2021 Greenhouse Gas Emissions Inventory for Juneau, Alaska

Preliminary DRAFT

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Acknowledgements

CBJ Assembly

Juneau Commission on Sustainability

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EXECUTIVE SUMMARY

The City and Borough of Juneau (CBJ) working with the Juneau Commission on Sustainability (JCOS) completed greenhouse gas (GHG) emissions inventories for calendar years 2007 [1]and 2010[2]. This inventory quantified energy use by and emissions from both CBJ government facilities and sources in the community at large. In the fall of 2021, the CBJ Assembly allocated funding and directed CBJ to update the community GHG report. This report on Juneau's GHG emissions updates the 2010 baseline information with 2021 energy use and GHG emissions data.[3] As in the 2010 report, this accounting is limited to Juneau's community boundary, which includes its internal energy economy, that is, the energy consumed within the community's boundaries. As such, it excludes external energy consumption related to activities essential to the economy such as fuel purchased outside of Juneau for barge and air transport, cruise ships, etc.

The methodology applied in this updated inventory involved the collection of energy, fuel, and vehicle data, and the calculation of GHG emissions based on fuel types and uses. The inventory employed standard international protocols and methodology to determine metric tons of carbon dioxide equivalent ($MTCO_2e$) for three greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Emissions are generally broken down into scope 1, 2 and 3. Scope 1 emissions refer to in-boundary emissions, such as combustion of fuels for stationary use, such as heating offices and buildings, as well as mobile use, such as in-boundary transportation, both driving, flying and marine transportation with fuels extracted within the boundary. Industrial processes, such as mining as well as waste and wastewater, are also scope 1 emission. Scope 2 emissions refers to grid supplied energy, such as power. Since power is generated and sold within Juneau, the scope 2 purchased electricity, is already counted as scope 1 generation from hydroelectric and diesel. Scope 3 would include out-of-boundary emissions, like biosolids hauled to Oregon for disposal, transmission and distribution losses outside of boundary, any transportation outside of Juneau, or fueling of transportation vehicles outside of Juneau, as well as other indirect emissions, such as imported goods and services produced outside of Juneau.

This 2021 inventory, like the 2007 and 2010 study, is also limited somewhat by the quantity and quality of available data – since the data presented in this study were affected by certain assumptions regarding energy consumption and emissions across sectors and fuel types. The primary difference between the 2007, 2010 and 2021 inventories, is that liquid fuels data that was modeled based on economic activity in 2021whereas fuel companies provided the data in 2010. Future updates of the model used for 2021 can incorporate actual fuel data if it is provided.

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[1] "City and Borough of Juneau Greenhouse Gas Emissions Inventory for 2007," March 2009. https://juneau.org/wp-content/uploads/2017/03/Juneau_GHG_Inventory_for_2007_FINAL.pdf

[2] "2010 Greenhouse Gas Emissions Inventory: City and Borough of Juneau," November 2011, https://juneau.org/wp-content/uploads/2018/04/GHGinventory11_16.pdf

[3] In this inventory, Global Protocol for Community-Scale Greenhouse Gas Inventories (GHG) is used to determine energy consumption (e.g., fuel use, electricity use) and appropriate emission factors.

Comparing the 2021 inventory to the 2007 report, the current study found that total community wide energy consumption in 2007 was 7.2 million MMBtu, which generated 440,000 MT CO2e of GHG emissions – 50% of emissions from transportation, and 31% from buildings. The 2021 reductions from 2007 for energy was 33%, and for emissions 36%.

Applying these methodologies and analyzing the data set out in this report, this study found that Juneau consumed 4.8 million MMBTU of energy and released almost 280,802 MTCO2e in 2021—a significant decrease in both energy use of 6.3 million MMBtu, and 397,000 MT CO2e of GHG emissions from the levels reported in the 2010 inventory – a 23% and 29% reduction, respectively, despite a slight growth in population between the years. The two sectors that consumed the most energy— transport and buildings—produced 50% and 26% of GHG emissions respectively, accounting for almost 77% of the area-wide GHG emissions in 2021.

Energy Consumption in 2007 (MMBtu)	% MT CO2e in 2007		Energy Consumption in 2010 (MMBtu)	% MT CO2e in 2010		Energy Consumption in 2021 (MMBtu)	% MTCO2e in 2021
7.2 million	440,000		6.3 million	397,000		4.8 million	280,802
% Change from 2007						-33%	-36%
% Change from 2010						-23%	-29%

While it is very encouraging to see a large reduction in community GHG emissions from the years 2007, and 2010 to 2021, caution should be employed when trying to detect a trend based upon just three points in time. There are many factors that can impact a point in time GHG emission inventory including whether the fuel use is actual or modeled and 2021 was still impacted by the lagging effects of the COVID-19 pandemic. To detect a trend with higher confidence requires more years of comparison. CBJ may opt to complete additional GHG emission inventories in the future to make the data set more robust.

Community GHG emissions - 2021

Community energy and emissions analyses for the City and Borough of Juneau, AK (CBJ) were divided into the following sectors:

1. Transportation (both on-road, water borne and air transport)
2. Buildings and the built environment (both stationary combustion and purchased electricity),
3. Industrials processes
4. Solid waste treatment

Table 1 below provides data on total emissions from Juneau by sector and source (fuel type) as well as additional detail about each sector and source. This table and the following notes provide the information used to generate the 2021 community energy use inventory. The energy use information, combined with the emission factor information was used to generate the GHG emissions figures found here and used in the updated 2021 Juneau Greenhouse Gas Emissions. The population of CBJ increased by 1.8% from 31,387 in 2010 to 31,973 by the end of 2021.

