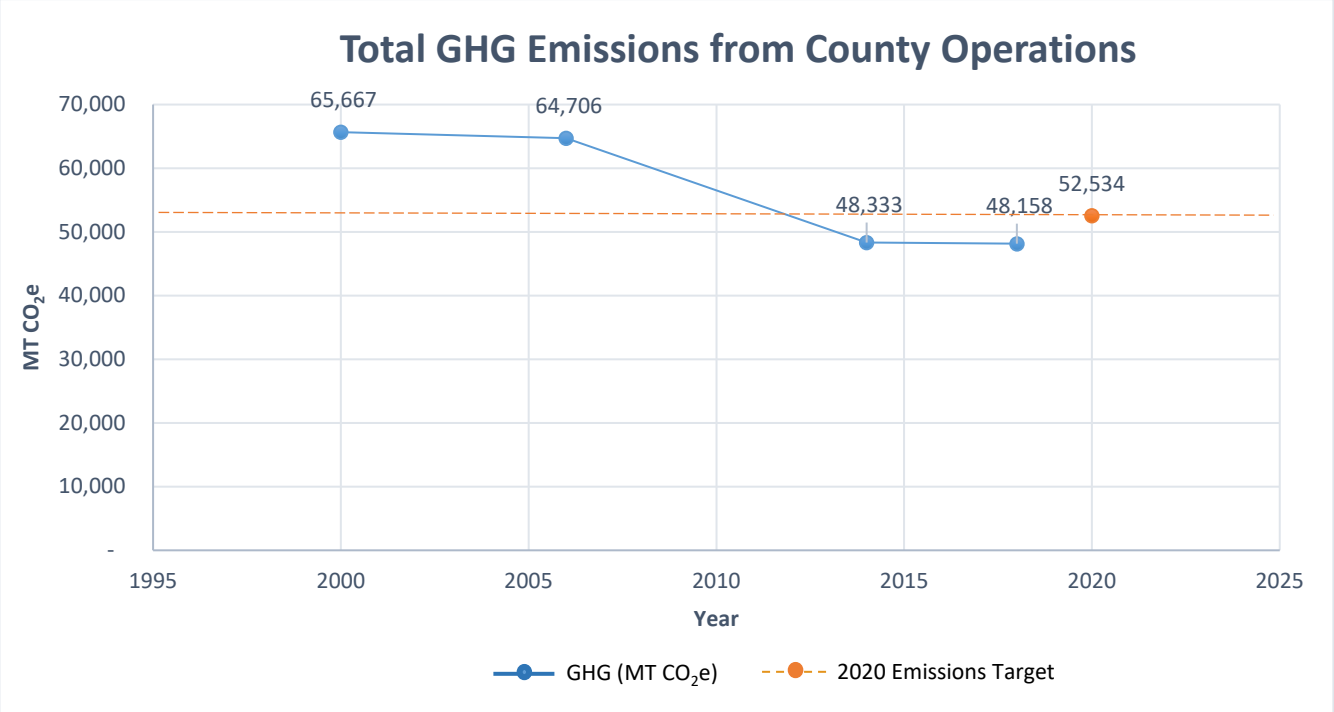
Table of Contents

Executive Summary

Key Findings

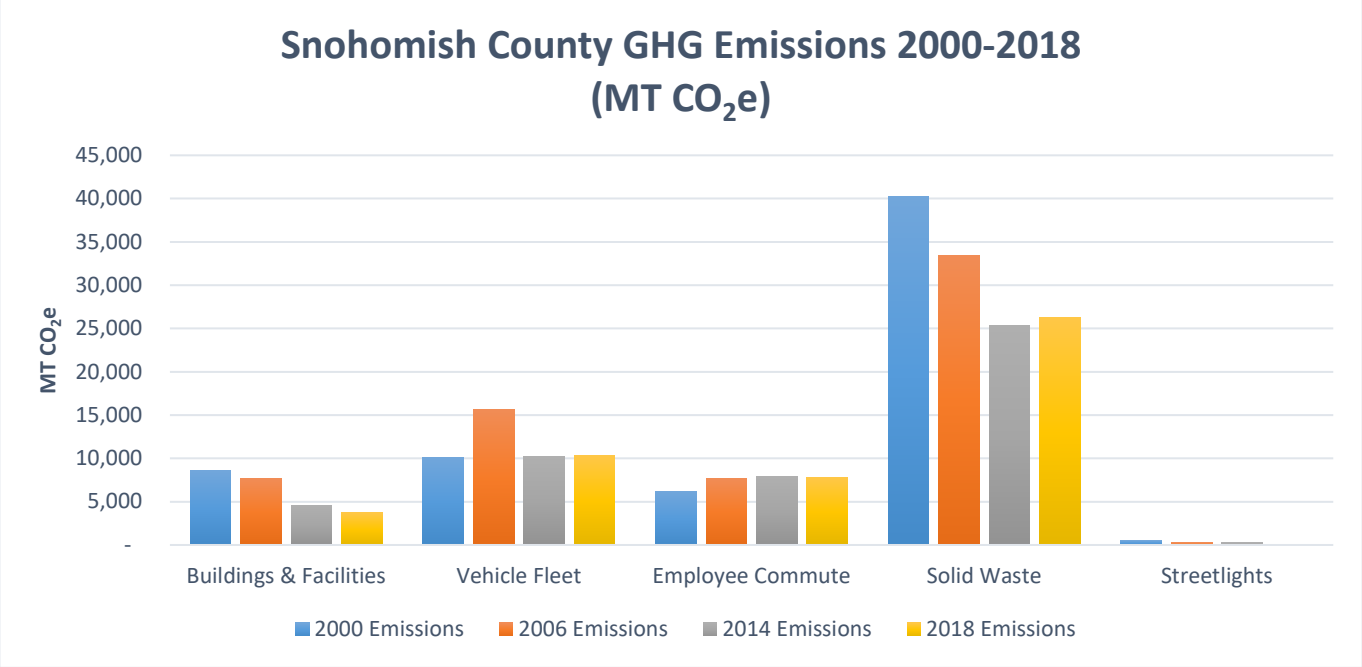
Greenhouse gas (GHG) emissions from county operations totaled 48,158 metric tons (MT) of carbon dioxide equivalent (CO_2e) in 2018. This total is 26.7 percent below the baseline emissions calculated for the year 2000. The county's emissions target, as established in Executive Order 13-48A, is a 20 percent reduction below 2000 levels by the year 2020. 2018 emissions inventory results indicate that the county met and surpassed this goal in 2018. This is a significant achievement particularly given that the county employee base has increased by over 50 percent since the year 2006, and the population served by county government has grown over 34 percent since 2000, an average annual growth rate of 1.6 percent.



Emissions baseline and target values were recalculated with this inventory report in order to incorporate emissions data from the closed Cathcart Landfill, which had not been included in previous GHG inventory reports. The Cathcart Landfill is a significant source of emissions for the county, accounting for 52.5 percent of the total emissions in 2018 (25,305 MT CO_2e out of a total 48,158 MT CO_2e).

The significant changes in the emissions from county operations in 2018 compared to baseline year 2000, include:

- A **57 percent decrease in emissions from the Buildings and Facilities sector**, from 8,563 MT CO_2e to 3,725 MT CO_2e.
- A **25 percent increase in emissions from employee commuting**, from 6,193 MT CO_2e to 7,722 MT CO_2e.
- A **385 percent increase in emissions from solid waste** generated at county facilities, from 200 MT CO_2e to 970 MT CO_2e.
- A **37 percent estimated decrease in emissions from the Cathcart Landfill**, from 40,000 MT CO_2e to 25,305 MT CO_2e.
- A **97 percent decrease in emissions from county-operated streetlights and traffic lights**, from 558 MT CO_2e to 16 MT CO_2e.



Finally, a key finding from this report is that **82 percent of the county's operational emissions are "Scope 1 emissions", which are primarily from the combustion of fossil fuels in buildings and vehicles, and from GHGs from the county's closed Cathcart Landfill.** One percent of county operational emissions are "Scope 2 emissions" from electricity generation, as the electricity supplied by Snohomish Public Utility District (PUD) is 97 percent carbon free. "Scope 3 emissions" account for remaining 17 percent of the county's operational GHGs and include emissions from employee commute and travel, and outsourced waste.

Forecasting 2020 and the Impacts of COVID-19

This 2018 inventory report demonstrates that the county has already reached its 20 percent emissions reduction goal two years before the 2020 target date from Executive Order 13-48A. The forecast scenarios included in this report show that GHGs from county operations are expected to continue to decrease in 2020 and beyond. This report was developed and published during the COVID-19 coronavirus pandemic and some operational changes resulting from the pandemic response are anticipated to reduce the county's carbon footprint. A significant portion of the county workforce has shifted to remote work and a more permanent telecommuting policy is likely to continue well beyond the coronavirus pandemic. As a result, emissions from employee commuting and waste generated at county facilities are estimated to decrease by 40 percent in 2020 from 2018 levels, and the county is forecast to achieve a 32 percent reduction in emissions in 2020 from the baseline year 2000.

While it is still unclear what the new "normal" will be post-COVID-19, the county's climate action plans for government operations and the Snohomish County community will continue to prioritize cost-effective solutions to reduce carbon emissions, adapt, and build resiliency for a changing climate.

I. Inventory Overview

This greenhouse gas (GHG) emissions inventory report provides a summary of GHGs produced by county operations in the 2018 calendar year. The purpose of conducting a GHG emissions inventory is to measure and track the county's progress in meeting its emissions reduction goals, and to illuminate where GHG emissions are increasing or decreasing. The Office of Energy and Sustainability has completed GHG emissions inventories for county government operations for the years 2000, 2006, and 2014. This inventory captures Scope 1, 2, and a limited set of Scope 3 GHGs produced by county operations, including emissions from combustion of fossil fuels, electricity consumption, employee commute, and closed landfills.

A. Changes for this 2018 inventory

GHGs from the county's closed Cathcart Landfill is a new field of data included in this 2018 inventory which was not included in the county's previous GHG inventories for government operations. GHGs from the closed Cathcart Landfill were not included in previous inventories, primarily because government agencies were not required to collect and report this information to the state and federal government until 2010. By including GHGs from the closed Cathcart Landfill in this report, the county is following best practices reporting protocol as established by ICLEI and Climate Registry – two of the most widely accepted third-party organizations in this regard. Furthermore, for the purpose of this report, Cathcart Landfill emissions have been estimated for the prior inventory report years, and these estimates are included in the analyses provided throughout this report[1]. Estimating Cathcart Landfill GHGs for previous reporting years was necessary to provide an accurate reflection of the county's overall GHG emissions trends, and progress in meeting its GHG reduction goals. 2018 GHGs from employee air travel are also included for the first time in this report. The goal of GHG emissions inventory is always to provide an accurate accounting of the county's total operational emissions; adding these two pieces of data to the 2018 report, and future GHG inventory reports, is a critical component to achieving this goal.

Finally, this 2018 inventory is the county's first attempt to provide a rough estimate for GHGs from one additional category: consumption-based emissions. Consumption-based GHGs – namely the goods and services that an organization purchases – can have a significant carbon footprint. Review of GHG inventories from other local governments across the country shows that consumption-based emissions can often be the largest source of an organization's or community's emissions. It is important to note that while an estimate for county government consumption-based emissions is provided in this report, it is not

[1] For more information on the methodology for estimating Cathcart landfill emissions, please see Section III.D.1: Inventory Methodology, Section IV.C.5: Government Operations Inventory Results, and Appendix B: Methodology Details.

included in the 2018 totals for government GHGs. The purpose of providing a rough estimate for this category in the 2018 inventory is two-fold; first to raise awareness of the importance of consumption-based GHGs, and second to indicate that the county intends to include a more comprehensive consumption-based analysis in future inventory reports, as time and resources allow.

II. Introduction

A. Background on Climate Change

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. A significant rise in greenhouse gas emissions over the last century has resulted in a warming planet, among other environmental impacts, as well as risks to human safety, health, and the economy. Global and national scientific agencies that study climate change, including the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the Intergovernmental Panel on Climate Change (IPCC), all agree that humans are the primary driver of greenhouse gas emissions. Human activities such as deforestation, burning fossil fuels to produce energy, and industrial processes are some of the primary sources of greenhouse gas emissions that present serious threats to our ecosystem and well-being.

Significant contributors to climate change include the burning of fossil fuels for energy in transportation and buildings which introduces large amounts of carbon dioxide and other greenhouse gases into the atmosphere. Emissions from methane generating activities like the decomposition of solid waste can also contribute to GHG emissions, with methane (CH_4) having a larger global warming potential (GWP) than an equivalent mass of carbon dioxide (CO_2). Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.[2] Impacts in Snohomish County include sea level rise in Puget Sound, reduced snowpack, and earlier peak spring stream flow. Ecological impacts from climate change threaten native species and habitats that are unique to the Pacific Northwest and contribute to the local economy.[3]

Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Many communities in the United States have taken responsibility for addressing climate change at the local level. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, waste diversion, and more, local governments can dramatically reduce emissions in their communities. Reducing fossil fuel use in the community and local government operations provide many additional benefits in addition to reducing

[2] IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland. https://www.ipcc.ch/report/ar5/syr/

[3] Mauger, G.S., J.H. Casola, H.A. Morgan, R.L. Strauch, B. Jones, B. Curry, T.M. Busch Isaksen, L. Whitely Binder, M.B. Krosby, and A.K. Snover. (2015). *State of Knowledge: Climate Change in Puget Sound. Report prepared for the Puget Sound Partnership and the National Oceanic and Atmospheric Administration*. Climate Impacts Group, University of Washington, Seattle. doi:10.7915/CIG93777D

greenhouse gas emissions, such as reducing utility and transportation costs, local job creation, and improving air quality, which in turn provides community health benefits.

B. Snohomish County Climate Actions

Snohomish County Executive Order 13-48A, and the county's Sustainable Operations Action Plan (SOAP), together provide the foundational framework for reducing GHGs from government operations and increasing environmental stewardship. Snohomish County recognizes that GHGs from human activity are catalyzing profound climate change, the consequences of which pose substantial risks to the future health, wellbeing, and prosperity of our community. Governments, organizations, and individuals all have an important role to play in addressing the urgency of climate change. This GHG inventory is a continuation of work beginning with the county's goal to reduce GHGs from government operations to 20 percent below year 2000 levels by 2020, established via Executive Order 13-48A. Strategies and actions for implementing the county's climate change and carbon reduction work is outlined in the SOAP, a policy document unanimously adopted by County Council in 2013. The county's progress in implementing SOAP action items can be found in the 2019 SOAP Progress Update, as well as the Energy Benchmark Report and Water Benchmark Report. At the time of the writing this report, the county is in the process of updating and revising the SOAP.

More recently, the county has taken significant steps to reduce GHGs from government operations. In 2019, Snohomish County Council and County Executive issued Joint Resolution 19-006, which calls for county government operations to achieve 100 percent clean electricity by 2030 and 100 percent clean energy in government operations by 2045. JR 19-006 also calls for a dedicated energy efficiency fund in the county's annual budget and development of a plan to transition the county away from fossil fuels.

NOW, THEREFORE, BE IT RESOLVED, by the Snohomish County Council and County Executive:

- *THAT, Snohomish County commits to a goal of 100% clean electricity by 2030 and a goal of 100% clean energy by 2045 for government operations and will move as quickly as possible to achieve that goal; and*
- *THAT, Snohomish County officials and employees will consider all municipal decisions in the light of making Snohomish County energy consumption 100% clean by 2045; and*
- *THAT, Snohomish County will take steps to reduce its consumption of fossil fuels, increase its use of clean and renewable energy, and continue to promote energy conservation efforts*

Snohomish County Council & County Executive
Joint Resolution 19-006

In March of 2020, the county adopted a new Green and High Performance Building Ordinance into County Code Chapter 3.06. This new ordinance for county facilities requires LEED gold certification for construction and remodels, prohibits the use of fossil fuels in new construction, and requires life cycle cost assessments to be performed and used as a key tool in decision-making.

In January of 2020, the county formed a new ad hoc Climate Action Advisory Committee (CAAC) to provide guidance for an updated Sustainable Operations Action Plan (SOAP) for county operations, and to help guide the development of a new climate action plan for the Snohomish County community. The CAAC is also tasked with helping to identify opportunities to realize equity and fairness across the county's diverse communities and help engage Snohomish County residents and businesses on sustainability and climate change issues. As a next key step, the county will develop a community GHG inventory followed by a community-wide climate action and environmental stewardship plan. This work is slated to start in late 2021.

