ENERGY TRANSITIONS INITIATIVE
U.S. Department of Energy

Sitka

Sitka GHG Inventory

November 2024




Public Comment is Closed

The Sitka Community Renewable Energy Strategy (SCRES) Technical Team is currently updating the draft and incorporating comments received. To get updates when the next version is available, email sustainability@cityofsitka.org

Sitka GHG Emissions Inventory

Table of Contents

1 Purpose

This Greenhouse Gas (GHG) inventory was prepared in close collaboration with the City and Borough of Sitka (CBS) under the Energy Transitions Initiative Partnership Project (ETIPP). ETIPP is a Department of Energy program focused on aiding remote and islanded communities in becoming more resilient. The goal of this inventory is to provide a GHG emissions baseline for the full community of Sitka. This can help the municipality track progress towards their decarbonization goals, as well as identify the policy mechanisms that could be implemented to reduce emissions.

The City and Borough of Sitka partnered with the Pacific Northwest National Laboratory through the ETIPP program. Pacific Northwest National Laboratory sought input from the Sitka Sustainability Commission to ensure they made acceptable assumptions and used the best data available.

2 Methodology

This section details the methodology used for calculating the GHG emissions for the full community of Sitka, following guidance from the GHG Protocol. The baseline year for this inventory is 2023, but many of the data sources are from previous years. We used the best available information at the time, and values can be updated as better data becomes available.

This report refers to the community in multiple ways. When referring to "Sitka", that generally means the full community. When CBS is mentioned, that refers to the local municipality, including the municipally owned utility. When referring to the "Sitka Sustainability Commission", that refers to the group of local community members appointed to a city board to advise CBS on matters of sustainability.

GHG inventories are classified by three scopes. Scope 1 emissions are emissions that occur within an organization's boundaries and within the power of the organization. Scope 2 emissions are indirect emissions that occur outside the organization's boundaries but consumed by the organization (most commonly through the purchase of electricity). Scope 3 are emissions that are indirect emissions (not included in scope 2) that occur in the value chain of the organization, including both upstream and downstream emissions. The city commission defined the purview of this inventory to be all scope 1 emissions (e.g. electricity generation, stationary fuel combustion, transportation, wastewater) as well as selected scope 3 emissions (e.g.. air travel, waste, shipping) that could be calculated and helpful for the municipality. Scope 2 emissions are not relevant to Sitka since their electricity is generated locally. An additional cruise ship analysis was completed and is detailed in the Additional Analyses Methodologies section.

Per direction from the Sitka Sustainability Commission, this inventory does not include carbon sequestration (the trees removing CO2 from the atmosphere) or nonanthropogenic emission from decomposition or natural processes. This inventory also does not include fugitive emissions from refrigerants. Since cooling is not needed frequently in Sitka, refrigerant emissions are estimated to be insignificant.

The source of combustion fuel data (fuel oil, kerosene, gasoline) comes from USACE's 2022 5 Year Cargo Report[1]. This report provides the amount of gasoline, diesel, and kerosene shipped to Sitka. This is the amount of fuel burned within Sitka, and therefore, the emissions associated with combustion from heating, driving, boating, and backup electricity generation. The following sections break down this total fuel consumption (and therefore,

[1] 5 Year Cargo Report, 2022: https://ndc.ops.usace.army.mil/wcsc/webpub/#/report-landing/year/2021/region/4/location/4808

emissions) into finer resolution categories. Breaking down this data into finer categories helps determine which policy levers can be pulled to best impact Sitka's emissions. Understanding the difference between heating, boating, driving, and cooking emissions can reveal which policy mechanisms has the highest impact on reducing emissions. Policy mechanisms can include incentivizing building energy efficiency measures and electrifying vehicles, building, or boats. Key assumptions and values used for calculating the categories below are summarized in the Appendix, along with classifications of which values should be updated.

Emissions are calculated by multiplying activity data (such as gallons of fuel consumed) by an emission factor (emissions per activity unit). Emission factors are taken from the EPA's GHG Factor Hub and converted to metric tons of CO2 equivalent (MTCO2e) [2]. This incorporates emissions from CO2, CH4, and N2O, using the global warming potential (GWP) of 100, as defined by the IPCC report[3].