Table 1. 2021 Community-wide GHG emissions

Sector	Fuel Type	Quantity	Units	MMBtu	%	$MTCO_2e$	% MT CO2e in 2007	% MT CO2e in 2010	% $MTCO_2e$ in 2021
	Heating Oil	6,572,542	gallons	910,025	19%	67,464	28%	22%	24.03%
	Propane	620,051	gallons	56,425	1%	3,498	1%	2%	1.25%
	Wood	1,175	cords	24,674	1%	2,510	2%	4%	0.89%
	Electricity	403,449	MWh	1,376,972	29%	2	1%	0%	0.00%
Built environment	**TOTAL**			**2,368,096**	**49%**	**73,475**	**32%**	**28%**	**26.17%**
	Propane	4,003	gallons	364	0%	23	0%	0%	0.01%
	Diesel Fuel	604,300	gallons	83,394	2%	6,218	14%	5%	2.21%
Greens Creek	Electricity	Included	MWh		0%	0	0%	0%	0.00%
	TOTAL			**83,758**	**2%**	**6,241**	**14%**	**5%**	**2.22%**
	Propane	204,785	gallons	18,637	0%	1,152	0%	0%	0.41%
Kensington[4]	Diesel Fuel	4,467,010	gallons	616,448	13%	45,749	0%	5%	16.29%
	TOTAL	**4,671,795**		**635,085**	**13%**	**46,901**	**0%**	**5%**	**16.70%**
Highway Transportation	Gasoline & Diesel	5,940,515	gallons	753,015	16%	55,039	25%	29%	19.60%
Air Transport	Ave Gas & Jet Fuel	3,909,528	gallons	522,259	11%	37,365	10%	9%	13.31%
Marine Transportation*	Gasoline & Diesel	4,800,000	gallons	464,960	10%	48,877	16%	17%	17.41%
	Electricity	764	MWh	2,606	0%	0	0%	0%	0.00%
Transportation	**TOTAL**			**1,742,840**	**36%**	**141,282**	**51%**	**55%**	**50.31%**
Waste	Waste		Metric			12,904		2%	4.60%
Total				**4,829,780**	**100%**	**280,802**			**100.00%**
Change from 2007				7,212,181 (-33%)		440,545 (-36%)			
Change from 2010				6,249,370 (-23%)		396,747 (-29%)			

**84% of marine transportation was due to cruise ships.*

4 AEL&P transmission and distribution system ends several miles from Coeur-Kensington

Figure 1 shows the total energy used by sector, including petroleum, wood, propane, and electricity.

FIGURE 1: 2021 COMMUNITY-WIDE ENERGY CONSUMPTION (SOURCE)

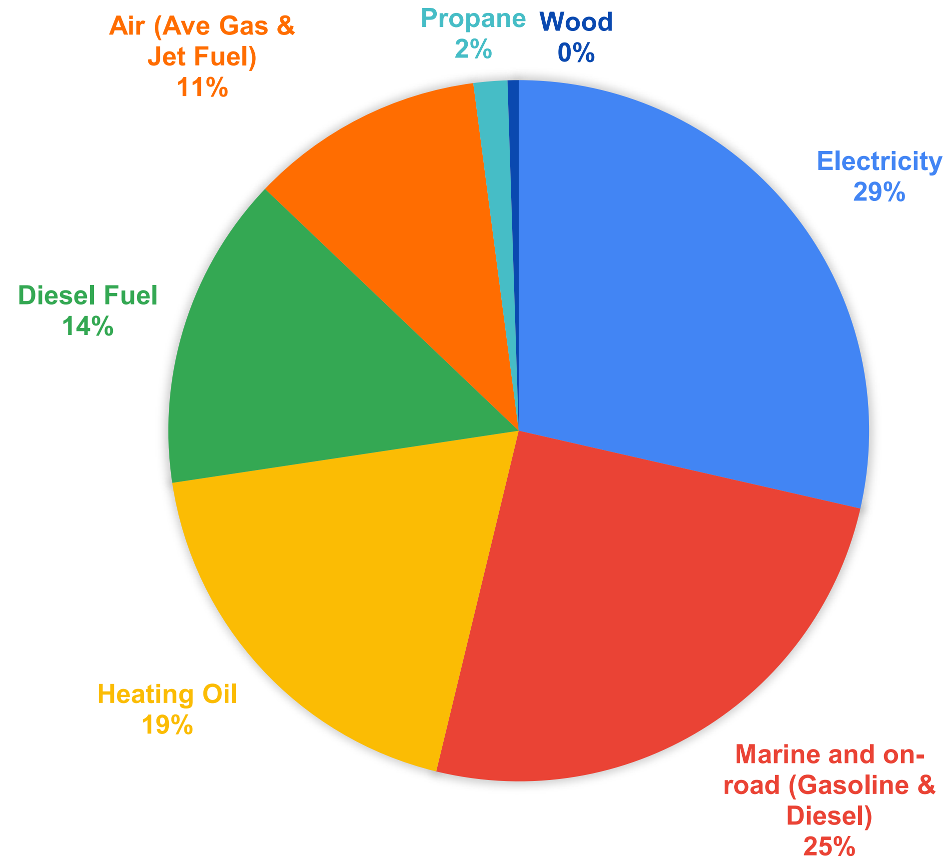
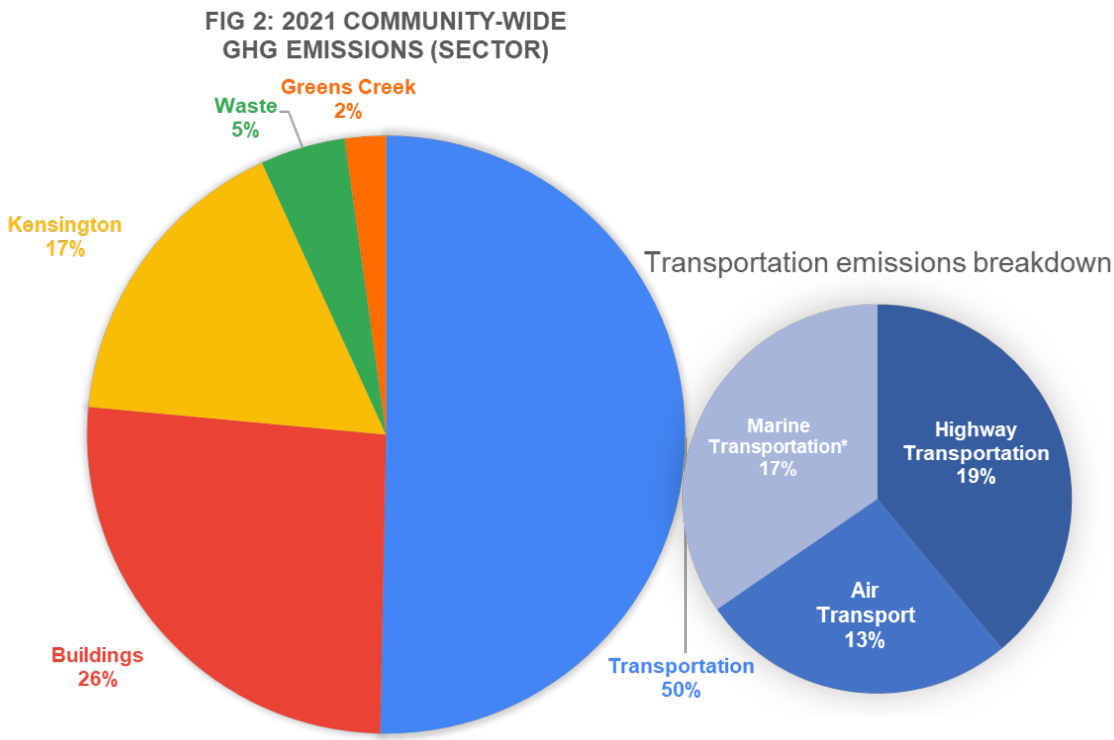