This 2018 inventory shows that GHGs from county government operations comprise less than 1 percent of the total Snohomish County community emissions, with county government and community GHGs at 48,158 MT CO_2e and 5,187,000 MT CO_2e[4], respectively. While emissions from local government operations (LGO) are a very small portion of community emissions, the county is the sixth largest

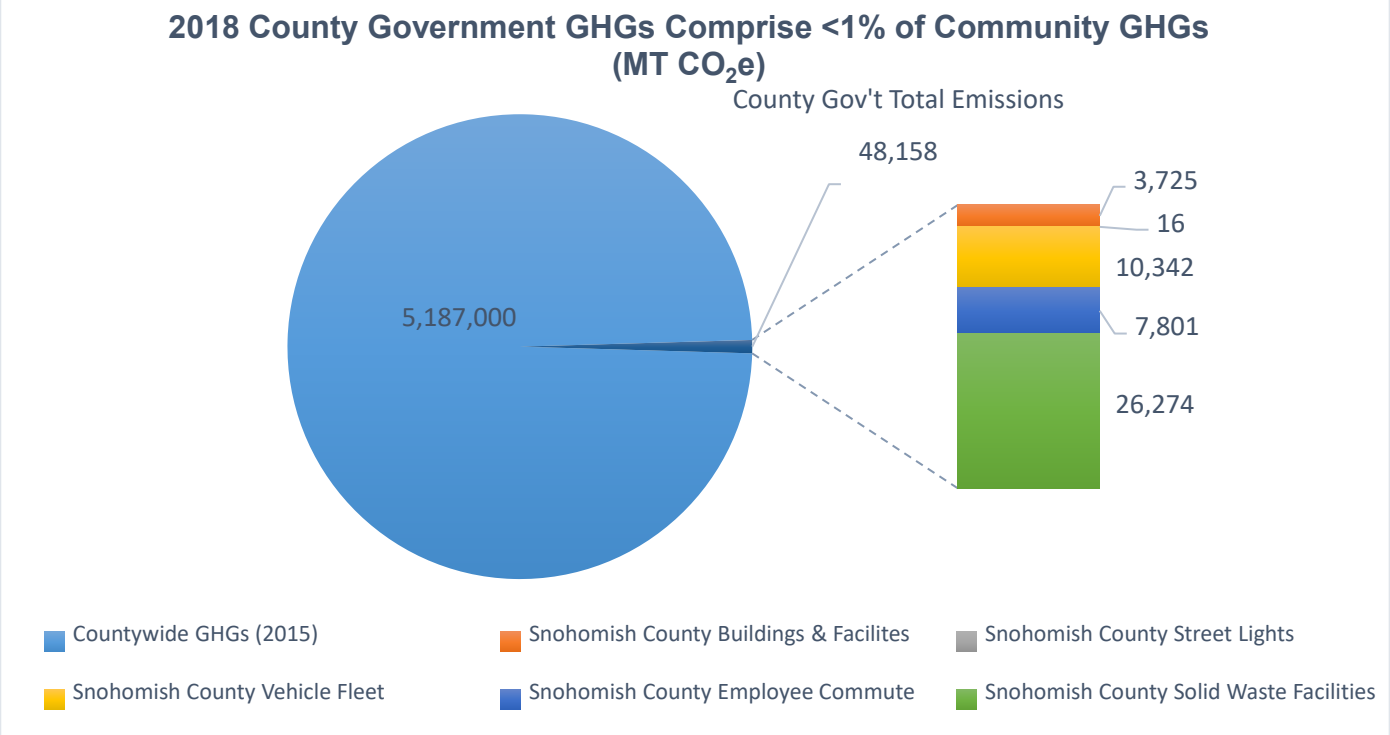


Figure 1 – GHGs from county government operations as compared to Snohomish County community GHGs

[4] Puget Sound Clean Air Agency. (2017). *Greenhouse Gas Emissions Inventory - 2015.* https://snohomishcountywa.gov/DocumentCenter/View/52994/PSCAA-2015-Inventory_SnoCo-Community-Inventory/

employer in Snohomish County with nearly 3,000 employees[5]. As such, every organization and all members of our community play a critical role in reducing greenhouse gas emissions. The county's continued commitment and leadership is critical to help other organizations actively address carbon emissions reduction.

[5] Economic Alliance of Snohomish County. (May 2017). *Snohomish County Top Employers – 2017*. https://www.economicalliancesc.org/wp-content/uploads/2018/01/1-SnoCo-Top-Employers_EASC.pdf

III. Inventory Methodology

A. Understanding a Greenhouse Gas Emissions Inventory

A critical step to achieving tangible greenhouse gas emission reductions requires identifying baseline emissions levels, as well as sources and activities that generate emissions, followed by regular monitoring and reporting of emissions reductions. This 2018 local government inventory report uses a standardized approach and methodology to quantify GHG emissions provided by the *Local Government Operations Protocol.*[6]

B. GHG Emissions Protocol

Three greenhouse gases are included in this inventory: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The tracking of these three greenhouse gases is standard practice in greenhouse gas accounting protocols. However, CH_4 and N_2O have much higher global warming potential compared to CO_2. Therefore, emissions of CH_4 and N_2O are multiplied by their global warming potential relative to CO_2 to provide a CO_2 equivalent (CO_2e).

Table 1 - 100-year global warming potential (GWP) of common greenhouse gases relative to CO_2

Common Name	Chemical Formula	GWP values for 100-year time horizon		
		2nd Assessment (1995)	4th Assessment (2007)	5th Assessment (2014)
Carbon Dioxide	CO_2	1	1	1
Methane	CH_4	21	25	28
Nitrous oxide	N_2O	310	298	265

The table is adapted from the IPCC Fifth Assessment Report (www.ipcc.ch). The 5th Assessment values are the most recent, but the second assessment report (1995) and fourth assessment report (2007) values are also listed because these values were used in calculating previous emissions inventory reports for county operations.

Most emissions in a community or organization are CO_2, which are generally produced from combustion of fossil fuels such as coal, gasoline, diesel, and natural gas. On average, methane accounts for about two percent of a community's emissions and comes primarily from waste decomposition in landfills and from local natural gas distribution system leakage, as well as small amounts as a byproduct of fuel combustion. However, with local government inventories where landfills are owned and operated by the local government, such as the closed Cathcart Landfill owned and operated by Snohomish County, methane can be a significant portion of total GHGs. Nitrous oxide is typically the smallest contributor to a

[6] ICLEI Local Governments for Sustainability. *Greenhouse Gas Protocols; Local Government Operations Protocols*. (May 2010). https://icleiusa.org/ghg-protocols/

GHG inventory, and generally comes from wastewater treatment process emissions, as well as small amounts as a byproduct of fuel combustion.

C. Quantifying Greenhouse Gas Emissions

1. Sources and Activities

Two central categorizations of emissions are used in this 2018 county operations inventory: 1) GHG emissions that are produced by "sources" located within the county government owned assets, and 2) GHG emissions produced as a consequence of county government "activities". The county, like many local governments, has more control over sources like fuel consumption, but less control over activities like building emissions from electricity usage as those emission occur at the site of electricity generation – an activity that is highly dependent on the source of that generation.

Source	Activity
Any physical process inside the jurisdictional boundary that releases GHG emissions into the atmosphere	The use of energy, materials, and/or services by county government that result in the creation of GHG emissions.

By reporting on both GHG emissions sources and activities, local governments can develop and promote a deeper understanding of GHG emissions associated with their operations. A purely source-based emissions inventory could be summed to estimate total emissions released within county government's direct control. In contrast, a purely activity-based emissions inventory could provide perspective on the efficiency of county government, even when the associated emissions occur outside the county government control.

Methodology Summary for Snohomish County Government 2018 GHG Emissions

The GHG emissions estimates in this report were calculated using ClearPath software developed by ICLEI (Local Governments for Sustainability). ClearPath models GHG impacts based upon internationally accepted climate science, namely the United Nation's Intergovernmental Panel on Climate Change 5th Assessment Report. Using the ClearPath software, the 2018 GHG emissions impact of county government activities was modeled by inputting primary data for a several sources such as energy used, waste generated, and fuel consumed. For each of these inputs an emissions intensity multiplier (or emissions factor) is assigned to calculate the respective global warming potential, typically expressed in metric tons of carbon dioxide equivalent, which is dependent upon the fuel source or input and the resultant emitted gases. Below is a summary of some of the sector inputs and emission intensity data sources used to compile Snohomish County's 2018 GHG Inventory.

Sectors	Data Inputs	GHG Intensity Modifier Inputs
Buildings and Facilities *(Electricity, Natural Gas, Propane)*	Electric consumption data provided by Snohomish County Public Utility District (PUD) Natural gas data provided by Puget Sound Energy and Cascade Natural Gas. Propane provided by various vendors typically used in emergency generators.	SnoPUD 2018 utility specific emissions factors used for carbon intensity of electricity. Carbon content of natural gas per the national EPA inventory.
Transportation *(Fleet vehicles and employee commuting)*	Annual fuel consumption by vehicle type provided by Snohomish County Fleet Division. Employee commute data from county's 2018 Commute Trip Reduction survey.	Emissions factors provided by ICLEI software from Annex 3 of the EPA's 2012 US GHG Emissions Inventory.
Solid Waste *(Garbage generated at county facilities)*	Garbage utility bills provided by local waste haulers. Landfill gas emissions data, official and unofficial estimates reported to EPA and Ecology.	EPA's 2008 Municipal Solid Waste Publication. Emissions intensity of landfill emissions was calculated in eGGRT online reporting system (EPA, Ecology).
Streetlights *(County-owned street and traffic lights)*	Electricity data provided by Snohomish County Public Utility District (SnoPUD).	SnoPUD 2018 utility specific emissions factors used for carbon intensity of electricity.

2. Quantification Methods

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.

- Calculation-based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is used:

  Activity Data x Emission Factor = Emissions

All emissions sources in this inventory are quantified using calculation-based methodologies. Activity data refer to the relevant measurement of energy use or other GHG generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled. Please see Appendix B: Methodology Details for a listing of the activity data used in composing this inventory.

3. Emissions Factors

The emission factors specified above in the figure titled "Methodology Summary for Snohomish County Government 2018 GHG Emissions" were used to convert energy usage or other activity data into associated quantities of emissions. Emissions factors are usually expressed in terms of emissions per unit of activity data (e.g. pounds CO_2/kWh of electricity consumed). The best practice for electricity emission factor is typically to use the regional grid average, or eGRID, provided by the US Environmental Protection Agency. A utility specific emissions factor is also accepted as industry best practice if it can be verified by a third party or is thoroughly documented and publicly available. Previous Snohomish County LGO inventories used a regional average emissions factors (i.e. eGRID) in determining emissions from electricity consumption, because SnoPUD's utility-specific emissions factor was not third-party verified. However, Washington state recently passed the Clean Energy Transformation Act (CETA), which makes the state a reviewer and verifier of utility-specific emissions factors. SnoPUD's 2018 emission factors were verified by Washington State. As such, this 2018 inventory uses a SnoPUD utility-specific emissions factor for Scope 2 emissions from electricity. The resulting impact is a lower CO_2e value per kWh of electricity used. However, it is important to note that this shift to SnoPUD's specific factor has minimal impact to the county's total emissions and Scope 2 emissions. Emissions by scope is discussed in more detail in the next section of this report.

Table 2 - Emissions Factors for Electricity Production

Emissions Factors	SnoPUD-specific	eGRID 2018
CO_2 lbs/MWh	42.35	174.255
CH_4 lbs/GWh	50	16
N_2O lbs/GWh	10	2

Since 2008, Snohomish County has utilized ICLEI's ClearPath software to perform a greenhouse gas emissions inventory that meets industry standard best practices. ClearPath software uses inputs from operational activities, applies the appropriate emissions factors, and calculates the resultant emissions based on best management practices of established and widely accepted environmental science.

D. New data sources for this 2018 inventory

1. Inclusion of Cathcart Landfill emissions and employee air travel

As discussed in Section I: Inventory Overview, this 2018 GHG Inventory includes emissions from the closed Cathcart Landfill, which have not been included in any of the county's three previous GHG inventories for county government operations. While the county owns five landfills, all of which are closed and capped, Cathcart is the only one that produces enough GHGs to trigger active monitoring and reporting required under Washington state and federal regulation. Mandatory reporting of stationary source emissions was required by the federal government and Washington state starting in 2010. For the purposes of this report and accurately tracking the county's progress in meeting GHG reduction targets, Cathcart Landfill emissions data (or an estimate) was included for all previous GHG inventory reporting years. For 2014 and 2018, Cathcart data reported by the county to the US EPA and Washington Department of Ecology through the eGGRT reporting system was used. For 2000 and 2006, GHGs from the Cathcart Landfill were estimated using the same methodology required for eGGRT submissions, as official emissions calculations for those years were unavailable. These two data points are considered unofficial estimates. More information on the methodology and results associated with landfill emissions can be found under Solid Waste in Section IV: Government Operations Inventory Results and Appendix B: Methodology Details.

Emissions produced from employee air travel for work purposes have also been incorporated into this 2018 inventory for the first time and are included in the 2018 GHG totals for county government operations.

E. Adjustments to the 2020 GHG Target for County Operations

As a result of the new data sources included in this 2018 report (as outlined above), the emissions baseline for 2000 was recalculated to 65,667 MT CO_2e to include year 2000 Cathcart Landfill emissions. For reference, the original 2000 baseline is 25,667 MT CO_2e and does not include landfill emissions. The recalculated 20 percent reduction from this new adjusted baseline is 13,133 MT CO_2e, and the adjusted 2020 target is 52,534 MT CO_2e. For reference, the original 2020 GHG target which did not include landfill emissions is 20,534 MT CO_2e. These new baseline and target values are reflected in all charts and data throughout this inventory report.

F. Consumption-based emissions

As noted above in the Inventory Overview, this 2018 inventory is the county's first attempt to provide a rough estimate for consumption-based emissions from government operations, as the GHGs associated with goods and services that the county purchases can significantly increase the county's carbon footprint. Again, it is important to note that the consumption-based emissions estimate is not included in the 2018 totals for government GHGs.

In order to quantify GHGs associated with the goods and services purchased for government operations, which are emitted outside of county boundaries, the C40 Cities Climate Leadership Group recommends conducting a consumption-based GHG inventory. This approach "captures direct and lifecycle GHG emissions of goods and services (including those from raw materials, manufacture, distribution, retail, and disposal). This approach also allocates GHG emissions to the final consumers of those goods and services"[7] using a top-down methodology, as a bottom-up approach is not practical considering the wide array of goods and services typically consumed". For this 2018 estimate of consumption-based GHGs, Snohomish County used a free tool developed by Carnegie Melon University. The tool is based on an environmentally extended input-output (EEIO) model to estimate supply chain GHGs. The model uses material GHG emissions information as well as information about industry transactions by one industry from other industries to determine how to allocate emissions across consumption categories for a particular industry and sector, in this case – general local and state government services. These data are used to estimate emissions from different consumption categories based on the total annual dollars spent on goods and services for the organization.

An estimate on the embodied emissions from purchased goods and services can be found in Section IV: Government Operations Inventory Results.

[7] C40 Cities. (March 2018). *Consumption-Based GHG Emissions of C40 Cities*. https://www.c40.org/researches/consumption-based-emissions

IV. Government Operations Inventory Results

A. Emissions Inventory Overview

GHG emissions for 2018 county government operations totaled 48,158 MT CO_2e, which is a 26.7 percent reduction from the 2000 baseline and indicates that the county is on-track to exceed its 20 percent reduction target by 2020. Figure 2 below shows that the largest share of GHGs is from the solid waste sector at 55 percent (26,274 MT CO_2e), which includes solid waste from county-owned facilities and from the closed Cathcart Landfill. The second largest source is from the transportation sector at 37 percent (18,143 MT CO_2e), which includes the county's vehicle fleet and fuel consuming equipment (21 percent), and employee commute (16 percent). Emissions from county-owned buildings and facilities comprise just 8 percent of total emissions, and GHGs from the buildings and facilities sector have decreased by 56 percent since the 2000 baseline (Table 3 below). Lastly, GHGs from county-owned streetlights have decreased by 97 percent since 2000, primarily due to LED retrofits. At 16 MT CO_2e, streetlight emissions are effectively zero percent of total government operation GHGs.

Total emissions by sector for baseline year 2000 and subsequent reporting years can be found below in Table 3. Table 3 also shows the net change in emissions for each sector in 2018 when compared to the baseline year 2000.

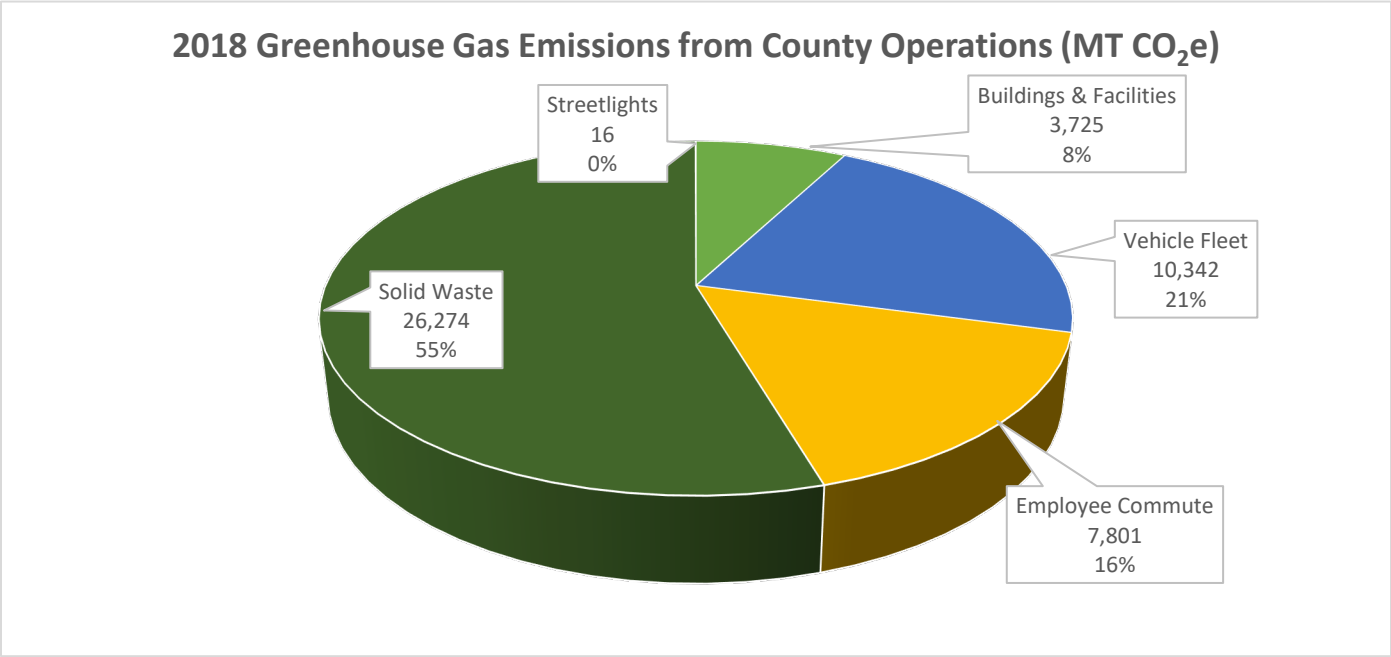


Figure 1 - Breakdown of 2018 GHG emissions by sector

Table 3. Snohomish County Government Emissions by Sector (MT CO_2e)

Sector	Subsector	2000 GHGs (Baseline)	2006 GHGs	2014 GHGs	2018 GHGs	2018 Change from Baseline
Buildings and Facilities		8,563	7,678	4,579	3,725	-56.5%
Transportation						
	Fleet and Equipment	10,153	15,593	10,266	10,342	+1.9%
	Employee Commute	6,193	7,707	7,859	7,722	+24.7%
	Employee Air Travel	Unknown	Unknown	Unknown	79	-
Solid Waste						
	Facility waste	200	254	491	970	+385.0%
	Landfill emissions	40,000*	33,200*	24,872	25,305	-36.7%
Streetlights		558	274	266	16	-97.1%
TOTAL		**65,667**	**64,706**	**48,333**	**48,159**	**-26.7%**

**Landfill emissions for 2000 and 2006 are estimated. See Section IV: Government Operations Inventory Results and/or Appendix B: Methodology Details for more information on the methodology for estimating landfill emissions.*

For the purposes of this report:

- The Buildings and Facilities sector refers to GHG emissions resulting from energy consumption (i.e. electricity & natural gas) by county-owned and operated facilities.
- Streetlights refers to GHG emissions resulting from electricity used to power county-owned or leased streetlights and traffic lights.
- Solid Waste refers to GHG emissions from garbage generated at county buildings and facilities once it is deposited in a landfill. It is important to note that this sector does not include public garbage received at county transfer stations, which is data that will be included in the community GHG inventory. New in the 2018 GHG inventory is the inclusion of emissions associated with decomposition of "waste in place" at the closed Cathcart Landfill. More discussion of this can be found in Section I.A: Inventory Overview above, sub-Section IV.C.5: Solid Waste below, and Appendix B: Methodology Details.