2.1 Electricity Generation

Sitka's electricity is generated from hydropower, so there are no emissions associated with its primary electricity generation. It should be noted that Department of Energy recognizes that there's some uncertainty to the emissions associated with hydropower from decomposition of organic materials in the reservoir, so this assumption may need to be updated in a future iteration as new science becomes available.[4] Sitka occasionally uses diesel for backup power. In 2023, 9,975 gallons of diesel fuel were used as backup power, resulting in 102 MTCO2e. We assume that 2023 can be used as a representative year and given the small percentage of emissions related to this year, variations from year-to-year are insignificant. Any longer failures or outages of the dams resulting in diesel being burned for electricity, such as that experienced in late 2016, would lead to increased emissions from this source.

2.2 Buildings

Buildings have emissions associated with their electricity and fuel consumption. Since Sitka's electricity generation is supplied from hydropower which has no emissions associated with its generation, their building emissions are solely from the combustion onsite that occurs for space heating, domestic hot water (DHW), and cooking. Electric heat pumps are increasingly common in Sitka, helping to reduce heating emissions. Since we do not have energy data for every building's space heating, DHW, and cooking needs, we estimate their associated emissions based on square footage, electric utility bills, state level energy intensity estimates, and fuel source across buildings.

2.2.1 Residential Buildings

The 2017 Sitka Borough Housing Assessment[5] states that Sitka has 3,513 occupied houses with the average square footage of 1,689 SF/house, resulting in Sitka's total residential square footage of 5.9 million SF. The Energy Information Administration's (EIA's)'s Residential Energy Consumption Survey (RECS) Dashboard[6] estimates the average space heating and DHW consumption by state. We use the value of 74 mmBtu per household, which is an

[2] EPA Emission Factors: https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf

[3] GHG Protocol, Global Warming Potential values: https://ghgprotocol.org/sites/default/files/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_0.pdf

[4] Department of Energy, Tracking the Carbon Footprint of Hydropower: https://www.energy.gov/eere/water/tracking-carbon-footprint-hydropower

[5] Sitka Borough 2017 Alaska Housing Assessment: https://www.ahfc.us/application/files/1215/1510/4582/Final_-_Sitka_Borough_Summary.pdf

[6] Residential Energy Consumption Survey (RECS) Dashboard, 2020. https://experience.arcgis.com/experience/cbf6875974554a74823232f84f563253?src=%E2%80%B9%20Consumption%20%20%20%20%20%20Residential%20Energy%20Consumption%20Survey%20(RECS)-b1

average of the RECS's Alaska and Washington state average space heating and DHW load. We did this to avoid overestimating Sitka's residential heating since Sitka often shares similarities with northern Washington's climate. Using utility bills, we determined which residential building's heating systems were electric. We processed all the electric utility bills by residential and commercial buildings. If the average electricity consumption over the summer months (June, July, August) were 30% greater than the winter months (November, December, January), we conservatively determined the building was heated by electricity. If not, we assumed it's heated by fuel oil and a small percentage by wood. This resulted in 82% of residential buildings used electric heating, 16% used fuel oil, and2% used wood for heating. This results in 3,971 MTCO2e from residential space heating and domestic hot water per year.

2.2.2 Commercial Buildings

For commercial buildings, we used the Sitka's 2024 Commercial and Industrial Square Footage data, showing 2.3 MSF for Sitka's commercial and industrial buildings. We assume that 25% of these building's square footage is not space conditioned (heated or cooled), from either unoccupancy (especially seasonal), warehouses, or storage. The EIA estimates that commercial buildings use on average 25 kBtu/SF for space heating[7]. The Commercial Building Energy Survey (CBECS) places Sitka, Alaska in the "cold / very cold" region and can be used to estimate Sitka's commercial buildings fuel source[8]. Using Sitka's building utility bills, we determined which commercial building's heating systems were electric. This resulted in 25% of commercial buildings used electric heating, while 75% are dependent on fuel oil. We combine commercial and industrial buildings in this analysis since Sitka doesn't have a large industrial footprint. We assume domestic hot water heating is included in this assumption since it is predominately electric water heating. This results in total commercial building emissions of 2,361 MTCO2e per year.

2.3 Ground Transportation

Since Sitka is an island, on-road transportation emissions include the fuel combustion emissions that occur from vehicles within the CBS boundary. According to the Alaska Department of Motor Vehicles, Sitka currently has 14,689 registered vehicles in 2024. However, we assume that not all vehicles are in driven regularly and that some are electric. Electric vehicles produce zero emissions in Sitka because the electricity is supplied by hydropower. We assume that 8,000 vehicles are driven regularly at an average of 12 miles/day with an average fuel efficiency of 20 miles per gallon of gasoline. This results in total gas vehicle emissions of 14,750 MTCO2e in 2024. We also assume that there are 1,000 trucks or vans or recreational vehicles that rely on diesel, resulting in 1,793 MTCO2e. This results in a total vehicle emissions of 16,532 MTCO2e.