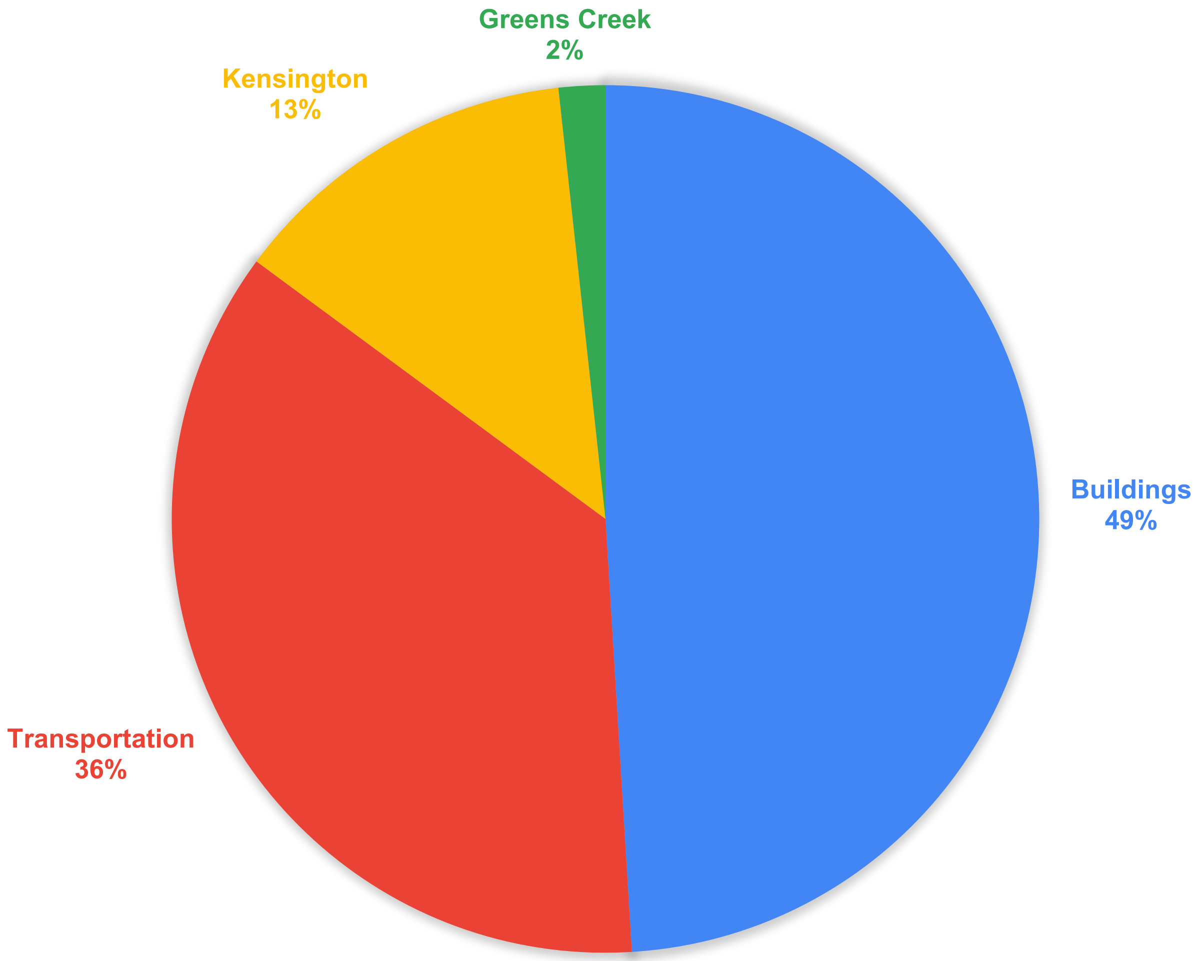
Figure 2 shows the emissions produced by each sector[5]. Energy use correlates to GHG emissions in most sectors, with the highest fuel consuming sectors, transportation and buildings, providing the greatest opportunity for future reductions in GHG emissions. In 2021, transportation contributed more than 50% of GHG emissions, with almost half (20%) coming from highway transport. Buildings produced almost 26% of community GHG, primarily from petroleum-based sources used for ventilation, space heating, and hot water.