- Vehicle fleet refers to the GHG emissions from fuel consumed in county vehicles and fuel-consuming work equipment. Vehicle fleet emissions associated with county-owned electric vehicle charging stations were excluded from the buildings and facilities sector and included in the vehicle fleet sector, as that electricity is fuel for vehicle travel.

- Employee Commute refers to the emissions from fuel use in passenger cars, carpools, vanpools, and buses associated with employee travel to and from work as well as air travel for work-related purposes.

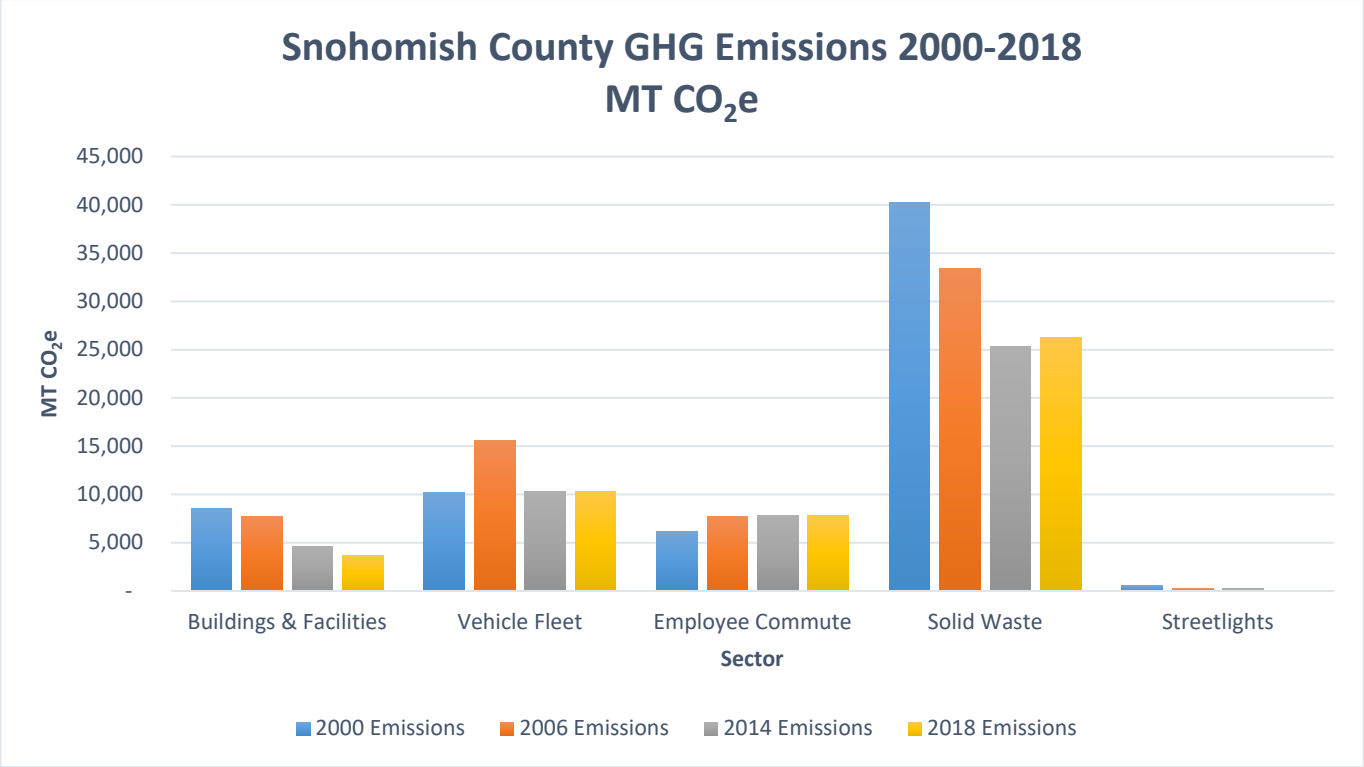


Figure 2 - Comparison of Snohomish County GHG emissions from 2000 to 2018 (includes unofficial estimates of landfill emissions data for 2000 and 2006)

The raw data used to calculate total 2018 emissions from government operations is shown in Table 4. An operational control approach was used for accounting, meaning that these totals do not include GHG emissions for operations where county owns an interest but has no control. For example, emissions from the new commercial terminal at Paine Field Airport are not included as the commercial terminal is privately owned and operated on leased county land.

Table 4: Government Operations 2018 Inventory

Sector	Fuel or source	Usage/Generation	Usage unit	Emissions (MT CO_2e)	Emissions (% of total)
Buildings	Electricity	21,654,184	kWh	456	0.9%
Buildings	Natural Gas	614,767	therms	3,270	6.8%
Buildings total				**3,725**	**7.7%**
Streetlights	Electricity	762,850	kWh	16	0.03%
Streetlight total				**16**	**0.03%**
Vehicle Fleet	Gasoline	548,681,	gallons	4,849	10.1%
Vehicle Fleet	Diesel	536,511	gallons	5,494	11.4%
Vehicle Fleet	Electric	2,062	kWh	<1	0.0%
Vehicle fleet total				**10,343**	**21.5%**
Employee Air Travel[8]		423,054	passenger miles	79	0.2%
Employee Vanpool Commute	Gasoline	1,469	gallons	10	0.02%
Employee Carpool Commute	Gasoline	43,714	gallons	308	0.6%
Employee Single-Vehicle Commute	Gasoline	816,623	gallons	7237	15.0%
Employee Bus Use		1,452,096	passenger miles	85	0.2%
Employee commute total				**7,801**	**16.2%**
Solid Waste Generation	Solid Waste	1,269	Wet tons	480	1.0%
Landfill Emissions	Methane Generation	904	Metric tonnes (CH_4)	25,305	52.5%
Landfill Emissions	Landfill Gas Combustion			490	1.0%
Solid Waste Total				**26,274**	**54.5%**
Government operations total emissions				**48,158**	**100%**

[8] Data unavailable/not included for: Planning and Development Services, Central Human Resources, Airport Administration, or Superior Court.

An overview of total recorded emissions from the year 2000 through 2018 (Figure 4 below) demonstrates that emissions have been trending downward over time. The county has reduced GHG emissions by 26.7 percent in 2018 compared to the updated baseline emissions from 2000. Between 2014 and 2018 emissions have remained nearly flat.

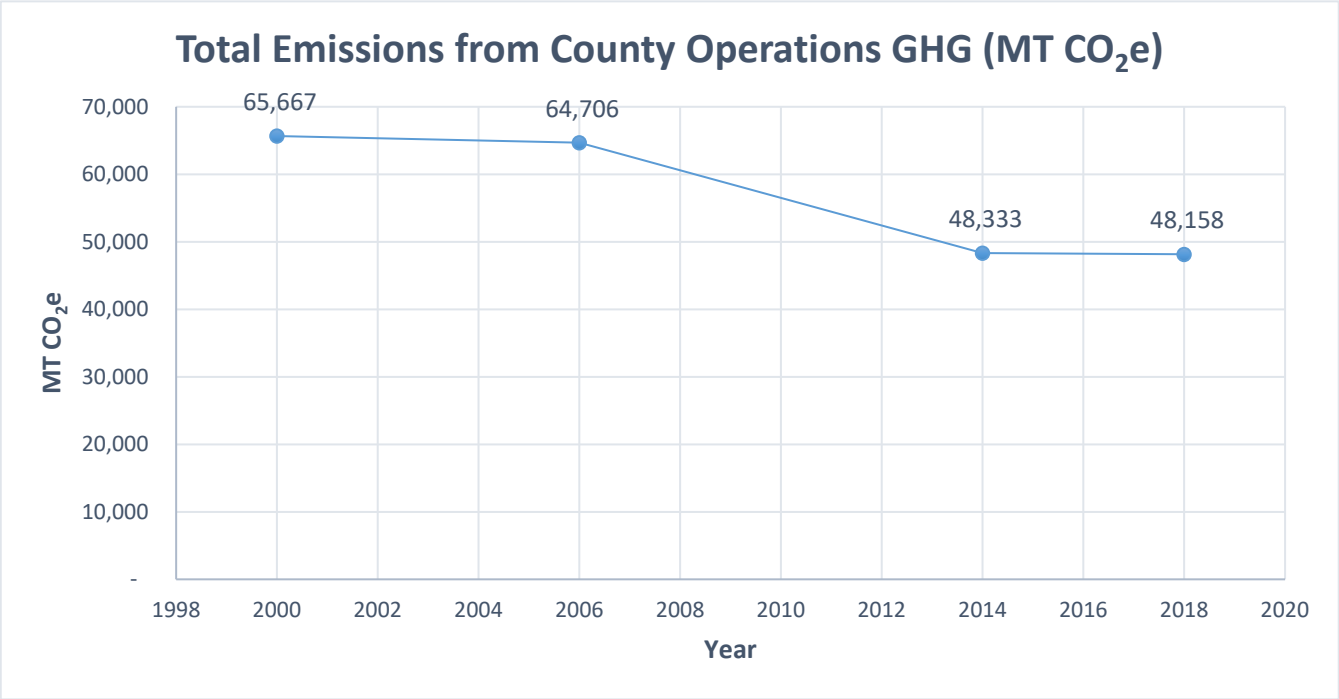


Figure 3 - Total GHGs from county operations from 2000 to 2018

B. Results by Scope

Emissions resulting from anthropogenic, or human-derived, activities are often categorized by 'Scope' as well as by the sector from which they were produced. The commonly used standard for GHG emissions reporting, the GHG Protocol Corporate Standard[9], classifies an organization's GHG emissions into three 'scopes', as outlined in Box 1. Between 2000 and 2018, county government emissions declined by 26.7 percent. In the same period county government Scope 1 emissions decreased by 25.2 percent from 52,683 MT CO_2e to 39,407 MT CO_2e. This reduction in Scope 1 emissions is primarily attributable to the natural decline in emissions from the closed Cathcart Landfill.

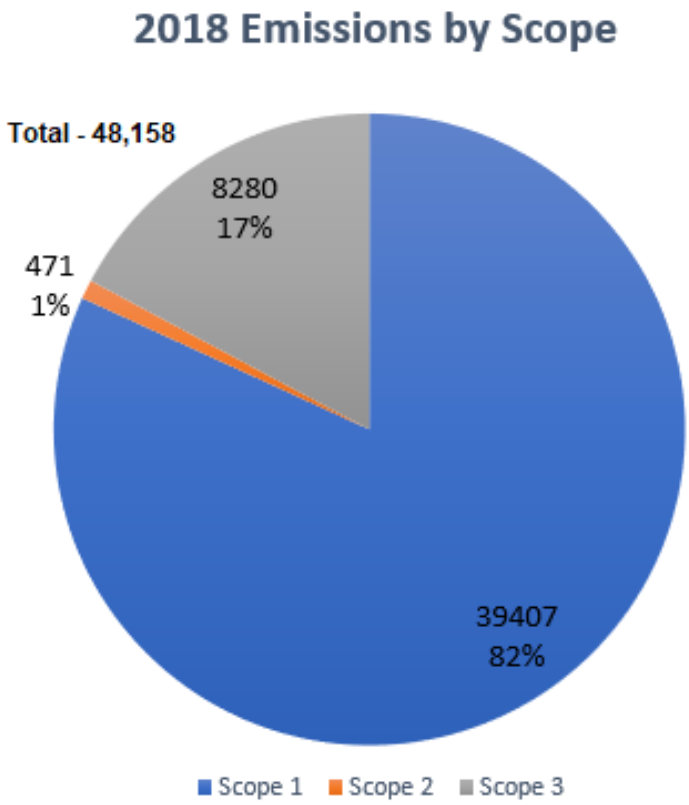


Figure 4 - 2018 emissions by Scope, as a percent of total and MT CO_2e

Box 1. GHG Emissions by Scope

This report uses a three-scope system to help categorize direct and indirect GHG emissions.

Scope 1: Direct emissions generated primarily from stationary source and mobile combustion, such as fuel combustion in fleet vehicles and natural gas use in buildings. Direct emissions from the decomposition of waste in a landfill under direct control or ownership.

Scope 2: Indirect emissions associated with the consumption of purchased or acquired electricity for heating, cooling, or steam.

Scope 3: Other sources of indirect emissions that are not captured in Scope 2, such as employee commuting, outsourced activities like solid waste disposal in a landfill,

[9] The Greenhouse Gas Protocol. (2015). *A Corporate Accounting and Reporting Standard; Revised Edition*. World Business Council for Sustainable Development, World Resources Institute. https://ghgprotocol.org/corporate-standard

Scope 2 emissions have decreased significantly from 2000 to 2018. Emissions from electricity consumed in county buildings and facilities decreased by 92.9 percent from 6,591 MT CO_2e in 2000 to 471 MT CO_2e in 2018. The primary reason that Scope 2 emissions comprise such a small portion of total government GHGs is due to the composition of the electric fuel mix supplied by Snohomish County Public Utility District (SnoPUD), as the carbon content of that fuel mix has decreased over time. In 2018, SnoPUD's fuel mix for electricity production was 80 percent hydroelectric, 10 percent nuclear, 7 percent wind generation, with the remaining less than 3 percent being "other generation" or "unspecified". These unspecified sources are spot market purchases with unknown origin which are assumed to be carbon intensive for reporting purposes. The electricity from hydroelectric, nuclear, and wind generation is largely carbon-free.

Scope 3 emissions increased 29.5 percent from 2000 to 2018, from 6,393 MT CO_2e to 8,280 MT CO_2e, respectively. Scope 3 emissions in this inventory include: waste generated at county facilities, employee commuting (all methods), and employee air travel for work purposes. The emissions from waste generated at county facilities and from employee commuting both increased since baseline year 2000.

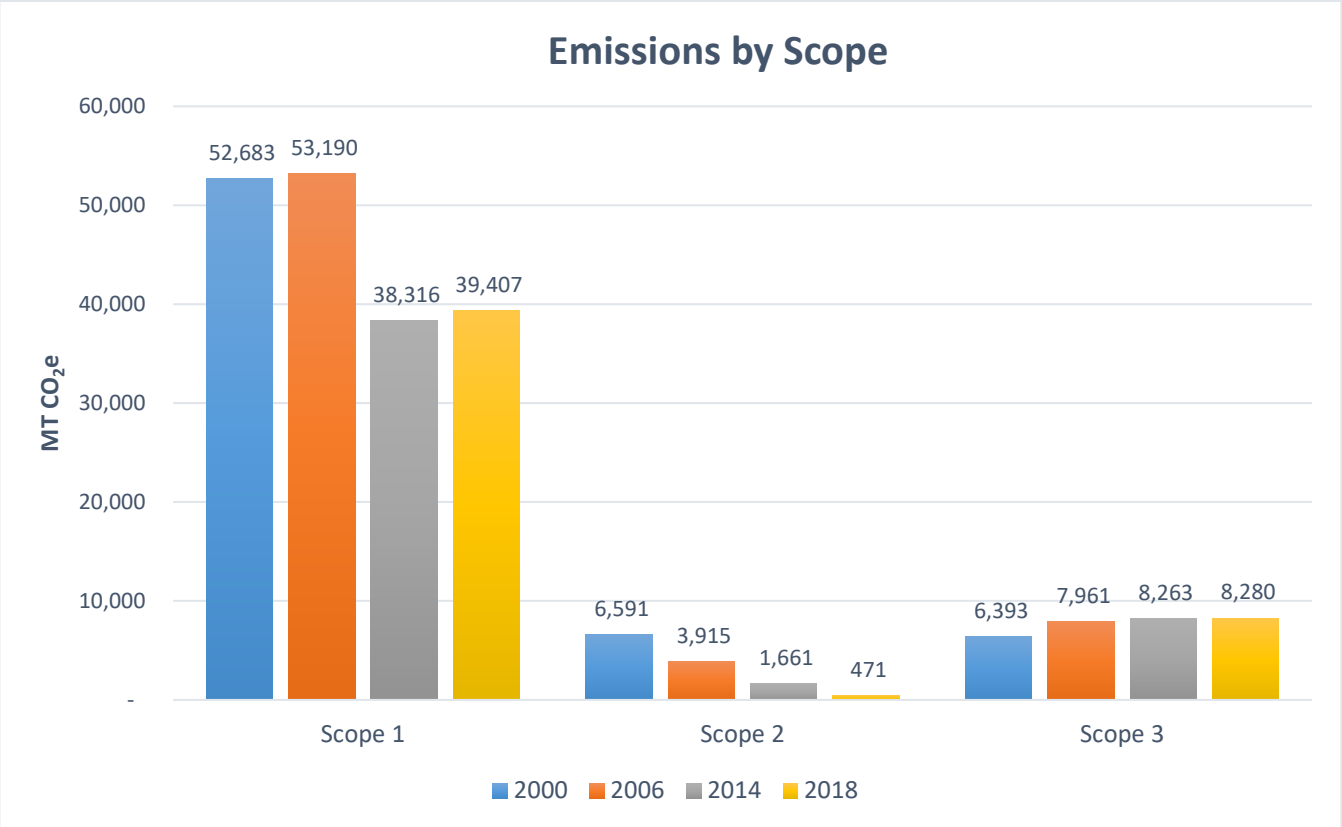


Figure 5 - Comparison of Snohomish County GHG emissions by Scope from 2000 to 2018 (includes unofficial estimates of landfill emissions data for 2000 and 2006)

1. Consumption-Based Emissions Estimate

As previously noted, this 2018 inventory is the county's first attempt to provide a rough estimate for GHGs from an additional Scope 3 category for government operations: consumption-based emissions. It is important to note that the consumption-based emissions estimate is not included in the 2018 totals for government GHG emissions.