Sitka has 100 small passenger vans or buses with cruise ship load/unloading permits associated with tourism. Assuming the cruise ships are at full capacity (see Cruise Ship section, based on 2024 cruise ship schedule), 607,000 tourists spend a day in Sitka per year. Assuming each cruise ship tourist is transported via van or bus for an average of 15 miles per day, this results in 460 MTCO2e per year.

[7] U.S. Energy Information Administration (EIA), *Heating U.S. commercial buildings is most energy intensive in cold climates*, September 2023: https://www.eia.gov/todayinenergy/detail.php?id=60301#:~:text=U.S.%20commercial%20buildings%20in%20cold,heating%20in%20each%20climate%20zone.

[8] U.S. EIA, Commercial Buildings Energy Survey (CBECS): https://www.eia.gov/consumption/commercial/data/2012/bc/cfm/b29.php

2.4 Air Travel

Since Sitka is an island, air travel is a prominent mode of transportation. This inventory includes emissions from fuel combustion for aviation occurring with the city boundary and from portions of transboundary journeys outside the city boundary. Sitka has multiple types of flights: commercial, personal, general aviation (e.g. medical, coastguard, etc.), and cargo. FAA data shows there were 1,812 commercial flights, 9,860 seaplane flights, 1,325 military flights, and 10,342 general aviation flights, resulting in a total of 23,339 flights in 2023.

According to the 5 Year Cargo Report, Sitka imports 658,000 gallons of kerosene, which in its highly refined form is a form of jet-fuel. This jet-fuel is used for smaller air travel such as seaplanes, small personal planes, and helicopters used for coastguard or medical evacuation. Emissions from burning this jet fuel are 6,700 MTCO2e.

Sitka's Rocky Gutierrez airport does not refuel planes onsite. Therefore, these commercial and cargo air travel emissions are not captured as fuel shipped to Sitka in the 5-year Cargo report. This also means that we do not have airport data on the annual jet fuel used at the airport. According to the Bureau of Transportation Statistics T-100 Segment Data for 2023,[9] Sitka's Rocky Gutierrez airport had 40,586 passenger-miles (number of passengers and the distance they've flown in thousands) in 2023. From this, we can calculate the air travel emissions using the passenger-miles based method. We assume most of these flights are classified as "medium haul" (such as to Seattle - ~850 miles), and therefore we use EPA's "Air Travel – Medium Haul" Emission Factor for passenger-miles. This results in a total of 5,300 MTCO2e from commercial travel. Currently, cargo plane data is not reflected in this calculation. Sitka's total air travel emissions are estimated to be 11,980 MTCO2e per year.

2.5 Marine Activity

Marine activity includes commercial fishing, recreational fishing and boating, and charter boats. Shipping is discussed in more detail in the Shipping section under Additional Analyses.

We investigated fuel use in commercial fishing using the State of Alaska CFEC Public Search Application and the calculated averages of tracked fuel usage from Sitka fishermen and fuel usage estimates from the Kempy Energetics analysis tool[10,11]. Using active fishing permits and the fuel usage estimates, we determined that the commercial fishing fuel consumption is 1,805,600 gallons of diesel per year. The estimated emissions from Sitka's commercial fishing is 18,500 MTCO2e per year.

Recreational boats include all boats that are not for commercial fishing or charter boats. We assume there to be about 1,000 active recreational boats based on boating registrations, taking an average of 20 miles trips, 4 times per month, 6 months per year, with an average fuel efficiency of 5 miles per gallon (which is approximately the fuel efficiently of a 20-ft recreational aluminum Hewscraft). This results in an estimated emissions of 1,660 MTCO2e per year.

Charter boats are popular in Sitka, especially during tourist season. The charter boat logbook, provided by Sitka Area Management, documents 7,920 charter boat trips taken in 2023 from 142 active vessels. These are the number of trips that ended in Sitka, and do not include private fishing trips, which are included in "recreational boating" in the previous paragraph. Charter boats are assumed to primarily run on diesel based on input from the Sitkan boating industry. Since no further information is documented regarding charter boats (such as size of boat and how

[9] Bureau of Transportation Statistics: https://www.transtats.bts.gov/Data_Elements.aspx?Qn6n=H

[10] CFEC, https://www.cfec.state.ak.us/plook/#permits

[11] https://kempyenergetics.com/white-paper/white-paper-example-1/

long the trip), we assumed that each trip goes 25 miles, with an average conservative fuel efficiency of 5 miles per gallon, consuming a total of 39,600 gallons of diesel. This results in 407 MTCO2e per year from charter boats.