[5] NOTE: Diesel fuel for industrial usage is shown in green, where heating fuel for stationary heating in buildings is shown in yellow. Diesel fuel for transportation is shown in combination (air and marine uses) in red, along with gasoline.



As the highest energy consumers, the transportation and building sectors will provide the greatest future opportunities to reduce energy use in Juneau. Buildings represent the greatest single energy consuming sector, accounting for 49% of total energy use, as shown in Figure 3. However, when highway, air, and marine transportation are aggregated, that combined transportation sector uses 36% of the community's energy. The borough's two large mines consume 15% of total energy.

FIGURE 3: 2021 COMMUNITY-WIDE ENERGY CONSUMPTION (SECTOR)



1. Buildings and the built environment: Includes energy types like electricity and fuels (diesel, propane, wood, etc.) which are in turn used in residential, commercial, and industrial buildings located within the community. Most emissions are from fuel used to heat buildings and provide hot water. Street and marina lighting was included in the built environment category, similar to building lighting, in terms of electricity usage. In 2021, liquid fuels consumption data was not provided by the respective fuel providers, as was the case in 2010 – this means that fuel actuals were obtained direct from primary data, whereas in 2021, fuel consumption was modeled based on activity.

For direct fuels for stationary use, unlike 2010 inventory where fuel data was directly available, a model was used that estimated energy use in BTU for the 2021 year. See Table 2.

Table 2. 2020 ACS survey estimates on CBJ heating fuel distributions.

Total occupied housing units	**12,922**	**100%**
Heating oil (Fuel oil, kerosene, etc.)	6,838	53%
Electricity	4,164	32%
Other	698	6%
Propane (Bottled, tank, or LP gas)	643	5%
Wood	242	3%

Heating oil refers to liquid fuels sold by suppliers and was estimated given fuel data was not available. A model was created that first evaluated the total heating-fuel based households in the CBJ boundary, from the American Community Survey (ACS) of the U.S. Census 2020. A similar approach was used for propane and wood. **Propane** also had historically included all propane sold by local distributors, like Amerigas and Arrowhead in 2010, and did not include propane delivered from outside Juneau to either mining operation. However, in 2021, due to the unavailability of this data, the same model was used as heating oil and fuel.

Wood energy data in 2010[6] and emissions calculations was based on the Alaska Department of Environmental Conservation Mendenhall Valley 2007 wood use survey extrapolated to the rest of the community. We applied a similar model[7] for both wood, propane and heating oil for the 2021 update – which included data for every building in the CBJ area, year-built, principal use of building, square footage and orientation, to estimate energy-use-intensity by fuel type.

Electricity includes almost all electricity sold by AEL&P in 2021, including electricity sold to cruise ships while docked in Juneau (538 MWh). In 2021, most electricity was produced by hydroelectric power with less than 0.2% provided by diesel fuel.

AEL&P provided data on consumption of electricity in 2021 within the CBJ boundary in MWh, broken down by major uses, such as residential, commercial (which included government and industrial customers) and transportation. According to supplier specific emission factors provided by AEL&P, the market-based scope 2 methodology resulted in 628.32 MT CO2e of emissions[8] which is a 6% decrease in electricity emissions, despite a 9% increase in total electricity consumption between 2010 and 2021. Please note, the location-based emission factors from the U.S. EPA for the ASCC Miscellaneous (AKMS) EGRID subregion, which includes CBJ, are 486 lbs./MWh or 0.24 MT CO2e/MWh. This EPA subregion is a compilation of several different islanded electrical utilities throughout the state of Alaska that are not interconnected, and so these emission factors do not accurately represent electricity production for the CBJ and therefore are not used in this analysis.

[6] By calculating the total number of households likely using wood from the 2020 ACS survey. The total number of households were used to understand the cords of wood used. Previously, a similar model was used in 2010 using survey data of households to estimate number of cords and pellets per household by the number of households, to determine total energy from wood used in MMBtu.
[7] https://www.energy.gov/eere/buildings/articles/energyplus
[8] Assuming the diesel emissions of 2.24 lbs. per kWh, or 0.00102 MT CO2e per kWh at 616,000,000 kWh of diesel generation reporting in CY2021.

Table 3. AEL&P 2021 downstream delivered electricity in CBJ sectors.