Embodied emissions from goods and services purchased by the county is estimated to be 177,000 MT CO_2e, which is approximately 3.5 times greater than the county's total 2018 GHGs at 48,158 MT CO_2e. This estimate was developed using Carnegie Mellon's Economic Input-Output Life Cycle Assessment Tool[10] for State and Local Government Enterprises based on $326 million spent in 2018 for goods and services for county operations. This emissions value includes broad estimates of resultant emissions from the production, transportation, consumption, and disposal (as applicable) of goods and services typically purchased by a state or local government. However, this consumption-based estimate includes GHGs from many of the sectors that have been calculated in this report, and therefore is not an accurate representation of this category of Scope 3 GHGs. In the future, the county intends to conduct a more accurate assessment of consumption-based GHGs for government operations, if resources are available to do so.

C. Government Emissions by Sector

1. Buildings & Facilities

Figure 7 shows that emissions from the operation of county buildings and facilities have steadily declined since 2000, with 2018 emissions at less than half of 2000 levels (3,725 MT CO_2e and 8,563 MT CO_2e respectively). Between 2010 and 2018, the county made significant investments in energy efficiency retrofits at county facilities through a combination of Energy Efficiency and Conservation Block Grant (EECBG) dollars from the American Recovery and Reinvestment Act (ARRA), and county dollars. EECBG funded building retrofits were completed in 2013, and reduced electricity and natural gas by nearly 3 million kilowatt hours and 126,343 therms, respectively. These retrofits resulted in a total annual emissions reduction of 2,688 MT CO_2e and have saved the county $380,151 in annual energy costs. The county also implemented additional energy efficiency retrofits through an energy services contracting organization (ESCO), which guarantees energy cost savings. The result of these additional retrofits resulted in annual reduction of over 2.7 million kilowatt hours of electricity, 42,966 therms of natural gas, and 9,376 hundred cubic feet (ccf) of water. The ESCO retrofits saved the county over $300,000 annually in energy savings, and over $42,000 in annual operational savings.

[10] Green Design Institute. (2018). *Economic Input-Output Life Cycle Assessment (EIO-LCA)*. Carnegie Mellon University. http://www.eiolca.net/cgi-bin/dft/use.pl?newmatrix=US388EPAEEIO2007

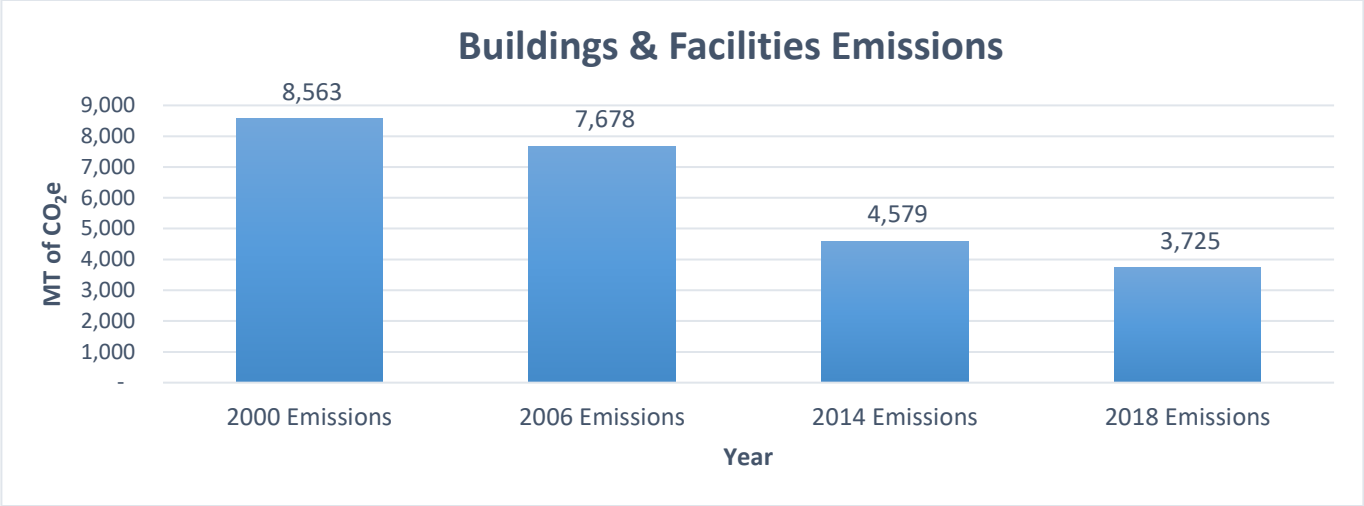


Figure 6 - Comparison of Snohomish County GHG Buildings & Facilities Sector Emissions from 2000 to 2018.

It is important to note that the county's total building footprint has increased since 2000, which has contributed to increased energy consumption and GHG emissions. In 2005, the county added 433,965 square feet of building space with the construction of the Oakes Street jail facility and Robert J. Drewel building (also known as the Administration East building). In 2008, 116,900 square feet were added to the county's building footprint with the construction of the Cathcart Way facility for Public Works operations.

Finally, the county has focused on low and no-cost energy savings through Strategic Energy Management (SEM) agreements with utility providers Puget Sound Energy (PSE) and SnoPUD. These programs provide the county with financial incentives and resources for meeting annual energy reduction targets through operations and maintenance (O&M) and behavior change strategies. SnoPUD discontinued their SEM program in 2017 but PSE's program is still active.

While the county's 2018 consumption of electricity decreased slightly since 2000 by 1.4 percent, natural gas consumption increased by 29.9 percent (Figure 8 and Figure 9 below). However, the GHG emissions associated with electricity consumption show a much more significant decrease of 92.4 percent (Figure 10). This is primarily due to an integration of cleaner fuel sources into the electric fuel mix supplied by SnoPUD over time. In 2000, approximately 22 percent of SnoPUD's fuel mix consisted of coal-generated electricity. In 2006, SnoPUD's fuel mix included only about 8 percent coal, and by 2018 less than 3 percent coal, as it has increasingly moved toward cleaner fuels, namely hydroelectric power. Hydroelectric power, as a percentage of SnoPUD's total fuel mix, increased from 64 percent in 2000 to 76 percent in 2005, and 80 percent in 2018.

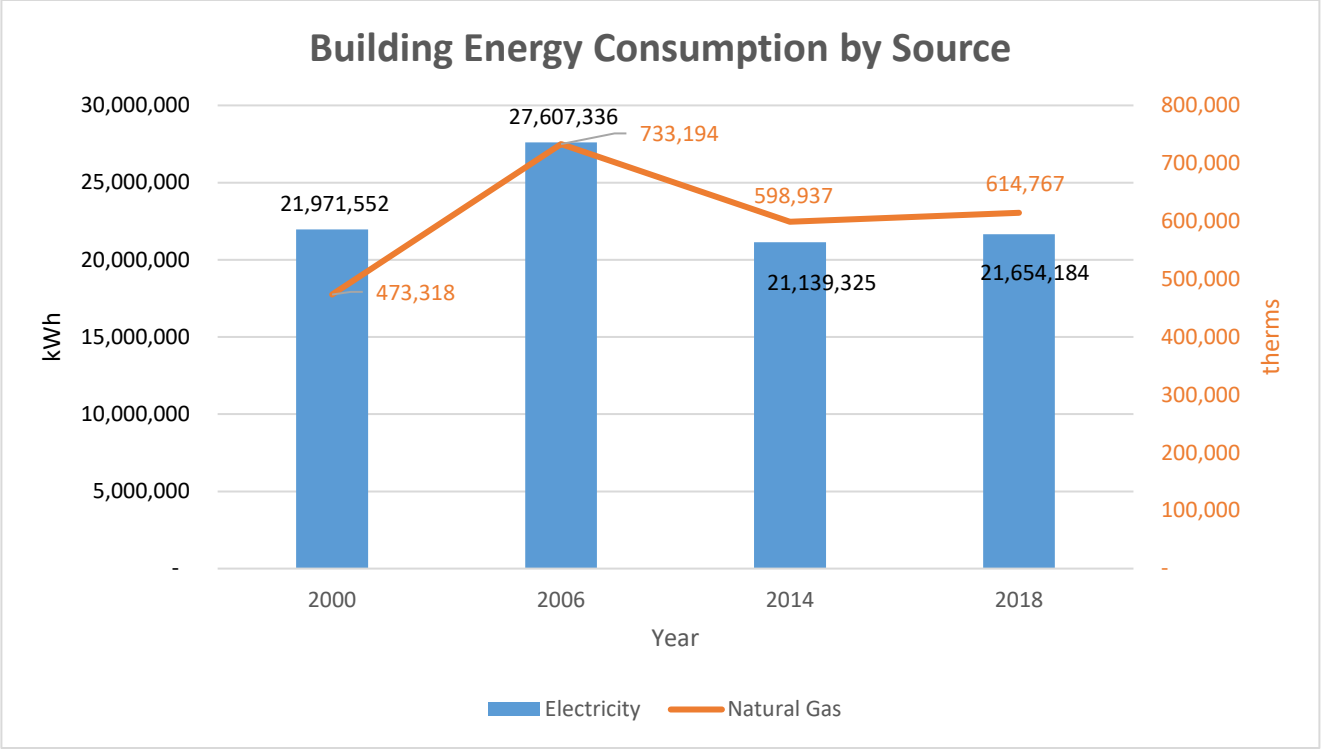


Figure 7 - County building energy consumption by source from 2000 through 2018

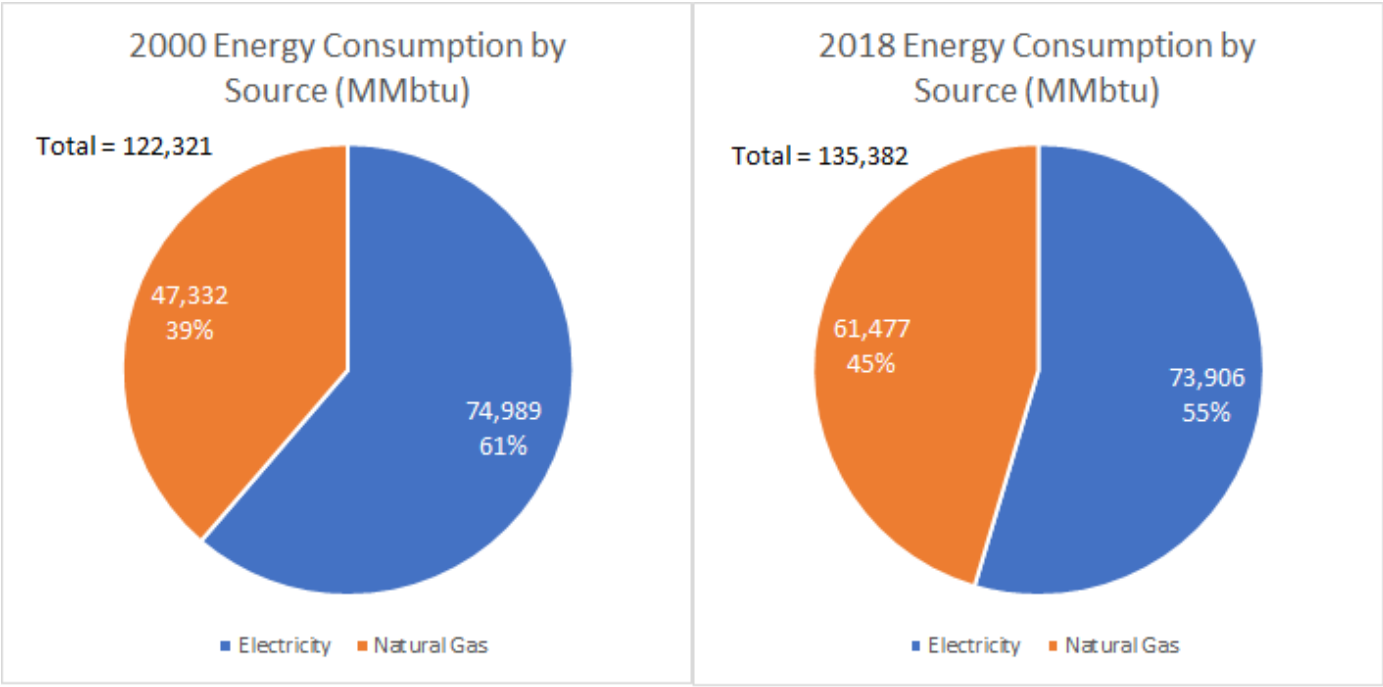


Figure 8 - Comparison of building energy consumption by source fuel from 2000 to 2018

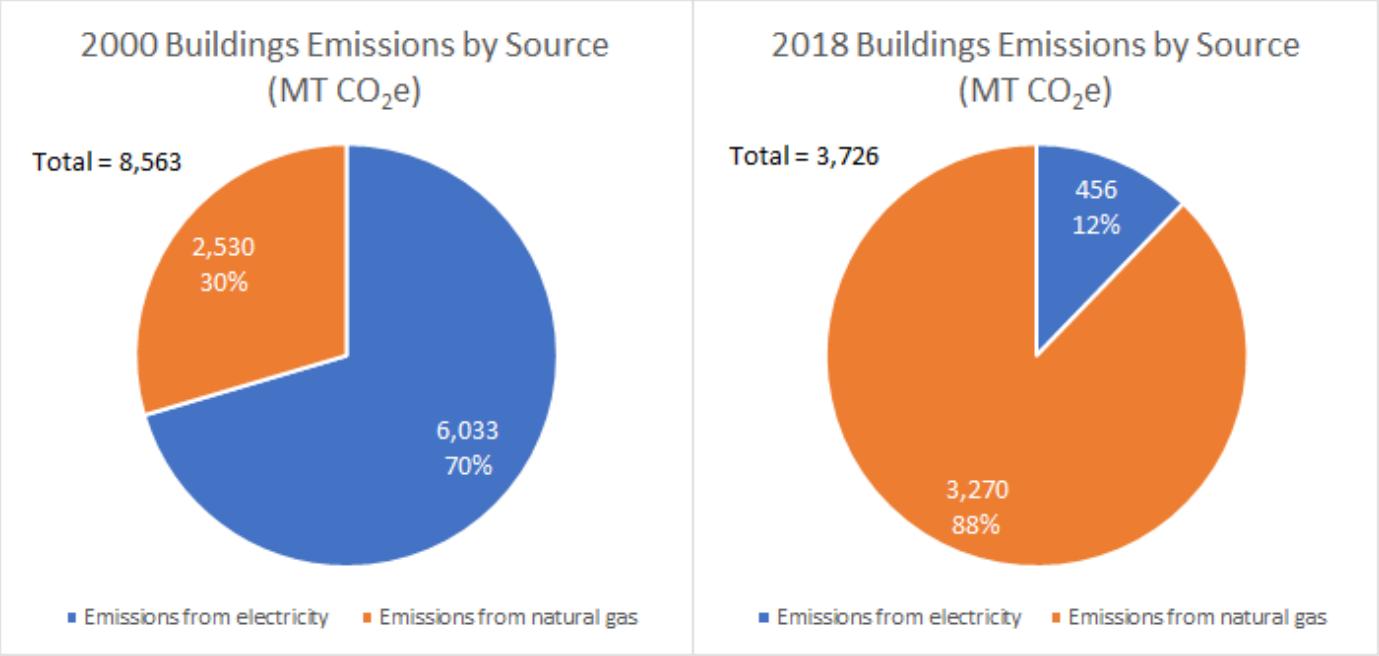


Figure 9 - Comparison of building emissions by source fuel from 2000 to 2018

2. Streetlights

Snohomish County's 2018 emissions from streetlights decreased by 93.9 percent from 2014 levels, and 97.1 percent from baseline year 2000. This significant reduction in emissions is a result of converting nearly all county streetlights to light emitting diodes (LED) lighting, which are much more energy efficient than other lighting types, such as high pressure sodium, incandescent, and metal halide.

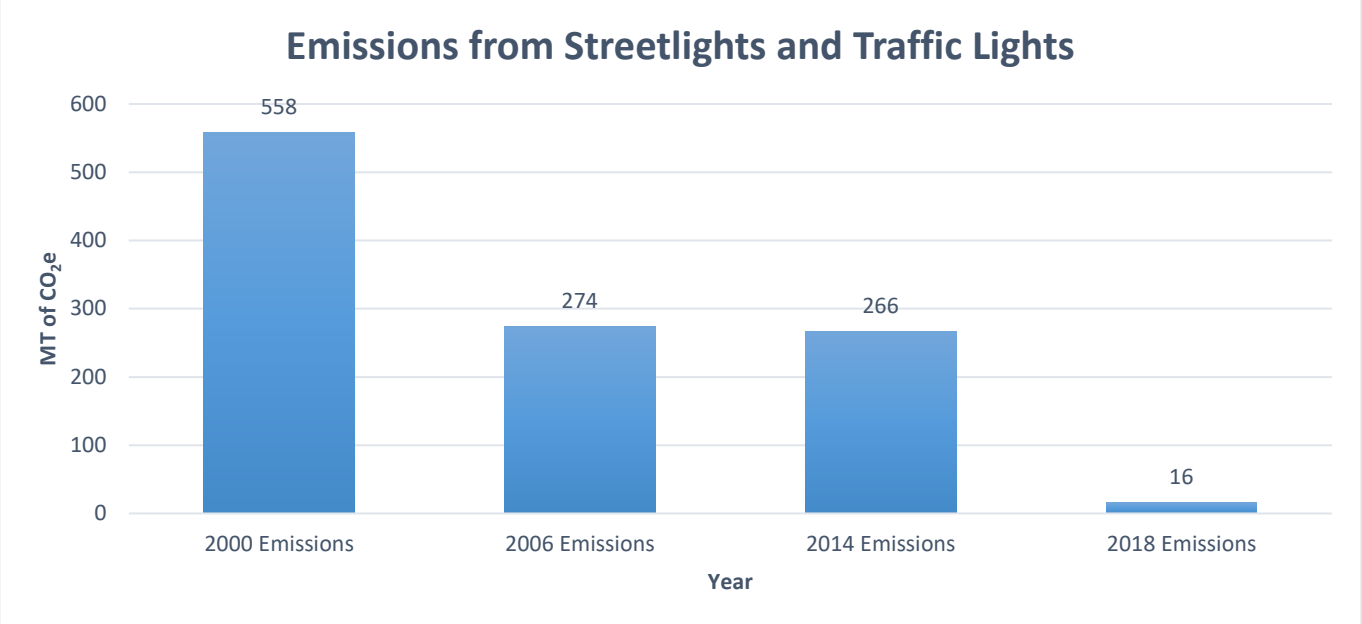


Figure 10 - Emissions from streetlights and traffic lights from 2000 through 2018

3. Transportation Fleet Vehicles

2018 fleet emissions have stayed relatively flat compared to 2000 baseline and 2014 emissions (Figure 12). Emissions in 2018 were 10,342 MT of CO_2e, a 1.9 percent increase over 2000 baseline emissions. The county's Fleet Division has continually sought to test and, where successful, implement the use of innovative equipment and technology to reduce the GHG emissions from fleet vehicles, such as electric passenger vehicles and work equipment, and the use of bio-diesel blended fuels.

