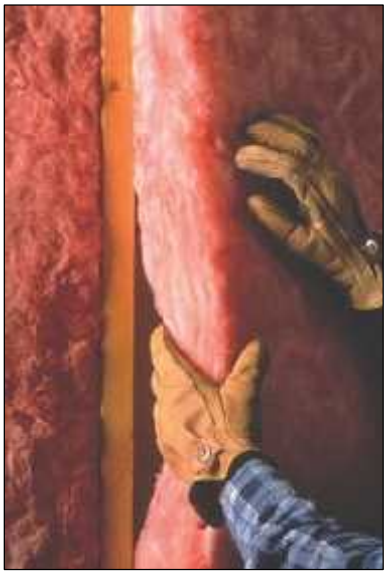
2010 Greenhouse Gas Emissions Inventory

City and Borough of Juneau



November 2011

Acknowledgements

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Karen Crane (CBJ Assembly)
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1. EXECUTIVE SUMMARY

In 2007, the City and Borough of Juneau, Alaska, completed its first greenhouse gas (GHG) emissions inventory in an effort to assess opportunities for reducing GHG emissions. The initial inventory quantified energy use by and emissions from both CBJ government facilities and sources in the community at large. This report on Juneau's GHG emissions updates the 2007 baseline information with 2010 energy use and GHG emissions data. As in the 2007 report, this accounting is limited to Juneau's *internal* energy economy (energy consumed within the community's boundaries) and excludes *external* energy consumption related to activities essential to the economy and sustenance of the community such as fuel purchased outside of Juneau for barge and air transport, cruise ships, etc.[1]

Because of its geophysical isolation, Juneau's *internal* energy economy is somewhat unique. Unlike most communities, Juneau's boundaries are sharply demarcated by geological features that create a contained situation amenable to accurate energy use inventorying based on information from local sources such as fuel distributors, the sole electrical utility (Alaska Electric Light and Power Company—AEL&P), the airport, and the area's two large mines. 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[2] used to determine metric tons of carbon dioxide equivalent (MTCO2e)[3] for three greenhouse gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

Applying the methodologies and analyzing the data set out in detail in appendices I through VIII, this study found that Juneau consumed 6.3 million MMBtu[4] and released almost 397,000 MTCO2e in 2010 (*see* Table 1)—a significant decrease in both energy use and GHG emissions from the levels reported in the 2007 inventory.

[1] Juneau's external energy use has been estimated to be approximately 103,200,000 gallons of fuel (over twice the community's estimated internal fuel consumption). William Leighty, personal communication, 2010.

[2] In this inventory, ICLEI's Local Government Operations Protocol (LGOP) is used to determine energy consumption (e.g., fuel use, electricity use) and appropriate emission factors. See Appendices for more detail on calculating GHG emissions, determining emission factors used in 2010, a comparison with 2007 emission factors, and energy used.

[3] CO2e is an abbreviation for carbon dioxide equivalent, the internationally recognized measure of greenhouse gas emissions. This measure is used worldwide to report the equivalent weight of carbon dioxide in metric tons (MTCO2e) (1,000 kilograms or 2,205 pounds). The global warming potential from each greenhouse gas is based on the amount of carbon dioxide that would have the same global warming potential measured over a specified time period.

[4] MMBtu is a unit of energy (one million British thermal units); in this report, units of fuels, electricity, and wood have been converted to MMBtu for purposes of comparison.

TABLE 1. JUNEAU'S TOTAL ENERGY USE AND GHG EMISSIONS 2007 & 2010			
	2007	2010	% Change
Energy Use (MMBtu)	7,212,181	6,249,370	-13%
GHG Emissions ($MTCO_2e$)	440,545	396,747	-10%

As shown below in Table 2, the two sectors that consumed the most energy—highway transport and buildings—produced 29% and 28% of GHG emissions respectively, accounting for almost 60% of the area-wide GHG emissions in 2010.

TABLE 2: JUNEAU'S TOTAL ENERGY USE AND GHG EMISSIONS BY SECTOR FOR 2010			
Sector	MMBtu	MTCO2e	%MTCO2e
Buildings	2,516,135	111,963	28%
Equipment & Non-Highway	285,772	20,477	5%
Greens Creek	471,540	19,735	5%
Kensington[5]	246,824	18,285	5%
Highway Transport	1,563,245	114,261	29%
Air Transport	519,836	37,192	9%
Marine Transport	646,020	67,910	17%
Waste[6]	0	6,925	2%
TOTAL	6,249,370	396,747	100%

Data presented in this study were affected by certain assumptions that must be made when quantifying energy consumption and emissions from that consumption by sector and in identifying emissions factors and calculating MTCO2e. This inventory, like the 2007 study, is also limited somewhat by the quantity and quality of available data. In light of these limitations, we advise readers to use findings reported in the 2010 community and local government GHG emissions inventory as close approximations rather than precise values.

This update begins with a general discussion of the 2010 findings for the City and Borough of Juneau's community-wide and local government energy consumption and GHG emissions and goes on to present a comparative analysis of the 2010 and 2007 inventories.