Sectors	kWh usage in 2021
Commercial	168,762,235
Residential	159,844,781
Government	74,842,124
Transportation	763,621

Table 4. AEL&P 2021 upstream generation of electricity for CBJ

Electricity generation CY 2021	
Diesel generation (MWh)	616
Hydro Generation (MWh)	431,652
Total Generation	432,268
% Diesel	0.14%
% Hydro	99.86%
Gallons of diesel combusted	51,408

2. Equipment: Includes gallons of fuel not used by motor vehicles licensed to operate on public ways and fuel for generators and construction equipment. The only equipment level emissions were already accounted for by generators operated by AEL&P, or industrial facilities and mining operations.

3. Transportation

Highway Transportation: This on-road transportation emissions included emissions from burning gallons of gasoline combusted by vehicles. While past GHG emissions from highway transportation are based on actual gallons provided by fuel distributors, given the lack of such data in 2021, a novel method to estimate vehicle miles traveled (VMT) was used, which was a recommendation in 2010.

Using the 2021 Average Annual Daily Traffic Count from the Alaska Department of Transportation & Public Facilities, the 2021 update estimated 152,063,352 miles of travel by passenger, light-duty and heavy-duty vehicles. In order to get 2021 vehicles by class codes, the inventory made use of the State of Alaska Division of Motor Vehicles' list of vehicles to determine the number of passenger cars and light and heavy trucks the inventory looked at data registered in the zip codes within City and Borough of Juneau on in December 2021, across Vehicle Class Codes. CBJ has a special attribute given its location, such that the lack of roads in or out of Juneau means that most fuels purchased in Juneau is used within borough boundaries. Since the assumptions regarding fuel usage across registered vehicles did not include electric vehicles, transportation emissions may be slightly skewed to gasoline and diesel. Electric vehicle charging was included as part of building electricity section.

Air Transportation: Emissions from air travel includes gallons of aviation gasoline and jet fuel provided by local distributors within CBJ. Generally, the fuel flowage records from the Juneau International Airport (JNU) based on reporting for the CBJ fuel flowage fee charged on all fuel sold at the airport is less than the combined amount from distributors, primarily due to less aviation gas being pumped at the airport than sold by distributors. However, in 2021, distributors' data on sold fuels were not available – so Juneau International Airport personnel provided data across all airlines and fuel types.

We also collected data on total enplanements from the Federal Aviation Administration (FAA) (306,512 enplaned passengers in 2021) with small carriers reporting directly to FAA, and not to JNU – which is why the 2021 data on enplanements was 253,170 passengers. Additionally, 1,594,283 tons of mail and 4,264,882 tons of freight being carried via the airplanes going out from CBJ. As a result, the total gallons of liquid fuels for 2021 was 3,909,529 – 170,530 gallons of aviation gasoline and 3,738,999 gallons of jet fuel, which overall was a 0.4% reduction from 2010 numbers. The 2021 sales of fuels were considered high given data over the past 7 years. There was 1.56 million gallons consumed in 2019, where consumption has typically ranged of 2.5-3 million gallons - generally affected by economic conditions, as well as varying purchasing policies of different airline companies that change year to year.

Marine Transportation: Historically, marine transportation emissions included all marine gasoline and diesel sold by the fuel distributors in Juneau, AK. These figures included fuel for the Alaska Marine Highway and other marine fuel pumped in Juneau, but did not include the fuel used to ship goods to Juneau or fuel used by cruise ships. In the 2021 update, due to no data provided by fuel distributors, an alternative process was used.

According to the GHG protocol for local governments, calculating scope 1 emissions, which refers to emissions from direct combustion of fossil fuels for all riverine trips, by marine ferries and boats traveling between seaports that originate and terminate within the CBJ boundary. The 2021 inventory first collected data at the Port of Juneau that had partial data for the major locations of activity for in-boundary CBJ marine fuel usage.

Table 5: Port-provided estimation for 2021

Location	Type	2021 data (gallons)
Rock dump	Petro Marine Fuel Dock	None
Bridge	Petro Marine Fuel Dock	Approx. 1.15 million
Harbor	Petro Marine Fuel Dock	885,000
Gitkof dock	Delta Western Fuel Dock	Approx. 1.15 million
Auke Bay Loading Facility	Fuel Truck Delivery	55,000
Seadrome Dock	Fuel Truck Delivery	240,000
Total		**3.45 million gallons**

Table: Port of Juneau, AK estimates of 2021 fuel gallons for marine transportation

Since it was not possible to obtain complete total real fuel sales estimates of fuel loaded onto marine vessels by inquiring with shipping companies or fuel suppliers, data was partially collected from some of the individual port and marine authorities within CBJ. State level data for Juneau from 2017, which was the latest year available from the state, was also requested and accessed, across the various vessel types:

Table 6: State-provided data for the last year of record

Category	Total gallons in 2017
Bulk Carrier	956
Cruise Ships – Diesel	4,149,642
Cruise Ships – Gas Turbine	244,203
Ferries	557,548
Fishing – Diesel	232,173
Fishing – Gasoline	29,171
Tugs	8,742
Total	**5,222,435**

Table: State of Alaska estimates of 2017 fuel gallons for marine transportation[9]

Additionally, private data was also acquired to identify the main drivers of marine activity at CBJ boundary, particularly, tonnes of freight and number of people across vessel types within the 2021 calendar year.