2.6 Solid Waste Disposal and Wastewater Treatment

Solid waste disposal and wastewater account for 8% of Sitka's GHG emissions. Municipal solid waste from Sitka is shipped to Washington. According to Republic Services 2023 Summary, Sitka shipped 7,618 tons of waste to Seattle in 2023. Using EPA's average mixed MSW emission factor, this produces 4,418 MTCO2e. Since this waste is generated within the city boundary but disposed in landfills outside the city, these are considered Scope 3 emissions. The city commission determined it is important to include since it reflects Sitka's operations.

Sitka also ships 240 tons of recycling, which does not include glass or metals, which produces 22 MTCO2e. Glass and metals recycling occurs onsite, but results in a minuscule amount of emissions. While recycling produces a minimal amount of emissions, we include it in "Solid Waste Disposal".

Wastewater treatment emissions can be calculated based on the total population served and type of treatment, using the federal GHG wastewater reporting methodology[12]. Based on a population of 8,380 people, and a wastewater treatment plant without nitrification or denitrification process, wastewater treatment results in a total of 8 MTCO2e.

3 Results

Based on our analysis, Sitka produced approximately **60,459 MTCO2e** in 2023. The sectors analyzed include vehicles, recreational and charter boats, commercial fishing, residential and commercial heating, waste and wastewater, and air travel. These calculations were validated against the Cargo Report which provide the total amount of fuel shipped to Sitka in a given year. Figure 1 and Table 1 show Sitka's GHG emissions by end use, revealing that the largest end uses of emissions are commercial fishing (31%), ground-based vehicles (27%), and small aircraft (seaplanes, small planes, helicopters) (11%).

[12] Federal Greenhouse Gas Accounting and Reporting Guidance, Council on Environmental Quality, 2016: https://www.sustainability.gov/pdfs/federal_ghg%20accounting_reporting-guidance.pdf

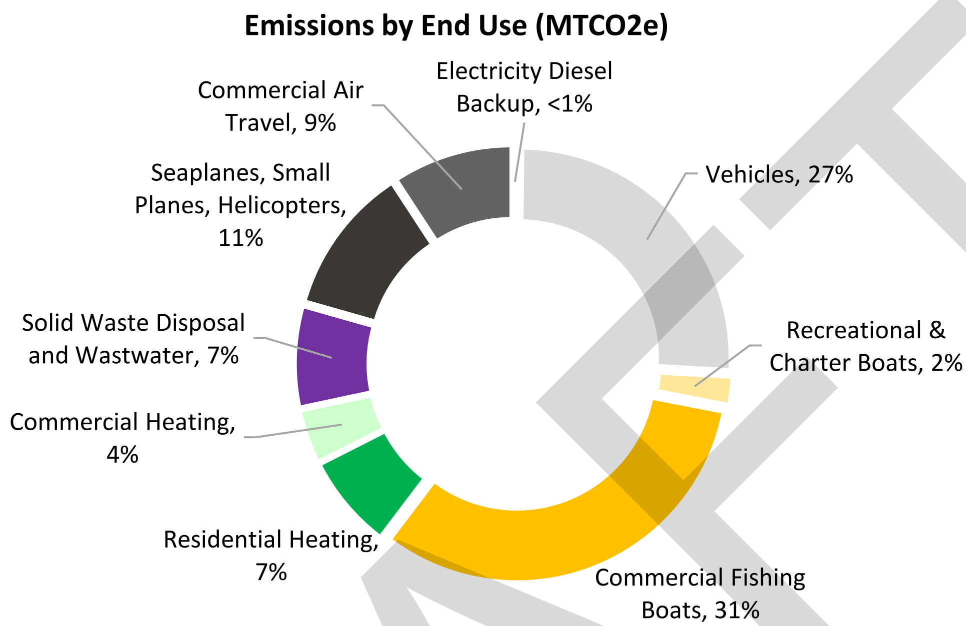

Figure 1. Sitka's GHG Emissions by End Use (MTCO2e)