[5] Coeur Alaska reported energy usage and emissions only for stationary equipment at Kensington Mine, as required by U.S. EPA; other energy usage and emissions associated with the Kensington Mine are included in the equipment and buildings categories.

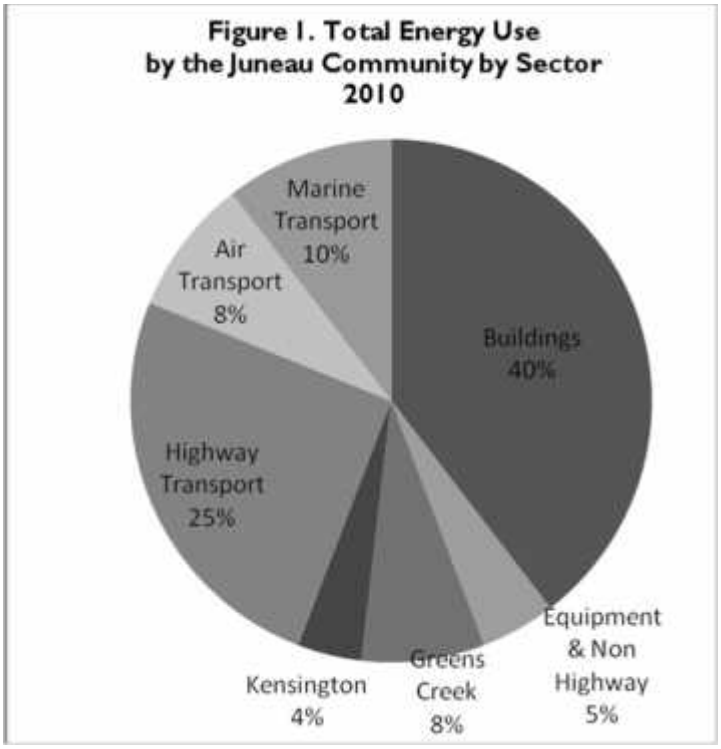
[6] See Appendix V for discussion of waste emissions.

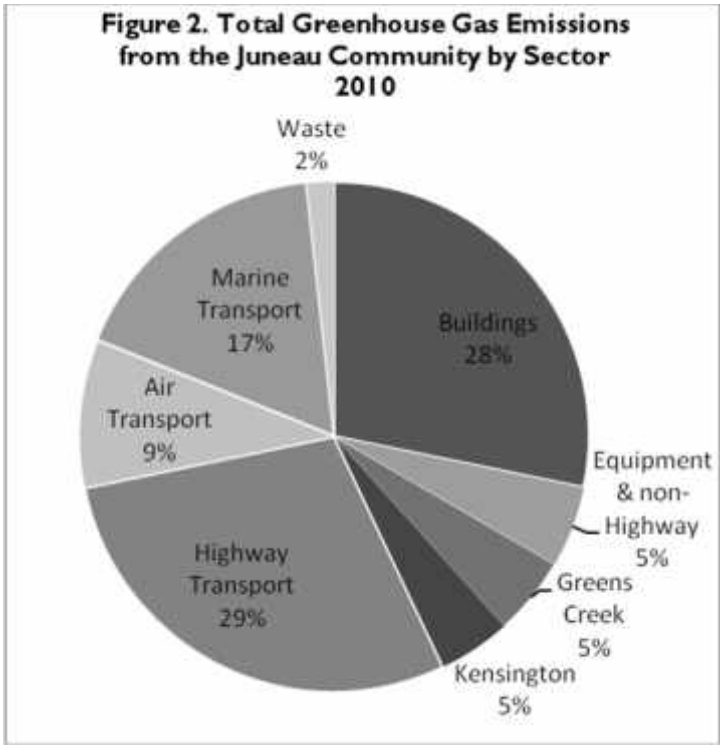
2. RESULTS OF THE 2010 INVENTORY

Community-at-Large Energy Use and GHG Emissions

The figures below summarize 2010 data for the Juneau community at large. Figure 1 shows the total energy used by sector, including petroleum, wood, propane, and electricity. As the highest energy consumers, the building and transportation sectors will provide the greatest future opportunities to reduce energy use in Juneau. Buildings represent the greatest single energy consuming sector, accounting for 40% of total energy use. However, when highway, air, and marine transportation are aggregated, that combined transportation sector uses 43% of the community's energy. The borough's two large mines consume 12%, and equipment & non-highway vehicles use another 5%.