The main source of vessel traffic information for the vessel types, is the AIS SHIPTYPE number broadcast through AIS, which is sometimes updated with reliable third-party information – mostly for IMO registered vessels. The classification is reliable, except for small vessels, without IMO numbers, the informational integrity is a function of the crew's inputs to the AIS transponders. Records of port calls included a list of arrivals to and departures from Juneau in 2021, with deadweight (the maximum weight of cargo in metric tonnes) of cargo and passenger vessels, and with the previous and next port information, as well as nautical miles travelled. Cargo vessels include containers, dry bulk, etc., and during the 2021 calendar year there were only four calls belong to 'Cargo' type. Tankers were not included in this category, as there were no port calls for tankers in the 2021 period. Passenger vessels include larger tourist cruise ships as well as smaller passenger vessels. Based on the tons and nautical miles of all the vessels leaving Juneau, in 2021 – for an estimated 4.8 million gallons equivalent of fuel consumption. 538 MWh of electricity was consumed by cruise ships in 2021, which was reduced significantly from 6,304 MWh in 2019, likely due to the global pandemic that began in 2020.

5. Industrial processes

Greens Creek Mine: The Hecla Greens Creek Mining Company operates on Admiralty Island near Juneau. This report uses information from EPA for Greens Creek consumption information for electricity, propane, and diesel fuel used for equipment and non-highway vehicles, heating, and hot water.[10] In 2021, Greens Creek Mine used 0.604 million gallons of Distillate Fuel oil (#2), 4,003 gallons of propane, as well as 38,000 gallons of used oil, emitting the 6,603 metric tons of total emissions. Between 2007 and 2010 Greens Creek GHG emissions reduced by 67%

[9] U.S. EPA (2020). Technical Support Document (TSD) - Preparation of Emissions Inventories for 2016v1 North American Emissions Modeling Platform - September 2020, page 60. For in CBJ (FIPS code 02110) in-boundary fuel-based emissions.

[10] A full GHG annual report is available for the company at https://www.hecla.com/wp-content/uploads/2021-Hecla-Sustainability-Report.pdf, listing overall mobile fuel use at just over 1 million gallons of diesel and 12,000 gallons of gasoline.

by shifting from self-generating electricity with diesel to using hydropower from the new Lake Dorothy hydropower project.

Kensington Mine: The Coeur Alaska Kensington Gold Mine operates at the northern end of the City and Borough of Juneau in the vicinity of Berners Bay. The mine started production in June 2010. Kensington supplied information on diesel fuel and propane for stationary use (as reported to the U.S. Environmental Protection Agency) in 2021. Kensington's reported diesel fuel includes stationary fuel used for generators, non-highway vehicles, heating, and incinerators. Kensington Gold Mine had used 4.47 million gallons of Distillate Fuel oil (#2) as well as 204,785 gallons of Liquified Petroleum Gas (LPG) and emitted 46,917 metric tons of CO2e, which increased drastically (2.5x) from 2010 – at 18,285 metric tons. It is to be noted, that this significant difference from 2010 was due to the fact Kensington had just opened, and the energy use for that year reflected only half year of their regular operational activities.

6. **Waste:**

Juneau's privately owned solid waste landfill is located in the Lemon Creek area and includes municipal solid waste and construction/demolition debris deposited in the Capital Disposal landfill. As a point of note, Capital Disposal landfill provided total waste tons for 2007 and 2010, divided into types of waste (paper products, food waste, plant debris, wood or textiles, and all other waste). The metric ton equivalent was determined using the following standard formula, assuming 1 short ton is 0.90 metric tons with the methane coefficients applied for each type of waste. Finally, the EPA national default value for the efficiency of methane collection (75%) was applied, with an assumed 1% of methane collected escaping during the flaring process.

In 2010, amounting to 25,310 metric tons of waste (28,121.6 short tons) resulting in 26,892 metric tons of CO2e, which included 75% capture of methane through the passive flare system (with 1% of the 75% escaping) – a methodology that had changed such that waste emissions are no longer factored as net zero. This adjustment resulted in 6,925 metric tons of emissions with flaring. In 2007, total annual waste added to the landfill was 33,277 short tons, equal to 29,949 metric tons, resulting in 31,823 MT CO2e of emissions which were 8,194 metric tons with flaring – resulting in an 18% reduction. In 2021, Capitol Disposal Landfill emitted 12,904 mt CO2e[11] which decreased significantly from the 2010 amounts of which was 26,893 mt CO2e. and a 6,925 mt CO2e w/flare. This was due to 1,539 MMBtu of diesel use, as well as 3066 MMBtu of used oil use, contributing to 341 metric tons of CO2e in 2021 for stationary combustion. Additionally, 12,562 metric tons of CH4 were emitted from the landfill decomposition and processing of both organic and inorganic materials, from municipal solid waste and construction or demolition debris, into the atmosphere, accounting for a combined 12,904 metric tons of CO2e. The normalized comparison is between 12,904 mt CO2e in 2021 which is 48% of the 26,893 mt CO2e in 2010 (an eleven-year period), was already on a reduction trajectory over a three-year period from 18% in 2007.

Operational GHG emissions for CBJ government – 2021

[11] According to the U.S. EPA Facility data

The table provides data on total emissions from CBJ by sector and source (fuel or electric). This table and the following notes provide additional information used to generate the 2021 operational government energy use findings. The energy use information, combined with emission factor determinations under the GHG local government protocol was used as the basis for the methodology used to generate GHG emissions findings for this report based on 2021 data. Local government energy consumption and emissions analyses were divided into the following sectors, keeping in line with 2007 and 2010 inventories:

1. Facilities;
2. School facilities;
3. Wastewater treatment and drinking water;
4. Capital transit; and
5. CBJ vehicle fleet.