Gasoline vehicles represent the largest share of vehicle fleet emissions at 47 percent (Figure 13). Heavy trucks make up the second largest share of vehicle fleet emissions at 32 percent, and diesel non-highway fleet vehicles and equipment are third at 16 percent. The amount of GHG emissions generated from the county's vehicle fleet are largely dependent upon the total number of fleet vehicles, the total distance driven, and the fuel efficiency of the vehicles. Currently, county fleet data consistently tracks total gasoline or fuel consumed.

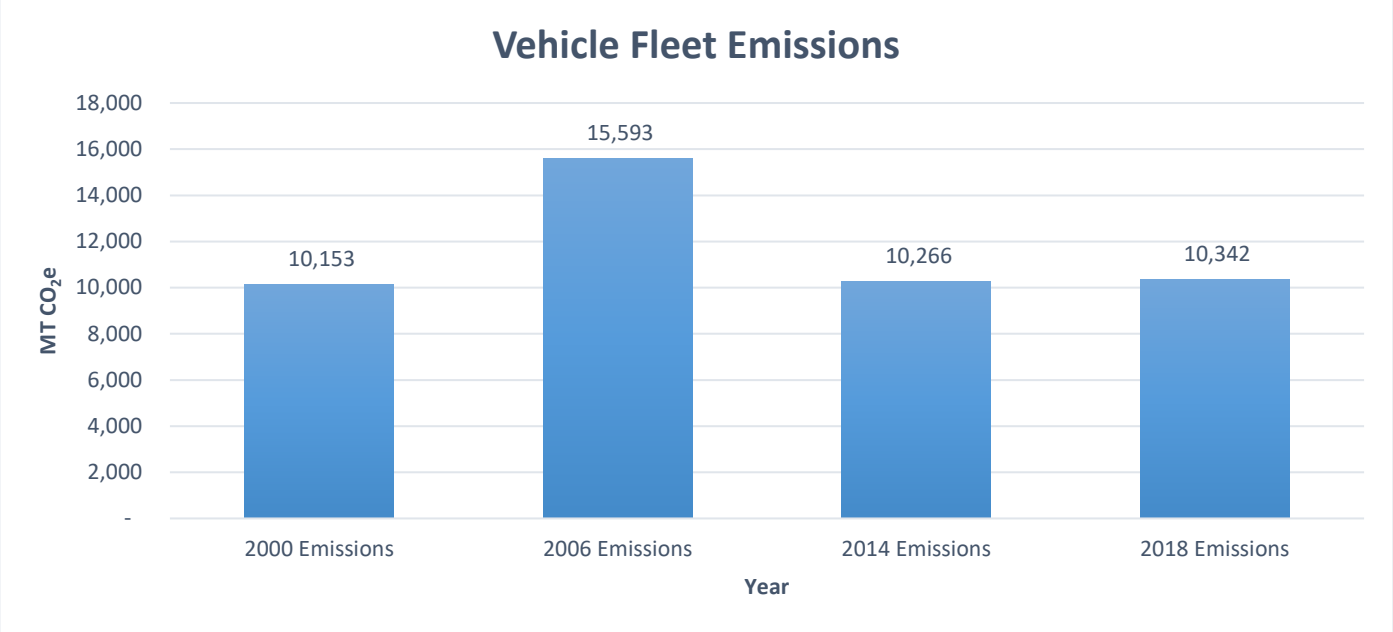


Figure 11 - Vehicle fleet emissions from 2000 through 2018

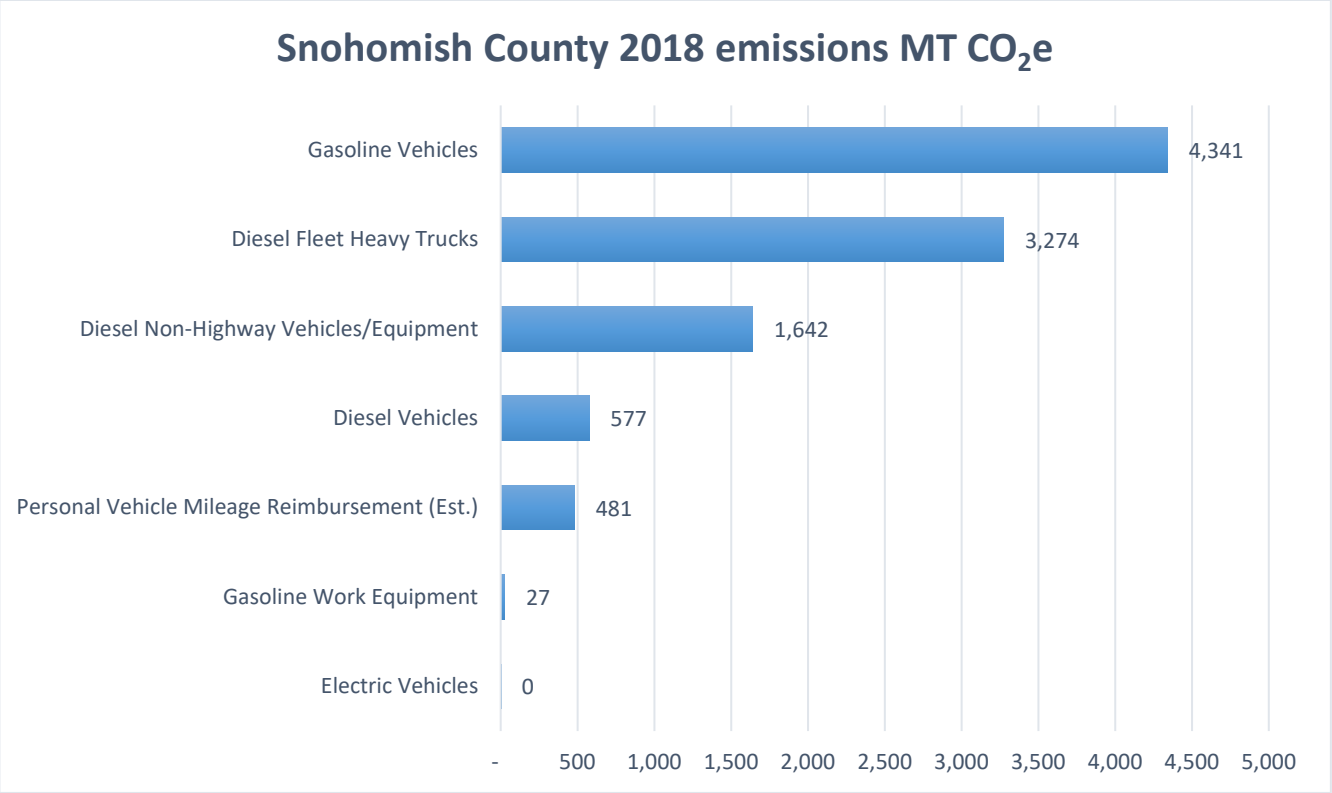


Figure 13 - 2018 Snohomish County Fleet emissions by vehicle type

4. Employee Commute

Emissions from employee commuting has increased by nearly 26 percent over the 2000 baseline (Figure 14), which can be attributed to multiple factors. The county's biennial employee commute survey data indicates that the percentage of employees that commute in single-occupancy vehicles has increased by 8.25 percent since approximately 2006 when survey reporting began, from 66.1 percent to 74.3 percent (Figure 15). In addition, the reported average one-way distance traveled per employee commute continues to increase, from 11.3 miles in 2014 to an estimated 11.7 miles in 2018 (Figure 15). The total number of county employees has also increased over time (Table 5), which contributes to more vehicle miles traveled from commuting.

Table 5 - Snohomish County Employee Base

	2006	2014	2018
Employees	1,934	2,750	2,987

Total number of employees is unavailable for the year 2000.

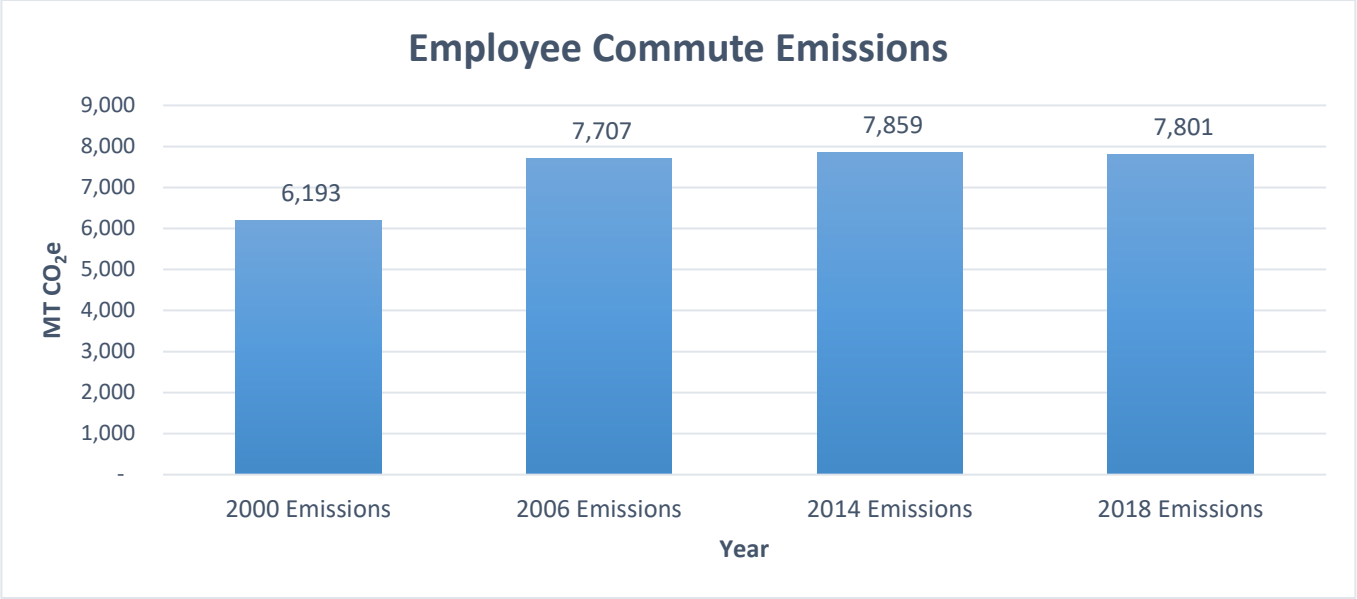
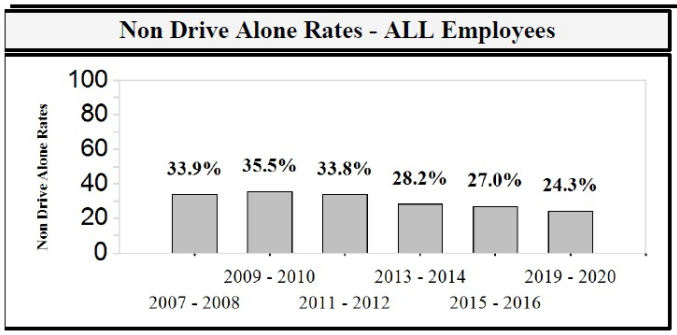
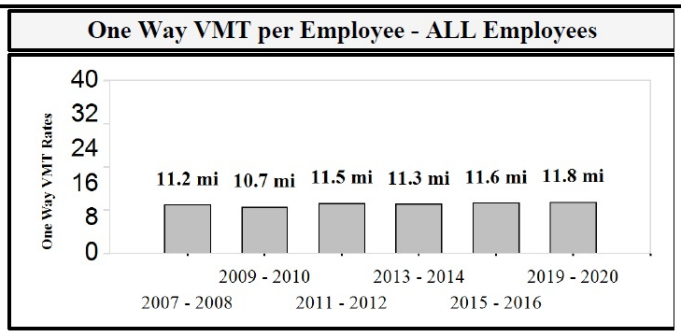


Figure 14 - Employee commute emissions by inventory year

Employee commute data is collected every two years for Snohomish County employees via commute trip reduction (CTR) surveys administered by the Washington State Department of Transportation. Results from the 2015-2016 survey and the 2019-2020 survey were averaged to estimate 2018 values. These estimated values were used to calculate the reported GHG emissions.





Site History and Targets **Annual Metric Tons CO2e** **Pounds CO2e**

Cycle	Non Drive Alone Rate - All	Non Drive Alone Rate - CTR Affected	Emissions for Surveyed Employees	Estimated Emissions for Total Employment	GHG per Employee's Roundtrip	VMT per Employee - All	VMT per Employee - CTR Affected
2007 - 2008	33.9%	34.5%	2903	4325	25.8	11.2	11.0
2009 - 2010	35.5%	35.9%	2599	4378	26.1	10.7	10.7
2011 - 2012	33.8%	34.3%	2501	3403	20.3	11.5	11.5
2013 - 2014	28.2%	28.6%	2463	3257	19.4	11.3	11.2
2015 - 2016	27.0%	27.3%	2530	4084	24.3	11.6	11.5
2017 - 2018	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Figure 15 - Excerpt from Snohomish County's 2019-20 Commute Trip Reduction survey

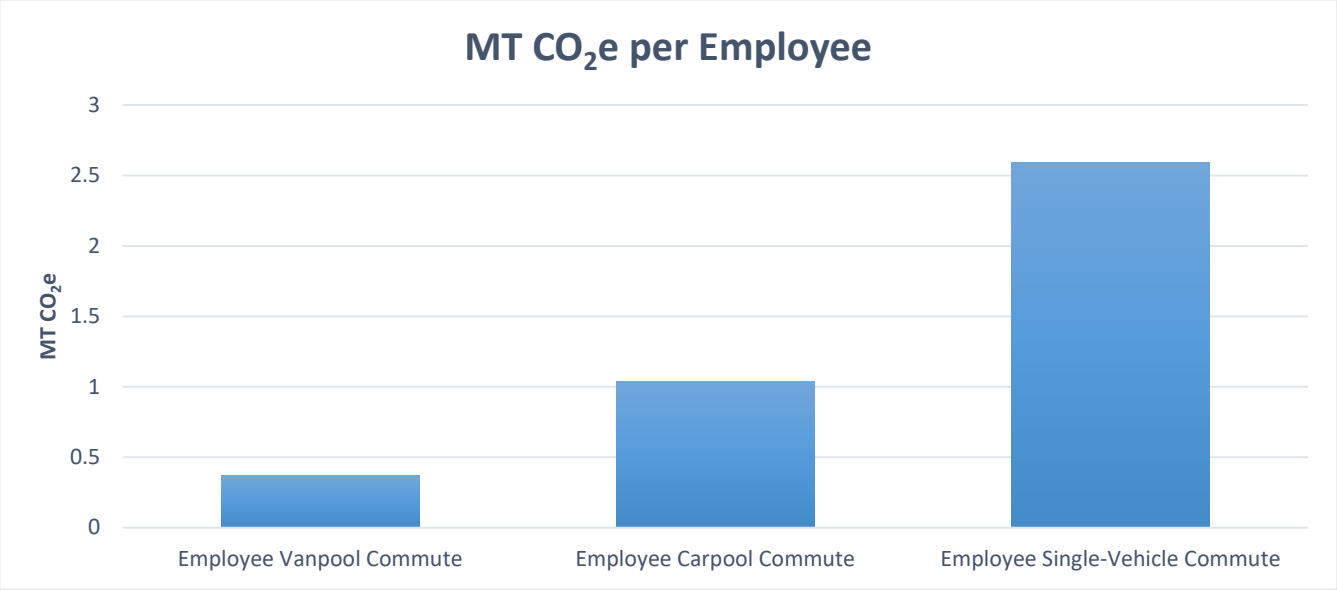


Figure 16 - Comparison of commuting mode by emissions per passenger

5. Solid Waste Sector

In this 2018 Inventory, emissions from the closed Cathcart Landfill are included for the first time. GHGs from the closed Cathcart Landfill were not included in previous inventories, primarily because government agencies were not required to collect and report this information to the state and federal government until 2010. By including GHGs from the closed Cathcart Landfill in this report (and future inventory reports), the county is following best reporting protocol practices as established by ICLEI and the Climate Registry – two of the most widely accepted third-party organizations in this regard.

For the purpose of this report, Cathcart Landfill emissions have been included for all previous reporting years and in the analyses provided throughout this report[11]. Including Cathcart Landfill GHGs for all previous reporting years was necessary to provide an accurate reflection of the county's overall GHG emissions trends, and progress in meeting its GHG reduction goals. For more information on the Cathcart Landfill data used in this report, please see Section III: Inventory Methodology and Appendix B: Methodology Details. Figure 17 below shows the total county government GHGs from solid waste generated at county-owned buildings and facilities and from Cathcart Landfill emissions for all inventory reporting years. Landfill emissions in 2018 totaled 25,305 MT CO_2e, a 36.7 percent reduction from baseline emissions.