Table 1. Emissions by End Use

End Use	Emissions (MTCO2e)	% Total Sitka Emissions
Commercial Heating	2,361	4%
Residential Heating	3,971	7%
Commercial Fishing Boats	18,507	32%
Recreational & Charter Boats	2,548	4%
Vehicles	16,543	27%
Seaplanes, Small Planes, Helicopters	6,699	11%
Commercial Air Travel	5,280	9%
Solid Waste Disposal & Wastewater Treatment	4,448	7%
Electricity Diesel Backup	102	<1%
Total Emissions	**60,459**	

Transportation is the largest emissions sector, accounting for 81% of Sitka's emissions, as shown in Figure 2. This consists of ground-based, marine, and air travel, including seaplanes, commerical planes, small planes, recreational and commercial boats, cars, and buses. It is unsuprising that transportation is such a large component of Sitka's emisisons since people are required to fly or boat to arrive in or leave Sitka, since this inventory includes scope 3 emissions. Waste accounts for 7% of Sitka's emissions., which includes the emissions assoicated with solid waste disposal, wastewater, and recyling.

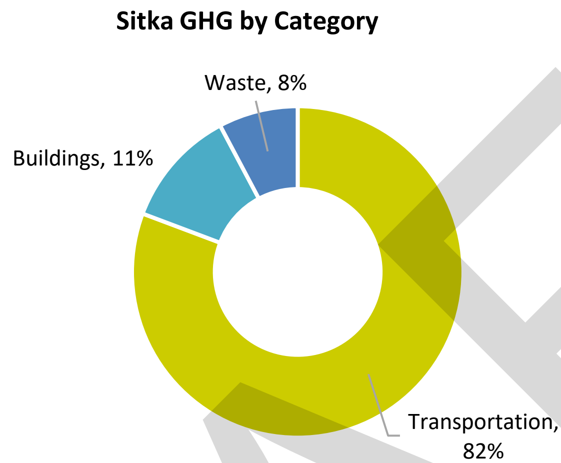

Figure 2. Sitka's GHG Emissions by Category (MTCO2e)

Figure 3 displays Sitka's emissions by source. Distillate fuel oil (also known as diesel) is the largest portion at 44%, and figure 4 separates these emissions by end use. The largest portion of distillate fuel oil comes from commercial fishing, followed by residential and commercial buildings. Gasoline is the second highest source of emissions at 29%. This reveals that promoting electrification is an impactful policy driver to reducing Sitka's emissions from vehicles, buildings, and boats. Air travel (from jet fuel, or a highly refined version of kerosene) account for 20%.

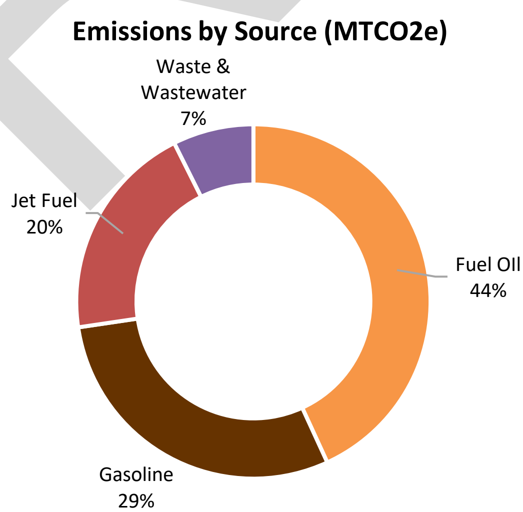

Figure 3. Sitka's GHG Emissions by Source (MTCO2e)

Figure 4 helps visualize the correlation of emissions source and end use, showing the interconnection of emission source to end use to general category.