Government consumption and emissions data have been included in the above community-wide calculations. However, the unique ability of local government to gather building, fleet, and department-specific data, as well as the government's enhanced ability to abate emissions through direct agency action, warrants the following separate analysis. The 2010 community GHG report also included a separate analysis of local government. Government facilities, including schools, accounted for 62% of all local government energy consumption in 2010 and accounted for 73% in 2021. Facilities, schools, and wastewater treatment plants produced 73% of government GHG emissions in 2010, vs 91% in 2021.

In 2010, the transportation sector produced 27%, while the CBJ wastewater treatment plant alone produced 13% of local government GHG emissions – however in 2021, the transportation sector produced 9% and wastewater 19% respectively. The 2021 GHG increases, compared to 2010, are driven mostly by schools and the biosolids dryer used at the wastewater utility. The Mendenhall Wastewater Treatment Plant prior to 2019 averaged about 80,000 gallons of fuel per year. Usage increased in 2019 when biosolids dryer came online. As production increased, fuel usage increased with an estimated attribution of 128,000 gallons annually. Similarly, energy usage in schools increasing after COVID could be attributed to increased amount of outside air being brought into facilities, correlating with increased fuel usage. In terms of electricity specifically, there are several electric-only facilities that have come online, as well as certain facilities converted to heat pumps since the 2010 GHG report. For instance, Dimond Park Aquatic Center and Mendenhall Valley Library accounts for a high proportion of the electricity increase.

Fleet energy and emissions included all fuel use (diesel and gasoline), provided by CBJ from an internal database tracking gallons of diesel and gasoline used by department. An alternative data source for vehicle fleet was gallons purchased (CBJ Purchasing Division); however, because CBJ indicated that the fleet database (Consumption Statistics) is a more accurate accounting of vehicle fleet fuel usage, the fleet database was used. The emissions factors for calculating metric tons of carbon dioxide equivalent (MTCO2e) for all CBJ vehicles (fleet and Capital Transit) use of gasoline and diesel included carbon dioxide (CO2) figures from local government emission factor databases. This list includes both on-road and off-road vehicles such as automobiles, trucks, Capital Transit buses, and miles driven, as well construction equipment for operational hours. In 2021 however, each vehicle had a departmental code that could be linked to other non-fleet departments, versus lumping all fuel consumption by vehicles to fleet.

This was due to data availability for vehicles, at the wastewater level (and other facilities) which were ascribed generically to fleet in 2010. As a result, direct comparison between departmental boundaries from 2010 to 2021 could be difficult, despite being more accurate representation of departmental emissions breakdown using 2021 categories. Items like government-operated lighting and water pumping, which ran on electricity in 2010, contributed essentially nothing to the government's share of area-wide GHG emissions. For 2021, lighting electricity usage was not broken down by AEL&P and were added to facilities overall power consumption.

These data trends highlight that an emphasis on increasing energy efficiency and decreasing fuel consumption related to buildings, transportation, and wastewater treatment will be key to reducing both annual government operating expenditures and area wide GHG emissions in the coming years.

Energy use and data collection

Electricity and petroleum fuel (mostly diesel, fuel oil and gasoline) use in facilities, schools, wastewater and drinking water treatment, Capital Transit, and the vehicle fleet were analyzed from data sources by department. Data for CBJ electric meters was obtained from AEL&P as well as Portfolio Manager software system maintained within CBJ, whereas data for CBJ fuel tanks was obtained from CBJ reports. Facility and department name were added to the meter specific information from AEL&P. The detailed list of CBJ tanks (provided by tank number by CBJ) was paired with the fuel provider information, using tank numbers, provided usage by facility, department, and fuel type. Each tank was associated with a source (vehicle fleet, facilities, or wastewater treatment) and with a department. Similar emission factors assumptions are made for operational footprint, as were the community estimations.

All energy data were provided by CBJ, except for scope 3 data around employee commute – which, in addition to emissions related to business travel conducted in 2021, were not items that were tracked in previous inventory years, 2007 and 2010. In the 2010 report, recommendations were made in terms of how to accommodate a more accurate picture of GHG emissions from both the CBJ fleet and community fleet. First, in 2021, the annual mileage for each CBJ vehicle and equipment were tracked, in addition to the consumption in terms of miles driven or hours operated. The exact type of fuel each vehicle and equipment use were also recorded. For community emissions, the State of Alaska Division of Motor Vehicles registration data by zip code and type (see community section for more details) were used.

Overall, local government accounted for 4.5% of community -wide energy consumption and produced a little over 3% of area-wide GHG emissions in 2010, compared to 6.6% and 4.96% in 2021 – being slightly higher as a portion of community emissions attributable to government operations even as the number of employees increased over this period. The CBJ government purchased about 1.25 million gallons of fuel in 2010 and almost 37.4 million kilowatt hours of electricity, compared to 1.38 million gallons of fuel and 37.4% in 2021 – given an approximately

5% increase in CBJ full time equivalents from 463 in 2010 to 486 in 2021. Table 7 also summarizes the portions of emissions attributable to specific departments[12] within CBJ.

[12] General government included Centennial Hall, City Hall, libraries, and miscellaneous other city facilities. Lighting under the 2010 and 2007 category included street lighting, traffic signals, and all docks and harbors meters– both dock/marina lighting and private boat electricity use, which were not broken down by AEL&P in 2021.