[11] For more information on the methodology for estimating Cathcart landfill emissions, please see Section III: Inventory Methodology and Appendix B: Methodology Details.

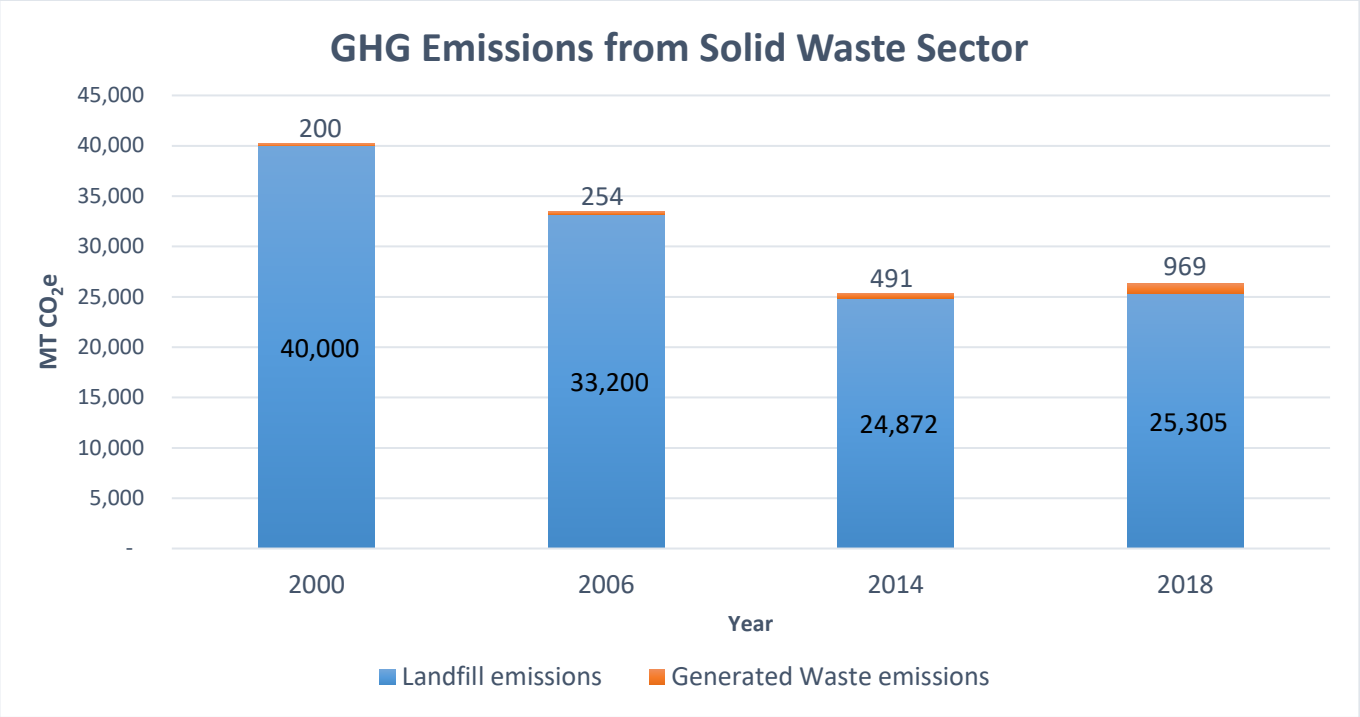


Figure 17 - Emissions from solid waste, including Cathcart Landfill emissions

If landfill emissions are excluded, as was the case in previous GHG inventory reports, there is still a downward trend in total county emissions between 2000 and 2018 (Figure 18). In this view, GHG emissions have been trending downward at an average rate of 156 MT CO_2e (or 0.6 percent) per year from 2000 to 2018.

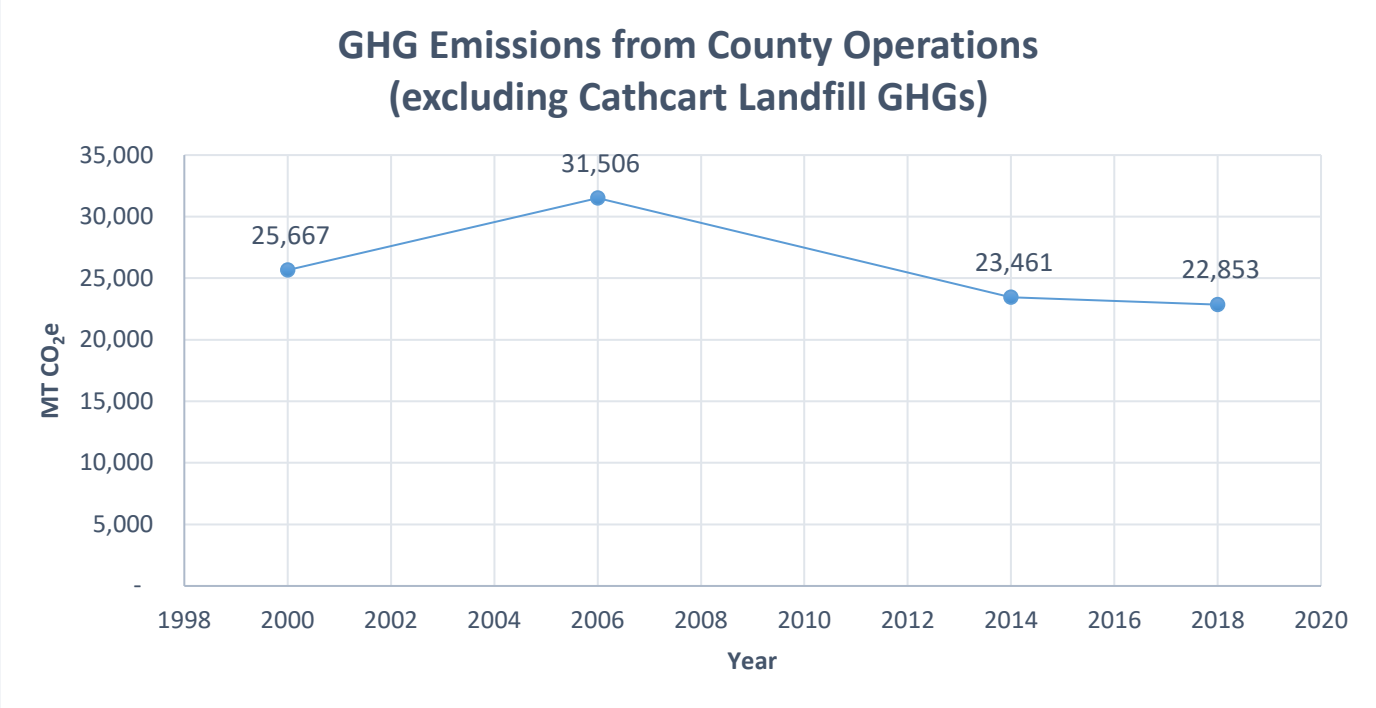


Figure 18 - Emissions from county operations excluding landfill data

Figure 19 shows how gases are produced over the life of a landfill, typically separated into four phases[12]. Landfill gas (LFG) occurs during the decomposition of organic material in landfills. Gas composition changes with each phase and waste in a landfill may be undergoing several phases of decomposition simultaneously. When waste is first deposited in a landfill, it is uncovered and can utilize oxygen (aerobic) to decompose – generating little methane. Then, as more waste and cover material are added on top of previously deposited waste, anaerobic conditions are established and methane-producing bacteria begin to decompose the waste and generate methane.[13] LFG is composed of roughly 50 percent methane and 50 percent carbon dioxide (CO_2). Methane is a potent greenhouse gas approximately 28 times more effective than CO_2 at trapping heat in the atmosphere over a 100-year period.[14]

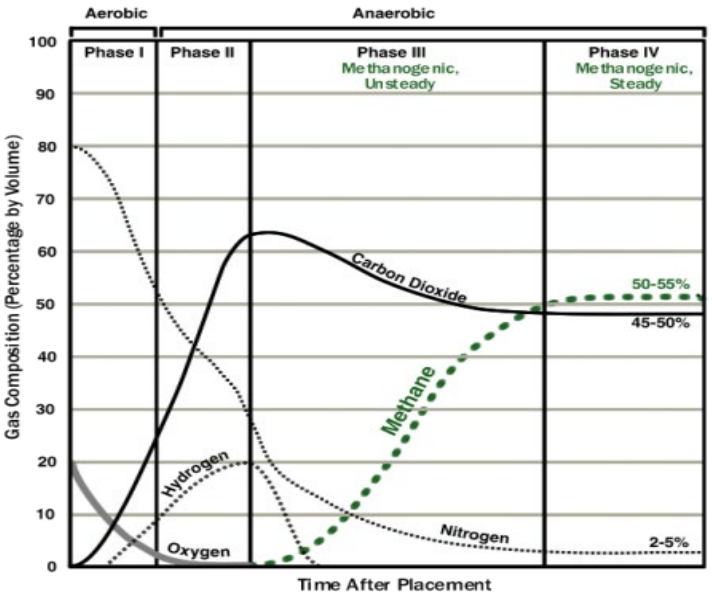


Figure 19 - Changes in typical LFG composition after waste placement

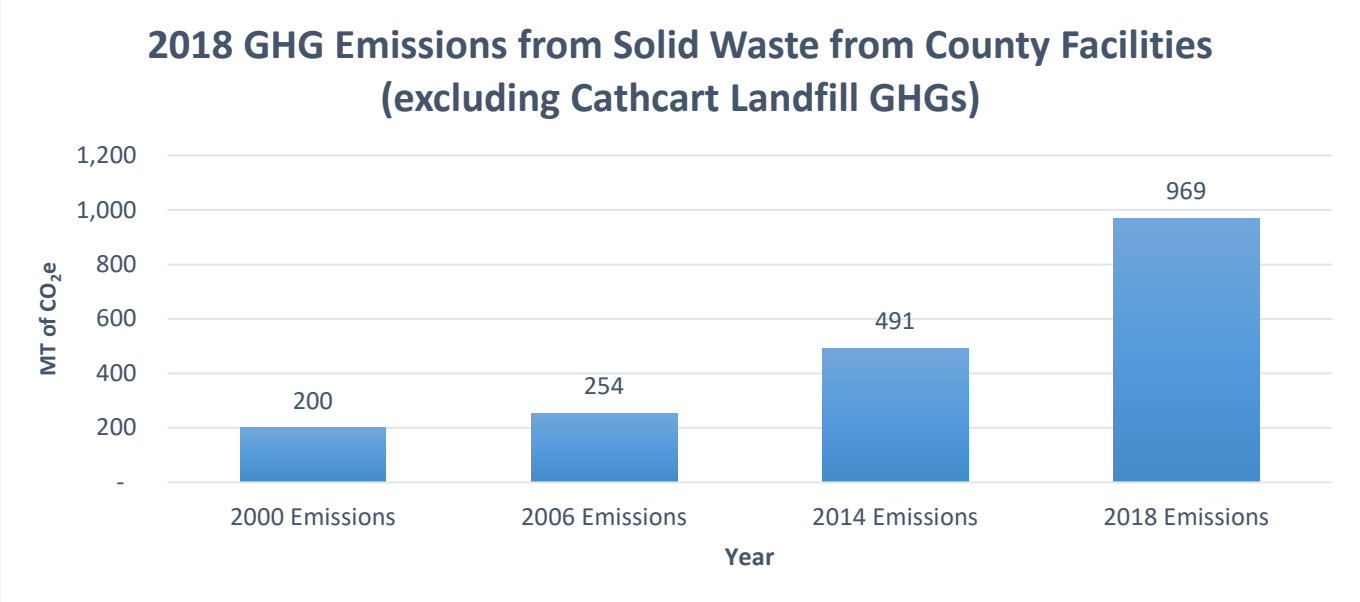


Figure 20 - Emissions from solid waste generated in county buildings and facilities, excluding landfill emissions

[12] Figure adapted from: ATSDR. (2008). *Chapter 2: Landfill Gas Basics. In Landfill Gas Primer - An Overview for Environmental Health Professionals.* Figure 2-1, pp. 5-6. https://www.atsdr.cdc.gov/HAC/landfill/PDFs/Landfill_2001_ch2mod.pdf

[13] EPA Basic Information About Landfill Gas: https://www.epa.gov/lmop/basic-information-about-landfill-gas

[14] EPA Basic Information About Landfill Gas: https://www.epa.gov/lmop/basic-information-about-landfill-gas

The 2018 emissions from waste generated at county facilities increased by 385 percent from baseline emissions (Figure 20) and increased by 97 percent from 2014 levels. An increase in total county employees since 2000 is a likely cause for this increase. The county employed a total of 1,934 employees at the end of 2006, 2,750 employees at the end of 2014, and 2,987 employees at the end of 2018 (Table 5, above). With more people working at county facilities, more waste generation is expected. Further, with a growing county population, more waste is generated at county parks for disposal. Since the 2014 inventory report, a number of waste diversion efforts have been implemented in county operations to keep recyclables and compostable materials out of the landfill, such as: implementing recycling collection at most county facilities, the Zero Waste Fair initiative to reduce waste at the Evergreen State Fair via organics and recycling collection, and regular employee training on correct recycling practices at county facilities. In 2016, approximately 160 tons of waste (or roughly 10 percent of estimated waste from county facilities) was diverted from the Fairgrounds, county campus, and jail facilities for recycling and composting. Waste that is diverted from landfill is not included in emissions calculations as it is processed for reuse rather than sent to a landfill.

V. Forecast Emissions for County Operations

A. Progress in Meeting the 2020 Target

Snohomish County's emissions target, established in Executive Order 13-48A, is a 20 percent reduction from baseline emissions for the year 2000. Total GHG emissions for baseline year 2000 are 65,667 MT CO_2e[15], which is an updated baseline total that includes Cathcart Landfill emissions. A 20 percent reduction from this revised baseline is 13,333 MT CO_2e, which yields a new 2020 GHG emissions target of 52,534 MT CO_2e. Figure 21 shows that 2018 GHG emissions for county government operations are 48,158 MT CO_2e which is 26.7 percent below 2000 levels. Unless GHGs increase between 2018 and 2020, it is anticipated that the 2020 target for GHGs from county operations will be met and surpassed.

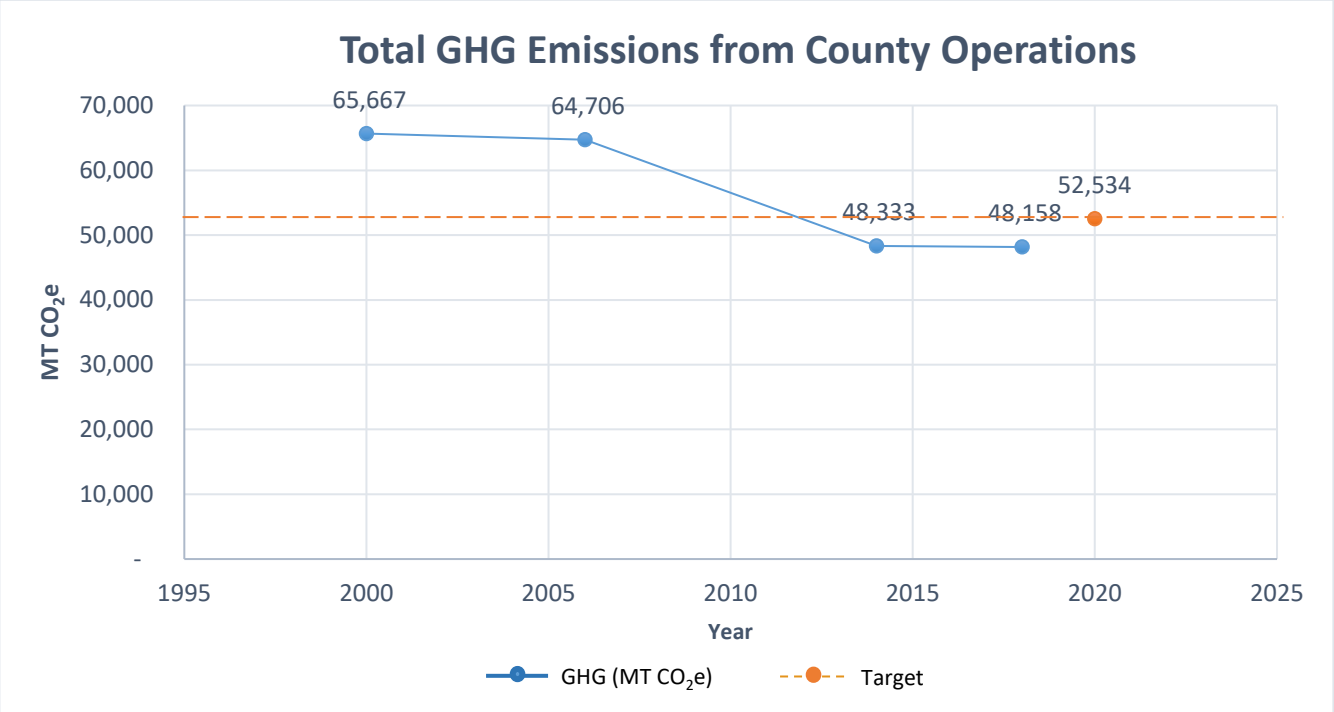


Figure 21 - Total Emissions from county operations and 2020 emissions target

Referring to Table 3 in Section IV: Government Operations Inventory Results of this report, emissions have decreased in three sectors since 2000: Buildings and Facilities, Streetlights, and landfill emissions from the Solid Waste sector. Between 2000 and 2018, the reduction in GHGs from county operations can

[15] This total includes 40,000 MT CO_2e from Cathcart Landfill emissions and 25,667 MT CO_2e for all remaining sectors, as described previously in the report.

be largely attributed to SnoPUD's transition to cleaner sources of electricity, investment in energy efficiency retrofits in county buildings, and the natural decline of emissions from the Cathcart Landfill.

B. 2020 Forecast Scenarios

Several different forecast scenarios have been created to help determine if the county will, in fact, meet its 2020 emissions target. The different forecasts are described in more detail below.

1. 2020 Forecast 1: Current trend (Linear Average)

The first forecast method assumes the trend from 2000-2018 will continue, and the 2020 forecast number is calculated using a linear average of this trend line. By using all existing GHG inventory data points, the average annual rate of emissions reduction is 973 MT CO_2e, or 1.5 percent per year. This method forecasts 2020 emissions to be approximately 45,000 MT CO_2e. As such, under this linear forecast method, the county would meet, and exceed, its 2020 target of 52,534 MT CO_2e.