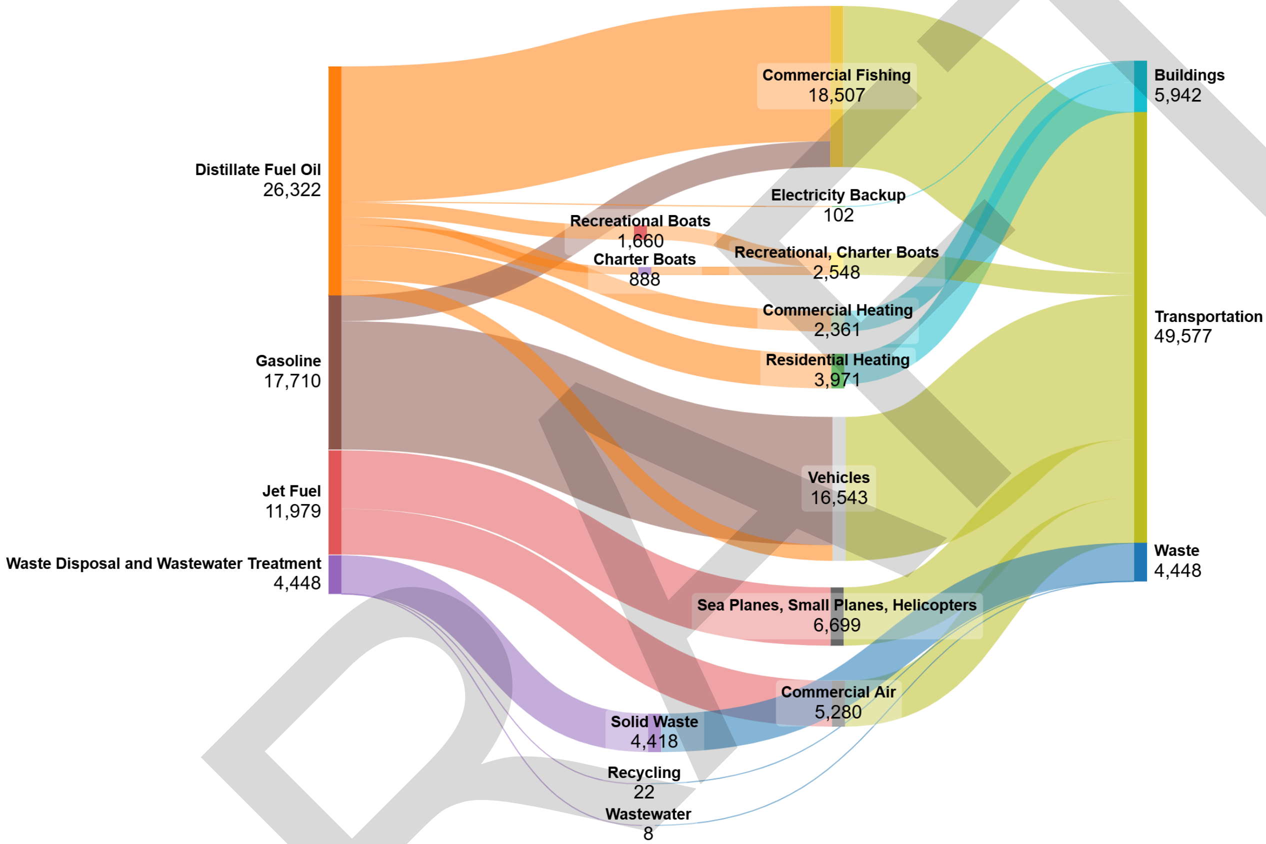

Figure 4. Sankey Diagram of Sitka's GHG Emissions by source, end use, and category (MTCO2e)

4 Additional Analyses

The following sections can either be included or omitted from Sitka's GHG inventory, depending on what policy levers Sitka would like to consider. GHG Inventories typically include measures that are within the jurisdiction's control and occurring within the jurisdiction's boundaries.

4.1 Shipping

Sitka is very dependent on marine shipping, which are considered scope 3 emissions and not always included in GHG inventories. Defining boundaries is important for estimating shipping emissions. According to the 2022 Cargo Report, Sitka ships and receives 235,316 tons of material via barges. A barge can carry one ton about 650 miles with one gallon of fuel, according to one study[13]. Assuming that a barge travels to and from Seattle, including stops in Ketchikan and Petersburg, the distance traveled is approximately 1,000 miles. Actual shipping distances may be greater. This results in approximately 362,000 gallons of diesel fuel consumed by the barges, or 3,700 MTCO2e. To improve estimates of shipping emissions, data from official records, manifests, or surveys can be used to determine the apportionment of emissions to Sitka from the overall shipping companies. It should be noted that barge transport is per gallon more efficient than other forms of shipping, such as trains, trucks, or barges.

4.2 Cruise Ships

Revenue from cruise ships and their passengers account for a large portion of Sitka's economic activity, although there are contentious divisions within the community about whether or not they should welcome them. Cruise ships do not draw power from Sitka's port, and they do not refuel in Sitka. This means that Sitka has little power to control cruise ship emissions (such as electrifying power), other than reducing the number of cruise ships that enter and leave Sitka. Because they are not being controlled by policy mechanisms within Sitka, cruise ships are not included in this GHG inventory, as is common practice in this situation. However, understanding the impact of cruise ship emissions on Sitka is still important. The community of Sitka has to deal with the pollution and local impacts of the emissions from the cruise ships, even though they cannot control those emissions.