Table 7: CBJ Operational emissions summary 2021

	FUEL			ELECTRICITY			Total			
Sector	**Gallons**	**MMBtu**	**MT CO2 e**	**KWh**	**MMBtu**	**MT CO2e**	**Total MMBtu**	**Total MTCO2e**	**% MTCO2e**	**% in 2010**
School Facilities	393,668	54,326	3,993	7,289,021	24,877	7	79,203	4,000	29%	21%
OTHER FACILITIES										
Hospital	250,358	34,549	2,547	6,021,139	20,550	6	55,099	2,553	18%	18%
Airport	19,173	2,646	193	3,174,334	10,834	3	13,480	196	1%	6%
Parks & Recreation	108,219	14,934	1,016	4,073,743	13,904	4	28,838	1,020	7%	6%
Public Works	50,937	7,029	497	2,239,370	7,643	2	14,672	499	4%	2%
General Government	24,499	3,381	247	3,344,780	11,416	3	14,797	251	2%	2%
Fire	69,291	9,562	691	634,976	2,167	1	11,729	691	5%	3%
Police	47,914	6,612	449	536,435	1,831	1	8,443	450	3%	1%
Harbors	15,602	2,153	152	1,473,797	5,030	2	7,183	154	1%	0%
Total	***979,661***	***135,193***	***9,784***	***28,787,595***	***98,251***	***29***	***233,444***	***9,814***	***71%***	***39%***
EQUIPMENT NON-FACILITY										
Wastewater	264,199	36,459	2,675	6,484,462	22,131	7	58,591	2,681	19%	13%
Water	12,759	1,761	118	1,750,513	5,974	2	7,735	119	1%	0%
Lighting	-	-	-	-	-	-	-	-	0%	0%
Total	***276,958***	***38,220***	***2,792***	***8,234,975***	***28,106***	***8***	***66,326***	***2,801***	***20%***	***13%***
FLEET[13]										
Capital Transit	127,572	17,605	1,297	230,000	785	0	18,390	1,297	9%	11%
Vehicle Fleet	463	64	4	105,305	359	0	423	4	0.03%	16%
Total	***128,036***	***17,669***	***1,301***	***335,305***	***1,144***	***0***	***18,813***	***1,301***	***9%***	***27%***
TOTAL	**1,384,654**	**191,082**	**13,878**	**37,357,875**	**127,501**	**38**	**318,584**	**13,916**	**100%**	
Change since 2010	11.08%	11.08%	10.67%	-0.21%	-0.21%	-43.13%	15.70%	10.49%		

Note: In 2010, the total operational emissions were calculated to be 12,594 MT CO_2e. For 2021, the total operational emissions increased to 13,916 MT CO_2e using the market-based scope 2 accounting, representing a 10.5% increase. Additionally, Scope 3 items such as business travel (70.89 MT CO_2e) and employee commute (1,411.35 MT CO_2e), which were not included in the past inventory of 2010, were estimated using departmental finance and imputed HR data – 1,482 MT CO_2e in 2021.

[13] Fleet vehicles and equipment, and their operational ownership or use attribution by various CBJ departments may have been different than past inventories.

CONCLUSION AND RECOMMENDATIONS

The 2021 GHG emissions inventory reveals that both energy use and GHG emissions for the overall community decreased compared to the 2010 inventory. However, while comparing the two non-consecutive years of information over an 11-year periods provides two data reference points, it does not enable us to define a trend. When comparing snapshots of energy use and GHG emissions from two nonconsecutive years, it is important to identify variables that may have influenced energy use and GHG emissions in each of the two years but that may not necessarily signify a trend in altered consumption dynamics. These include factors like relative discrepancies in the availability, accuracy, and reliability of collected data, revisions in the emission measurement framework, variations in economic productivity, differing degree heating days,[14] and the construction or demolition of buildings.

Obtaining additional reference points over the coming years would enable the borough to identify areas of lasting improvement more readily than we can here, given the gaps in the years separating the collected data sets and only three data sets. To accurately identify trends in area-wide energy use and the production of GHG emissions, it is recommended that annual community-wide energy use and GHG emissions inventories be conducted for five consecutive years. After usage and emissions patterns and the effectiveness of abatement efforts have been determined through analysis of these consecutive years of data using the most similar methodology, it will be possible to determine whether inventories will continue to need to be conducted annually or biennially.

As the local, state, and federal governments continue to move forward with energy efficiency and conservation measures, consideration should be given to breaking out the buildings energy use and GHG emissions sector into three separate categories—such Residential Buildings, Government Buildings and Commercial Buildings—in order to better identify and address energy-related dynamics in each of these areas – as such energy use analyses of specific buildings will help in determining which buildings would produce the greatest energy savings from weatherization, energy system upgrades and other retrofitting. CBJ departments specifically, should continue to track and keep records of energy use and costs and operational GHG emissions, by department and, where building or system energy audits are completed, by building and/or system. In addition, obtaining an accurate accounting of square footage for these types of buildings will help in determining energy per square foot and comparisons among buildings in Juneau.

[14] The heating degree days (HDD) for 2021 were 8659, compared to 8074 for 2010 and 8656 for 2007- as such, such year-to-year variations introduce differences in GHG driven by energy use associated with greater demands. HDD will continue to be the dominant issue as heating load (demand) has a significant impact on fuel use. Juneau's electrical demand peaks in the winter, and that would translate to other direct fuels as well. Although it could change in the future with rising temperatures, CDD impacts are negligible in Juneau given there are few occurrences, with air conditioning load being uncommon. Beyond Juneau, where climates are warmer, the summer tends to be the season when loads peak because of air conditioning.