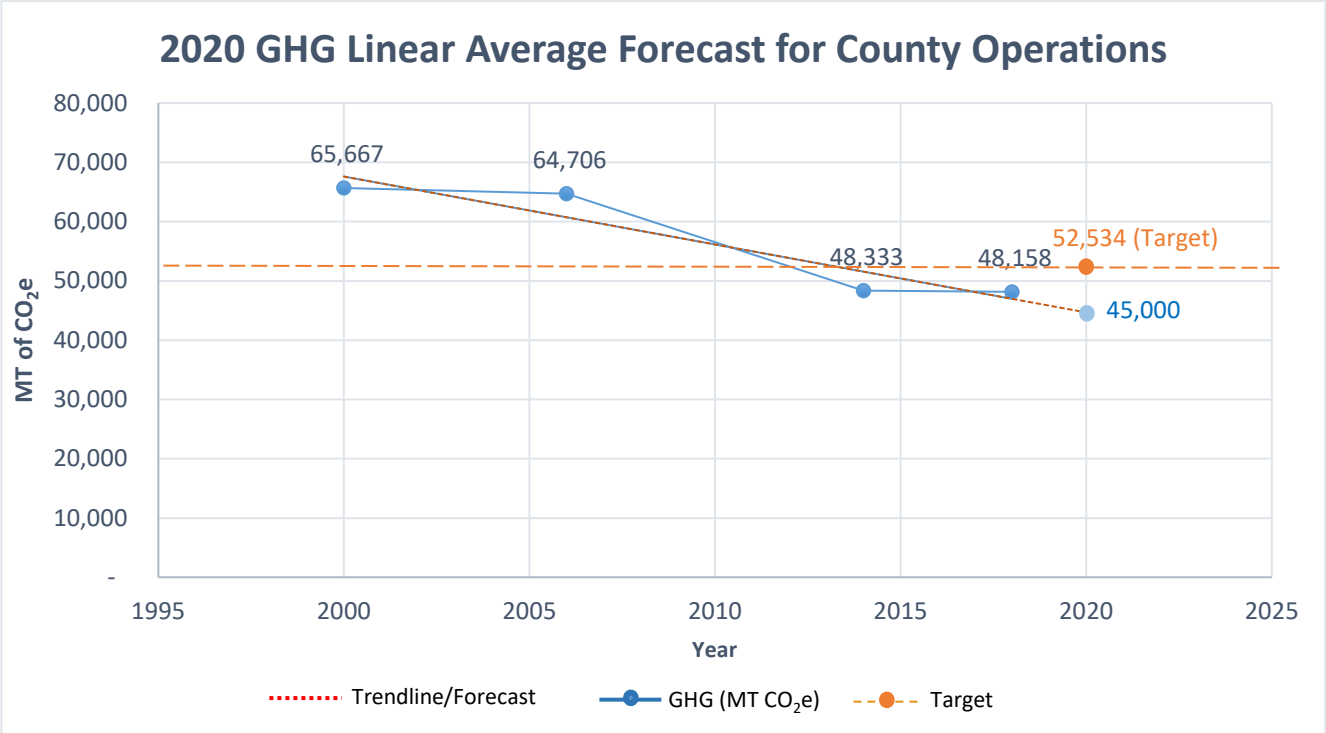


Figure 22 - 2020 forecasted emissions via linear average method

2. 2020 Forecast 2: Aggressive reduction

The second forecast method uses the county's period of most aggressive annual emissions reduction in the past for a 2020 forecast. For county government operations, the largest GHG reduction period was between 2006 to 2014 (as seen in Figure 23 below). The total reduction between 2006 and 2014 was

16,373 MT CO_2e, or an average of 2,046.6 MT CO_2e per year. Assuming this same annual reduction rate in 2019 and 2020, a total of 44,065 MT CO_2e is the forecasted total for 2020. This forecast represents a 32.9 percent reduction in emissions over the 2000 baseline, exceeding the 2020 target by 8,469 MT CO_2e.

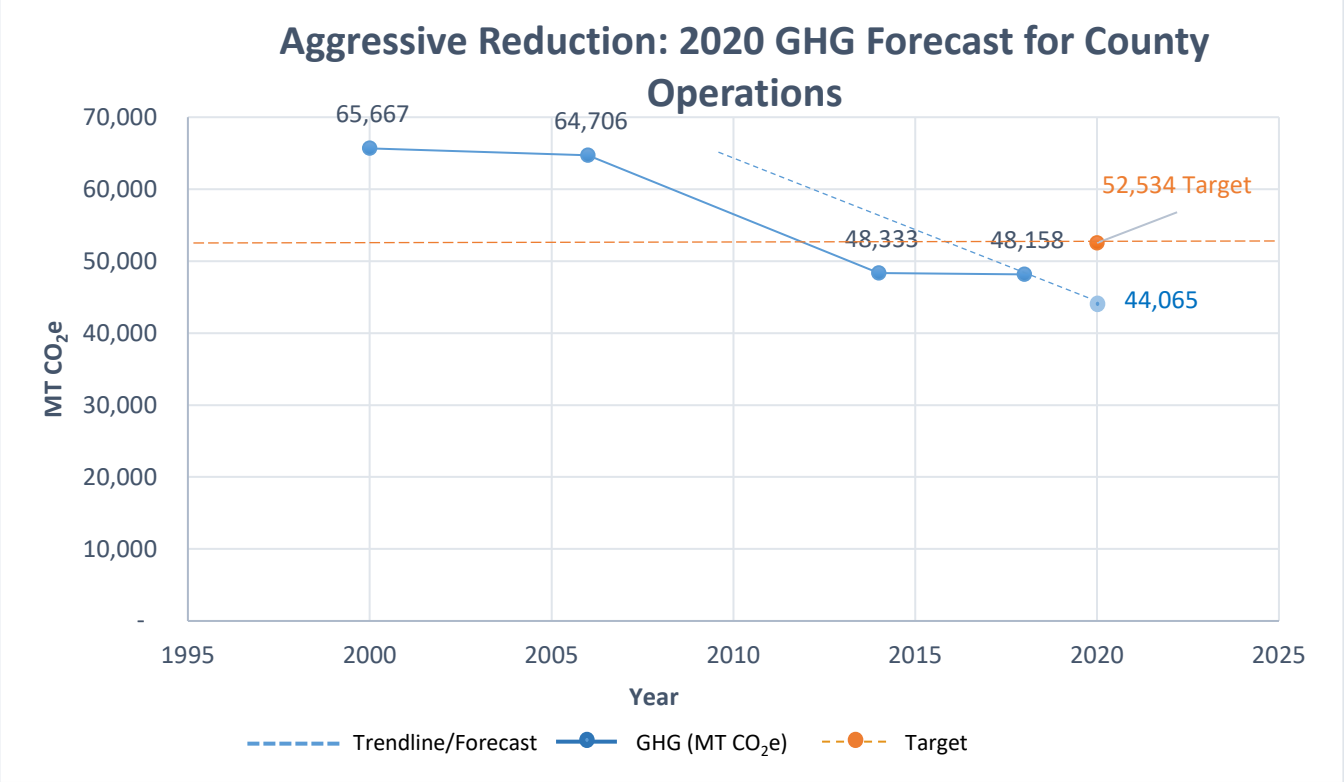


Figure 23 - 2020 aggressive reduction emission forecast

3. 2020 Forecast 3: COVID-19 impacts

A third method for forecasting emissions starts with 2018 GHG levels and then incorporates changes both experienced and anticipated to occur in 2020 for each sector. While this report was being written, the COVID-19 global pandemic had begun, which brought significant changes to county operations – namely, that a large portion of county employees are working remotely or with social distancing measures in place and, for a short period of time, some county operations and activities were halted or reduced. Some of the impacts, such as changes in building energy use, were directly observed and extrapolated through the end of 2020 while other impacts such as changes in vehicle emissions are estimated. As a result, this third forecast incorporates some of the COVID-19 impacts that have occurred in 2020 and estimates the impacts of these changes on future county emissions.

In the Buildings and Facilities sector, the primary COVID-19 impacts on energy consumption include a largely remote workforce. In the 3rd quarter of 2020, a review by staff estimated that 990 employees, comprising over 30 percent of the county workforce, had shifted to remote work rather than commuting to the county facilities. From January through July of 2020, electricity use in county buildings decreased 3.3 percent and natural gas use decreased 3 percent compared to the same period in 2019. As such, a 5 percent reduction was estimated for total 2020 COVID-19 impacts on energy use in county Buildings and Facilities.

In the Transportation sector, a 3 percent GHG emissions reduction from 2018 levels was estimated based on an observed reduction in Fleet activity between March and May of 2020. Fleet Vehicle activity has largely resumed as 'normal' since May. Employee Commute emissions are expected to decline significantly with approximately 30 percent of the workforce telecommuting and all employees required to limit non-essential travel. As a result, a 40 percent reduction in Employee Commute from 2018 levels is estimated in 2020. Lastly, emissions from employee air travel, the smallest sub-sector of transportation emissions, is estimated to be a 60 percent reduction from 2018 levels - as all unnecessary employee air travel was suspended starting in April 2020.

Within the Solid Waste sector, a 40 percent reduction in emissions from 2018 levels is expected in 2020. This 40 percent reduction was estimated based on at least 30 percent of employees working remotely starting in April 2020, which is expected to reduce the amount of waste generated in county facilities by a similar percentage. County administrative buildings recorded a 38 percent reduction in waste in the period from January through October of 2020 when compared to the same period in 2018. Cancellation of the 2020 Evergreen State Fair, and all Fairgrounds activities after April 2020, has eliminated the generation of an estimated 90 tons of landfill waste from the Evergreen State Fairgrounds. Similarly, the social-distancing restrictions and closures of county parks and cancellation of community events is estimated to result in the prevention of approximately 200 tons of waste from being generated at these locations. Together, these estimates total approximately 500 tons, which is 40 percent less than 2018 levels. No change is expected from Cathcart Landfill emissions.

Finally, no change is expected in emissions from the Streetlights sector.

Table 6 and Figure 24 show that the overall impact of COVID-19 to 2020 county government operations emissions is anticipated to be a 32.8 percent reduction over the 2000 baseline (i.e. total emissions of 44,138 MT CO_2e in 2020). Under this forecast scenario, the county is anticipated to exceed its 20 percent GHG reduction target in 2020, as the COVID-19 pandemic has forced the county to quickly adopt to new operations in order to keep employees and the community safe. It is anticipated that the

county would meet or exceed this 2020 reduction target, even if emissions from the Cathcart Landfill were excluded.

Table 6 - 2020 Forecast emissions with COVID-19 related impacts

Sector	Subsector	2000 GHGs	2006 GHGs	2014 GHGs	2018 GHGs	2020 Forecast	% Change: 2020 vs. 2000
Buildings and Facilities	Electricity	6,033	3,641	1,396	456	433	-92.8%
	Natural Gas	2,530	4,037	3,184	3,270	3,107	22.8%
	Subtotal	**8,563**	**7,678**	**4,579**	**3,725**	**3,539**	**-58.7%**
Transportation	Fleet and Equipment	10,153	15,593	10,266	10,342	10,032	-1.2%
	Employee Commute	6,193	7,707	7,859	7,722	4,633	-25.2%
	Employee Air Travel	N/A	N/A	N/A	79	32	-
	Subtotal	**16,346**	**23,300**	**18,125**	**18,143**	**14,697**	**-10.1%**
Solid Waste	Facility waste	200	254	491	970	582	191.0%
	Closed Landfill emissions	40,000	33,200	24,872	25,305	25,305	-36.7%
	Subtotal	**40,200**	**33,454**	**25,363**	**26,275**	**25,887**	**-35.6%**
Streetlights	Electricity	558	274	266	16	16	-97.1%
	Subtotal	**558**	**274**	**266**	**16**	**16**	**-97.1%**
Total		**65,667**	**64,706**	**48,333**	**48,159**	**44,139**	**-32.8%**
Total excluding landfill		25,667	31,506	23,461	22,854	18,834	-26.6%

*Data may not add to total due to rounding

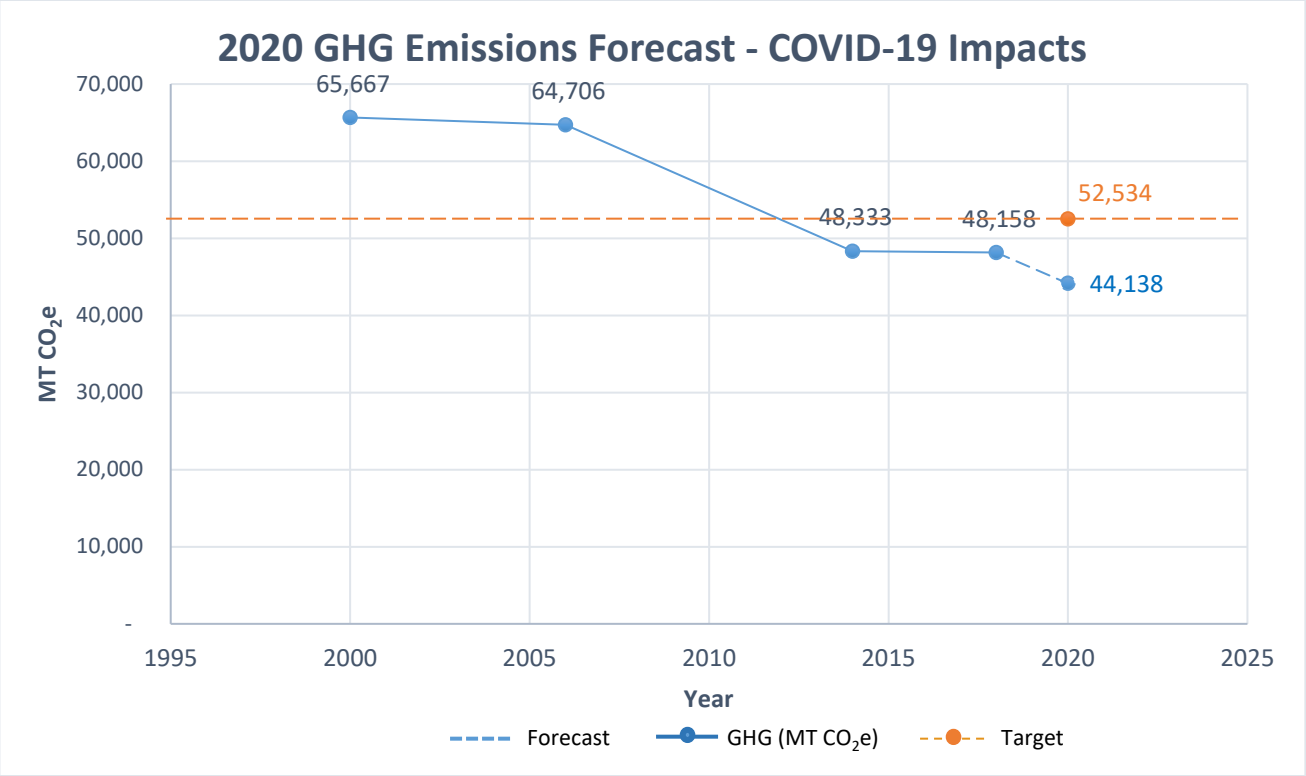


Figure 24 – 2020 forecasted emissions with COVID-19 related impacts

C. Forecast to 2050

This final section of the report is a long-term forecast of county government emissions through 2050. While a specific emissions goal for county government operations beyond 2020 is yet to be determined, the County Executive and Council recently passed Clean Energy Joint Resolution 19-006 which calls for 100 percent clean electricity and 100 percent clean energy in all government operations by 2030 and 2045, respectively. For the purposes of this report, a 2050 goal of carbon neutrality for county government operations is used for forecasting purposes. Figure 25, below, shows projected emissions for Snohomish County from a "business as usual" baseline. The "business as usual" baseline assumes that all ongoing efforts to reduce energy consumption and GHG emissions are halted. Examples of such efforts include: the county's Commercial Strategic Energy Management program, recycling and composting of waste, any future ESCO projects, fleet fuel-efficiency or alternative-fuel improvements not required by state or federal regulations, and employee alternative commute options. The emissions forecast for 2050 incorporates the following assumptions:

- 'Business As Usual' line: Continuation of the current county population growth rate seen from 2000 to 2018 – a 1.6 percent average annual increase which results in a 0.825 percent annual increase in emissions from 2021 onward.

- Avoided Emissions:
    - State legislation: Clean Energy Transformation Act (CETA), and Clean Buildings Initiative (HB 1257), updates to the Washington State Energy Code.
    - County policy: Clean Energy Joint Resolution 19-006, Waste Reduction Resolution 19-015, the Green and High-Performance Building Standard into Snohomish County Code, updated county goals and targets via updated Sustainable Operations Action Plan, 2020 Comprehensive Plan, and a Snohomish County community climate action plan.
    - Anticipated permanent changes from the COVID-19 pandemic, namely increased telecommuting and a consolidation/reduction in county-owned facilities.

The anticipated impact of these assumptions for the 2050 forecast are outlined in more detail below.