We used the 2024 cruise ship schedule to determine the number of cruise ships visiting Sitka annually. There are 38 cruise ships with a scheduled 332 trips to Sitka. We define the scope of cruise ship emissions to include just the number of emissions they produce while within Sitka's boundary: transiting to and from the port and while docked. We have the number of people each boat carries as well. We assume a 3-hour maneuver time, which is the time to approach Sitka, tie to the dock, and leave. We assume the average stay in Sitka is 8 hours. We assume the docking load to be ~50% of the total power to power lights, heating, swimming pools, etc. We assume the fraction load of the generation to be 60%. This results in a calculated emissions value of 23,000 MTCO2e per year.

Cruise ships increase other emissions in Sitka, that are captured in other parts of this inventory. For example, increased people may result in increased building energy and transportation emissions. There are 100 small passenger vans or buses with cruise ship load/unloading permits associated with tourism in Sitka. Assuming the cruise ships are full, this results in 607,000 tourists per year. Assuming these vehicles travel an average of 15 miles per day, this results in an associated emissions of 460 MTCO2e per year. (Note: these emissions from tourist buses are already captured in the vehicle data from the inventory. This analysis is just to separate out the emissions impact from cruises.)

If cruise ships are included in the inventory, cruise ships while within Sitka's waters produce 80,600 MTCO2e. Figure 5 shows an infographic communicating the impact of cruise ships on Sitka's GHG emission inventory.

[13] Texas A&M Transportation Institute, *A modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2014.* 2017. https://nationalwaterwaysfoundation.org/file/31/final%20tti%20report%202001-2014%20approved.pdf

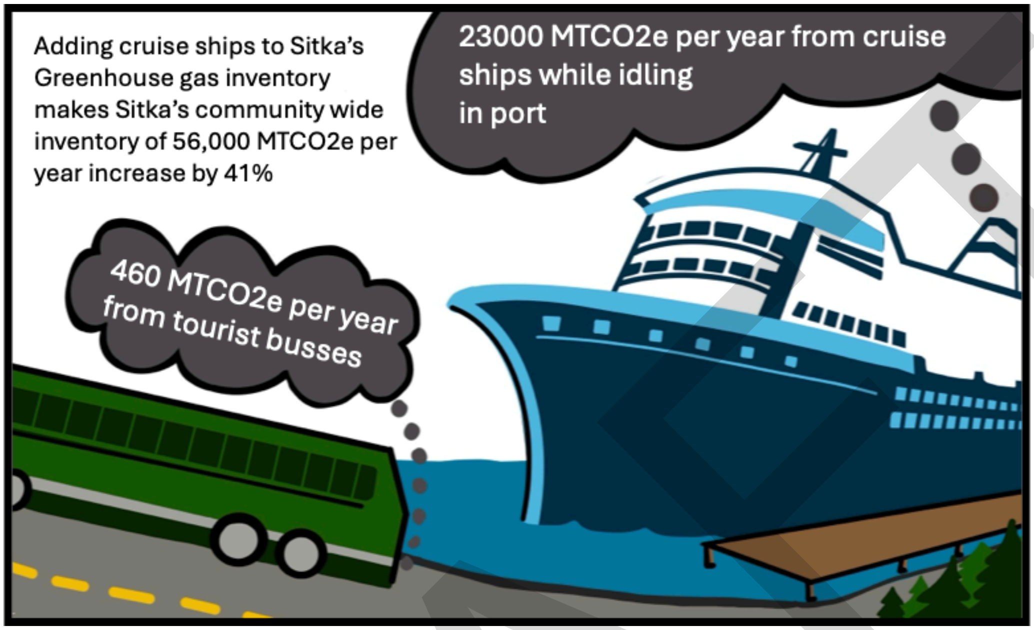

Figure 5. Infographic displaying cruise ship impacts on Sitka.

4.3 Additional Analyses Results

Including estimated shipping and cruise ship emissions in the inventory results in 84,000 MTCO2e. Adding these increase the inventory's GHG emissions by 31%, as shown in Figure 6. This emphasizes the impact cruise ships have on the community's emissions, even when just transiting and idling within their boundary.