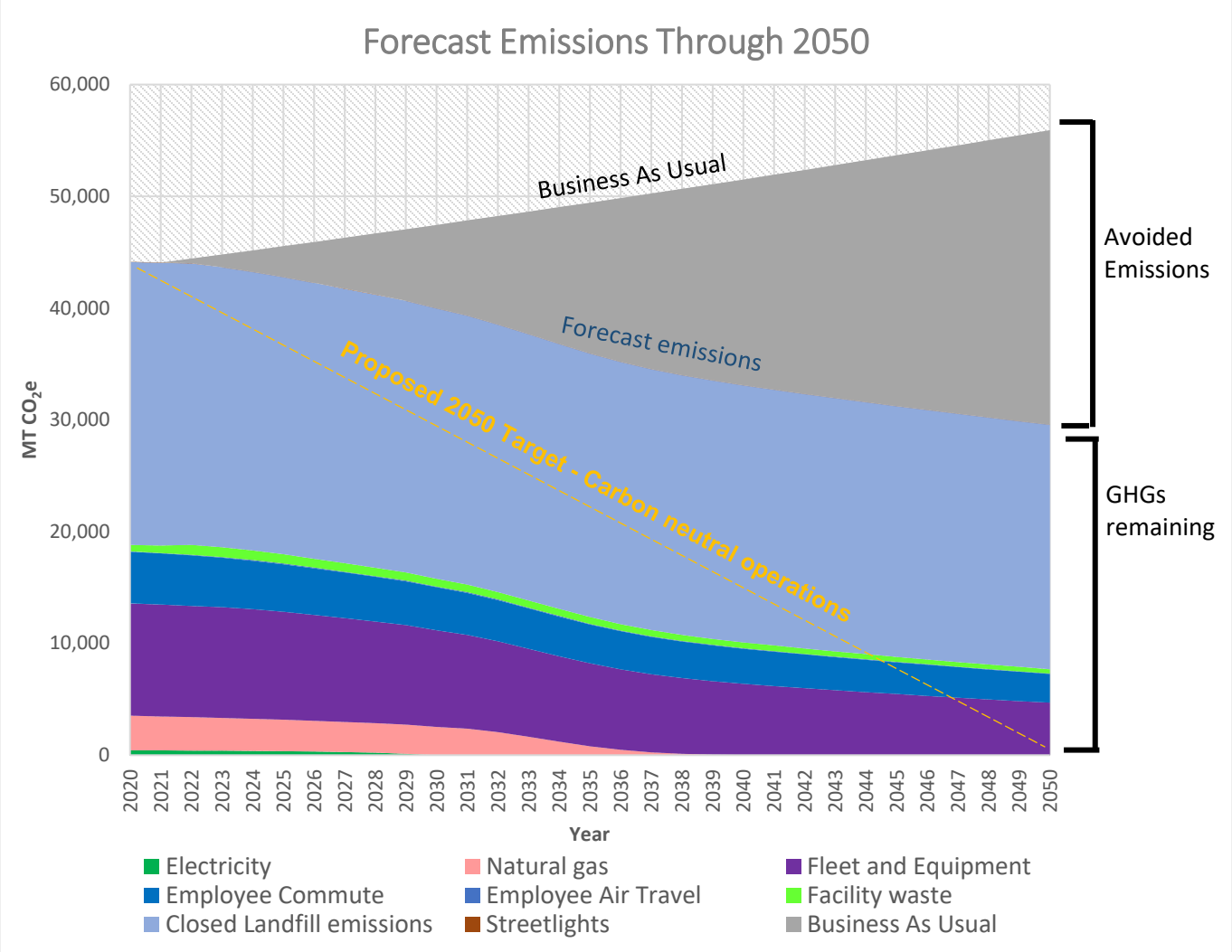


Figure 25 - Forecast emissions for county operations through 2050

1. Buildings and Facilities

2020 GHG emissions from electricity consumption are anticipated to be very similar to 2018 at approximately 1 percent of total county government emissions. Emissions from electricity are assumed to be zero by 2030, in accordance with the county's goals outlined in Clean Energy Joint Resolution 19-006. At the same time, SnoPUD will be working to eliminate 100 percent of GHGs from its portfolio by 2045 in order to meet the requirements of the Washington Clean Energy Transformation Act (CETA). Assuming that the county will reach the Clean Energy Joint Resolution goal of 100 percent clean electricity by 2030, the forecast incorporates a 10 percent annual reduction from 2020 until the target date of 2030 at which time emissions from electricity use will be zero MT CO_2e through 2050 either from carbon-free electricity generation, carbon offsets, or a combination thereof.

Emissions from natural gas are assumed to reach zero by 2045, again, assuming that the county achieves the goal of Clean Energy Joint Resolution 19-006. As such, an annual reduction of 2 percent of total related GHGs from 2020 through 2030 is used in the forecast for on-going energy efficiency and electrification efforts. From 2031 through 2045, a more aggressive annual emissions reduction is assumed in order for the County to reach the stated goal of eliminating emissions from fossil fuels by 2045. As many existing county buildings approach the expected end of useful life between 2020 to 2045, new facilities will be constructed or remodeled to conform with the county's Green and High Performance Building Standard, which requires prohibits the use of fossil fuels for heating and requires LEED Gold certification. Emissions from natural gas in county buildings and facilities are assumed to decrease by approximately 170 MT CO_2e per year and achieve zero emissions in 2045.

2. Transportation

The Transportation sector of county operations is forecast to have a 50 percent reduction in emissions by 2050, this includes emissions from the fleet and equipment subsector. As electric vehicle technologies continue to progress, assumptions made for this forecast coincide both with the county's Clean Energy Joint Resolution 19-006, and with the growth of cleaner fuels (e.g. electric, and hybrid fuel vehicles). As such, an average annual emissions reduction of 2 percent is assumed through 2030 for the fleet vehicles subsector, followed by 3 percent annual reductions from 2031 through 2050. However, with the current pace of battery technology and vehicle electrification, it is unlikely that the entire county fleet vehicles will be completely shifted off of fossil fuels by 2050. The county uses many specialized vehicles and equipment such as vacuum-extractor (vactor) trucks, airport fire response vehicles, and heavy construction equipment which currently do not have a viable clean energy substitute in development. The

county is forecast to reduce emissions from fleet vehicles and equipment from 10,032 MT CO_2e in 2020 to 4,700 MT CO_2e in 2050.

With respect to GHGs from employee commute, the adoption of permanent telework and/or flexible work arrangements for 15 percent of county employees as a result of COVID-19 is anticipated. Adoption of battery electric and other clean energy powered vehicles in the employee commute subsector is expected to accelerate, particularly for passenger vehicles. Like the county fleet, employee personal vehicles are not expected to be free of emissions by 2050. New mass transit, and clean vehicle technologies, are also expected to significantly reduce the number of county employees commuting in single-occupant vehicles. In total, these changes are forecast to drive a 2 percent reduction in employee commute emissions each year from 2021 through 2050, reducing annual emissions from 4,600 MT CO_2e in 2021 to 2,560 MT CO_2e in 2050.

Finally, the Employee Air Travel subsector is expected to increase by 100 percent from 2020 levels by 2023 as pre-COVID-19 air travel resumes, resulting in annual emissions of 65 MT CO_2e in 2023. Emissions are expected to decrease by 1 percent annual from 2023 through 2030 and from 2030 onward emissions are expected to decrease by 2 percent per year as airlines incorporate the use of fuels with lower carbon emissions. Annual GHG emissions in 2050 are forecast to be 40 MT CO_2e.

By the year 2050, 7,300 MT CO_2e of annual emissions is forecast in the county's Transportation sector, including 4,700 MT CO_2e from fleet vehicles, 2,560 MT CO_2e from employee commuting, and 40 MT CO_2e from employee air travel. This represents a 50 percent reduction in GHG emissions from 2020 to 2050 for the Transportation sector.

3. Solid Waste

By 2022, emissions from waste generated at county facilities are expected to increase from 2020 forecast levels to approximately 90 percent of recorded 2018 emission levels, or 900 MT of CO_2e. This increase is expected as community events and activities resume at the Evergreen State Fairgrounds and other county sites and as a portion of county employees return to work at County facilities following the COVID-19 pandemic and associated remote work arrangements. Though, as noted in the Transportation section above, permanent telecommuting is assumed for approximately 15 percent of the county workforce, which will help reduce the amount of solid waste generated at county facilities. From 2022 to 2050, a 3 percent average annual reduction in waste at county facilities is assumed through expanded waste diversion efforts and to meet the goals of Waste Reduction Resolution 19-015. In 2050, 380 MT CO_2e is estimated in waste generated from County facilities; a 34 percent reduction from 2020 forecast emissions.

Emissions from the Cathcart Landfill are expected to decrease from 2018 levels by approximately 0.5 percent per year through 2050. This 0.5 percent average annual reduction has been reflected in reported emissions from the landfill from the period of 2014 to 2019. This reduction in Cathcart Landfill emissions is expected as part of the natural decline of emissions from closed landfills, as referenced in Section IV of this report under Solid Waste. 2050 emissions from Cathcart Landfill are estimated to be 21,800 MT CO_2e.

4. Streetlights

As noted above, emissions from electricity generation are expected to decline to zero by 2030 in the effort to reach the goals in the county's Clean Energy Joint Resolution, and therefore emissions from county streetlights and traffic lights are also assumed to be zero by 2030. An annual 2 percent emissions reduction is assumed in 2021, followed by a more aggressive reduction each year until 2030 as a result of 'greening' the electricity grid and the purchase of carbon offsets as necessary.

5. Summary

In 2050, the total emissions from county operations is forecast to be 29,572 MT CO_2e, an average annual reduction of 1.3 percent from 2020 expected emissions. This 2050 emissions forecast is a 33 percent reduction (i.e.14,556 MT CO_2e) from 2020 estimated levels GHGs. Emissions from the consumption of natural gas and electricity in county facilities are assumed and forecast to be eliminated entirely from the county operations. Approximately 74 percent of the forecast emissions in 2050 are expected to come from county landfills, 16 percent from Fleet and vehicle equipment, 9 percent from Employee Commute, 1 percent from Facility Waste and 0.1 percent from Employee Air Travel. If the county were to adopt a 2050 carbon neutrality goal, then the remaining 29,572 MT CO_2e in government operations emissions would likely need to be mitigated through the purchase of carbon off-sets.

VI. Conclusions and Next Steps

A greenhouse gas inventory is an excellent tool to measure progress in meeting emissions reduction targets. Snohomish County has made significant progress in reducing overall emissions from government operations since establishing an initial baseline and target. Using the adjusted emissions total for the baseline year 2000, the county has already achieved the targeted 20 percent reduction in emissions as of 2018.

Each greenhouse gas inventory report is critical to inform the county's actions around climate change, including where to prioritize efforts for GHG reduction. As mentioned in previous sections of this report, the county intends to include the following in future GHG inventories: refrigerants, and a more precise and in-depth accounting of emissions associated with purchased goods and services. Refrigerants often have a high global warming potential (GWP) and are found in the county vehicle fleet and in buildings for heating and cooling.

The 2018 GHG inventory results are intended to help focus and prioritize actions to reduce emissions from county government operations. It provides important information that will help drive policy priorities for the county's Sustainable Operations Action Plan (SOAP), the countywide climate action and environmental stewardship plan, the comprehensive plan, and much more.

Based on the inventory results, the following areas have the greatest potential for emissions reduction:

- When HVAC equipment needs replacement, replace HVAC equipment that uses natural gas with an electric alternative.
- Continue energy efficiency retrofits and the strategic energy management program at all county government facilities, especially where natural gas is used for thermal heating.
- Transition fleet vehicles to a clean fuel alternative, as appropriate and after consideration of vehicle needs.
- Adopt a permanent telecommuting policy for county employees, where appropriate for the job function.
- Continue promoting transit and other less carbon-intense employee commute options through the SmartRide program.
- Evaluate the feasibility of methane capture system at the Cathcart Landfill, possibly using captured methane as a renewable energy source.
- Develop a plan to reduce commercial real estate holdings in order to maximize the financial, environmental, and other benefits from employee telecommuting.

VII. Appendix A – Glossary of Key Terms & Abbreviations

Term	Definition or Meaning
Anthropocentric	Caused by human activity
CAFE standards	Corporate Average Fuel Economy standards as set by the National Highway Traffic Safety Administration
CETA	Clean Energy Transformation Act – Washington state legislation relating to elimination of emissions from electricity generation[16]
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent - a measure used to compare the emissions from various greenhouse gases based upon their global warming potential[17]
eGGRT	US Environmental Protection Agency's electronic Greenhouse Gas Reporting Tool
eGRID	Emissions and Generation Resource Integrated Database – a comprehensive inventory of environmental attributes of electric power systems issued by the US Environmental Protection Agency.
Emissions	Used interchangeably with the terms "greenhouse gases" or "GHGs"; broadly refers to greenhouse gases emitted from anthropocentric activity
GHG	Greenhouse gas
GWP	Global Warming Potential – a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period relative to the emissions of 1 ton of carbon dioxide (CO_2)
ICLEI	ICLEI – Local Government for Sustainability (formerly known as the International Council for Local Environmental Initiatives)
LGO	Local government operations
MT	Metric ton(s) – approximately 2,204.6 pounds of mass
Operational control approach	One of two control approaches utilized in calculating GHG emissions. Operational control approach does not account for GHG emissions from LGO operations in which an organization owns an interest but has no control. The other approach is a Financial control approach.
SEM	Strategic Energy Management
SOAP	Sustainable Operations Action Plan

[16] Clean Energy Transformation Act. Washington Department of Commerce. https://www.commerce.wa.gov/growing-the-economy/energy/ceta/

[17] United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, World Bank. (2005). *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003*, *Studies in Methods*, Series F, No.61, Rev.1, Glossary, United Nations, New York, para. 3.27. https://stats.oecd.org/glossary/detail.asp?ID=285

VIII. Appendix B - Methodology Details

A. Government Operations Inventory Data

Electricity Emissions Factors

Snohomish County Public Utility District (SnoPUD) provides electricity to all of Snohomish County, including the county's facilities. SnoPUD publishes a CO_2 emissions factor for its electricity as noted in Table 7[18],

Table 7: Snohomish Public Utility District Electricity Emissions Factors for 2018

Utility	CO_2 (lbs./MWh)	CH_4 (lbs./GWh)	N_2O (lbs./GWh)
SnoPUD	42.35	5	10

Buildings and Facilities

SnoPUD, Puget Sound Energy, and Cascade Natural Gas provided energy use details for all Government Facilities regarding electricity and natural gas.

Streetlights and Traffic Signals

Data on streetlight energy use was obtained from Snohomish County's Public Works Department and SnoPUD.

Vehicle Fleet

Most fleet vehicle data were obtained from the county's Fleet Services Division and a small of amount vehicle fleet data was provided by individual departments. Emissions from personal vehicles used to perform work duties is estimated using the total dollar reimbursement made to employees for personal vehicle use, dividing that value by the mileage rate for 2018 ($0.545 per mile) to determine the total Vehicle Miles Traveled.

Employee Commute

A survey of how employees get to work was conducted in the county's Commute Trip Reduction Survey, as required by the state of Washington. 934 employees (out of an employee base of 2987) responded to the survey with information on their personal commutes.

From these numbers, average MPG was calculated for gasoline and for diesel vehicles. The VMT from respondents was then multiplied by 2987/934, to estimate VMT for all employees. The US national average MPG numbers were used along with the calculated VMT to calculate emissions. These values are shown in Table 8.

Table 8: Employee Commute VMT and MPG

Fuel	Employee commute VMT	Average MPG
Gasoline – Passenger Vehicles	8,157,169	24.2
Gasoline – Light Trucks	9,065,500	17.5
Diesel - Transit Bus	1,452,096	17.5

Solid Waste

Values for solid waste generated at county facilities are a combination of actual tonnage as reported by the county's waste haulers as well as estimates from sites where waste generation is lower. Sites with higher waste generation typically are weighed by haulers and the county is charged certain fixed fees as well as a variable fee per ton of waste collected. From the sites where waste is weighed and the county is charged by weight, an average cost-per-ton was calculated for county-generated waste: $171.39 per ton. At site where waste generation is lower, waste haulers do not weigh the waste collected but rather charge a flat rate per pick-up. For GHG emissions reporting purposes, where actual tonnage is not available, the total dollars billed for a site is divided by the average cost-per-ton to calculate an estimated tonnage. This estimated tonnage is then used to calculate the resultant GHG emissions.

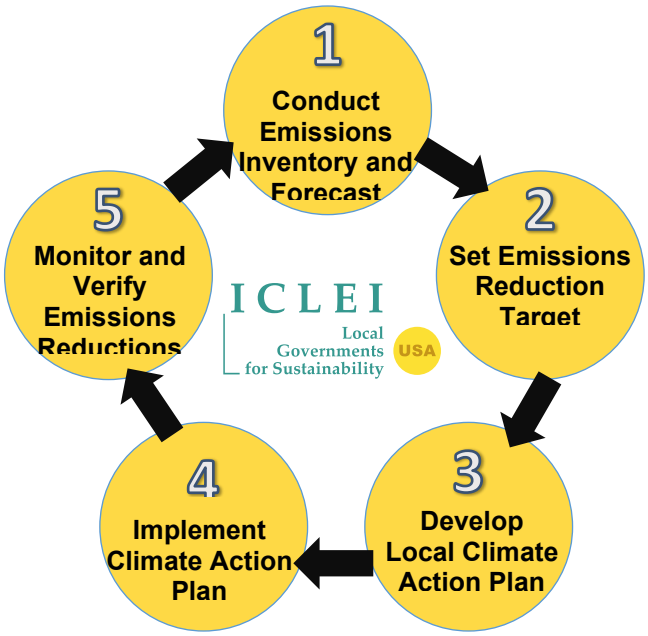
Waste collected at each of the county's transfer stations is not included in this emissions report. This is community-generated waste that is then transported to the Roosevelt Landfill in Klickitat County and so does not fall within the scope of this report.

Landfill gas emissions are calculated from several sources and taken together via state and federally recognized best practices from the US EPA to provide a final estimate of CO_2e emissions. One source of data is the calculated estimate of methane generated by the quantity of waste-in-place at the landfill. Another data source is the monitoring of greenhouses gases captured in the surface gas pipelines installed over the landfill. Additional data is gathered from the input and output gas monitoring from the active gas flaring system that destroys captured methane from the landfill. Accepted oxidation factors are also used as an input to landfill emissions calculations based on the characteristics of landfill.

IX. Appendix C – ICLEI Climate Mitigation Background

A. ICLEI Climate Mitigation Program

Since 2008, Snohomish County has partnered with ICLEI – Local Governments for Sustainability (formerly known as the International Council for Local Environmental Initiatives, now simply "ICLEI") to identify sources of greenhouse gas emissions from county operations, develop emissions reduction targets, and identify actions to achieve the targeted reductions. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level and comprises a global network of more than 1,750 local and regional governments, across 100+ countries. ICLEI provides a framework and methodology for local governments to identify and reduce greenhouse gas emissions, organized along Five Milestones, also shown below:



Snohomish County Local Government Operations have been active in all five milestones – conducting both an inventory and forecast of Local Government Operations GHG emissions, setting both a mid-term and long-range target, as well as various plans to reach those targets.