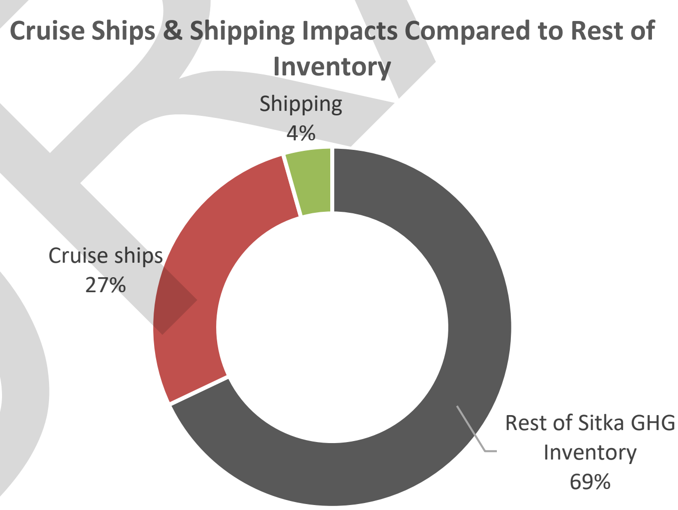

Figure 6. Impact of cruise ships and shipping impacts

5 Next Steps

Now that the GHG inventory baseline has been created, it can be used for multiple purposes. For example, comparing GHG inventories across municipalities can be useful to begin to answer questions like “How much is Sitka contributing to global GHG emissions?” However, comparing inventories can be challenging because different inventories include different scopes. For example, not all inventories include air travel. GHG inventories can be used to highlight the impact various policy levers can be pulled, emphasizing which mechanisms have highest impact and which (while still useful) may have smaller impacts.

A baseline inventory is useful when updated at a regular interval to track progress towards decarbonization targets. We will conduct a training for CBS to update the inventory in the future, either for new years to compare to this baseline, or update values as better data comes available.

6 Appendix

Table 2: Main assumptions

Calculation	**Building Heating- Commercial**		**Ground Transportation- Personal**				**Ground Transportation- Vans and Buses**			
Input assumption	Commercial buildings average 25 kBtu/SF for space heating	75% of commercial buildings use fuel oil	14,689 registered vehicles	8,000 vehicles driven regularly	Vehicles average 12 miles/day	Average fuel efficiency of 20 miles per gallon	100 vans or buses permitted for tourists	607,000 tourists per year	Each tourist is transported 15 miles	
Calculation	**Air Travel**									
Input assumption	1,812 commercial flights	9,860 sea plane flights	1,325 military flights	10,342 general aviation flights	658,000 gallons kerosene	40,586 passenger-miles at airport	Most commercial flights are "medium-haul"	EPA's "Air Travel – Medium Haul" Emission Factor	Cargo plane data is not reflected in this calculation	
Calculation	**Marine Activity- Commercial**		**Marine Activity- Recreational**			**Marine Activity- Charter**				
Input assumption	Commercial fishing fuel consumption is 1,805,600 gallons per year, using Kempy Energetics analysis tool		1,000 active recreational boats	Recreational boats average of 20 miles trips, 3 times per month, 6 months per year	Average fuel efficiency of 5 miles per gallon	7,920 charter boat trips taken in 2023 from 142 active vessels	Charter boats are assumed to primarily run on diesel	Each trip goes an average of 25 miles	Average fuel efficiency of 5 miles per gallon	
Calculation	**Waste**		**Wastewater**							
Input assumption	Sitka shipped 7,618 tons of waste to Seattle in 2023	240 tons of recycling	Population of 8,380 people	Wastewater treatment plant without nitrification or denitrification process	Federal GHG wastewater reporting methodology					

Color Key:

Confident in values and unlikely to need to adjust in the future except in response to major projects or new scientific understanding

Confident in estimate, but numbers will need to be updated in future iterations of the inventory.

Additional, better, or more local data could improve estimate, but the overall impact would likely be small. Estimate is still technically justified with general understanding.

More or better data could improve estimate and the overall impact could be meaningful

274 **Greenhouse Gas Emissions Inventory Guiding Questions:**

If you want to leave public comment but don't know where to start, here are some prompting questions to help get you thinking.

Is the document clear and easy to understand?

Are there areas you want more information or clarity?

Are the assumptions used to calculate emissions easy to understand?

Are there any categories/sources of emissions that are missing?

What is the most useful piece of information in the GHG emissions inventory to you?

What would make this document more useful for you?

Public Comment on Sitka's Greenhouse Gas Emissions Inventory is open until December 31st, 2024. Please submit comments to sustainability@cityofsitka.org

If you need additional assistance commenting, please contact (907) 747-1856