Figure 2 shows the emissions produced by each sector. Energy use correlates to GHG emissions in most sectors, with the highest fuel consuming sectors, buildings and transportation, providing the greatest opportunity for future reductions in GHG emissions. In 2010, transportation contributed 55% of GHG emissions, with over half (29%) coming from highway transport. Buildings produced 28% of community GHG, primarily from petroleum-based sources used for ventilation, space heating, and hot water. Comparing the area's two large mines, Greens Creek was found to have consumed about nine times more energy than Kensington in 2010, an excess largely accountable to Kensington having not begun full production until late June of that year. However, despite the wide discrepancy in their relative energy consumption, the two mines contributed approximately the same portion of the area's GHG emissions (5% each) in 2010. The gap between Greens Creek's high energy consumption





and its low GHG emissions is attributable to the mine's having converted from diesel to hydroelectric power following the installation of an undersea cable from the mainland in 2006.[7]

Figures 3 and 4 illustrate, respectively, total energy consumption and GHG emissions by type of energy. As in the case of the Greens Creek mine, discussed above, these findings demonstrate the role of hydropower in lowering area-wide GHG emissions, especially in years when very limited diesel is used to supplement hydropower generation, as was the case in 2010. Still, that year, petroleum-based fuels supplied 75% of Juneau's energy and accounted for 92% of area-wide GHG emissions, while hydroelectric sources supplied 20% of the area's energy and produced virtually no emissions. (The remaining 8% of GHG emissions came from waste, wood, and propane use.) These figures highlight the need for Juneau to focus on both reducing overall energy use and moving away from petroleum-based fuels in favor of non-emitting sources.

Figure 3. Total Juneau Community Energy Use by Source 2010

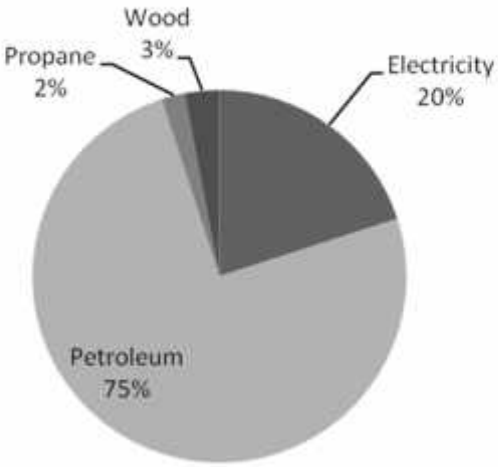
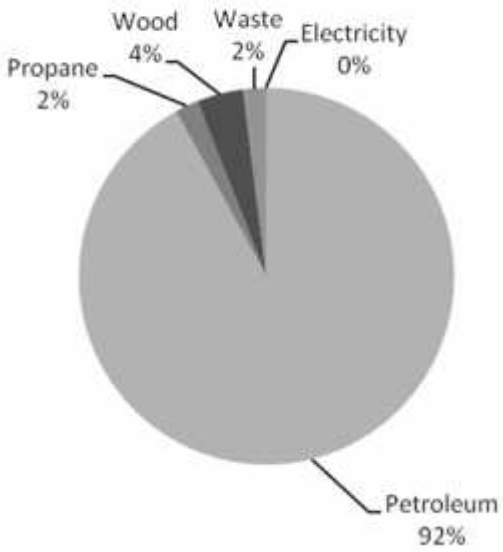


Figure 4. Greenhouse Gas Emissions from the Juneau Community by Source, 2010

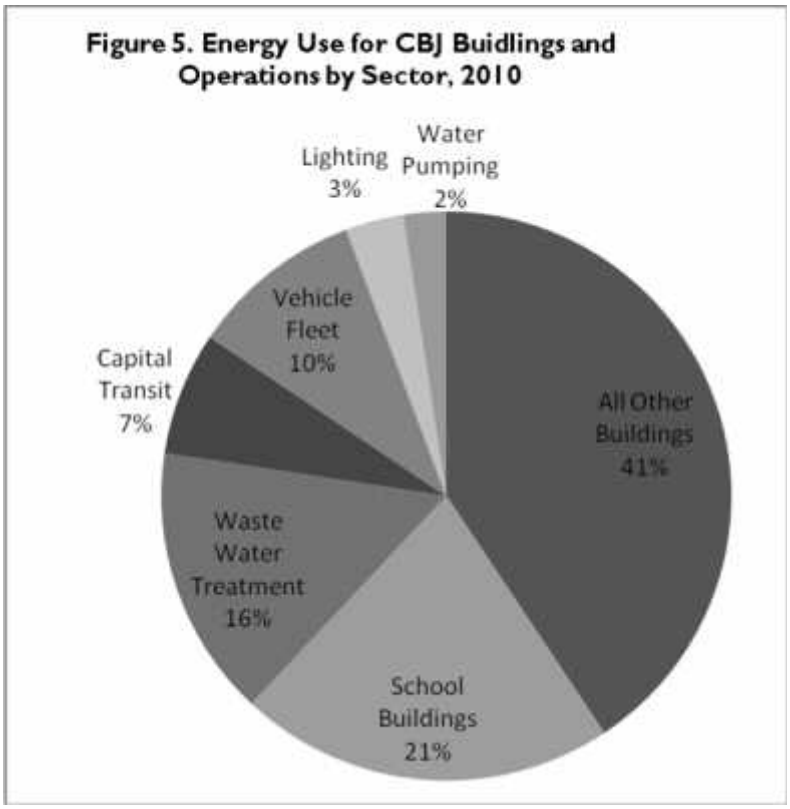


Local Government-Related Energy Consumption and GHG Emissions

Overall, local government accounted for 4.5% of area-wide energy consumption and produced a little over 3% of area-wide GHG emissions in 2010. The CBJ government purchased about 1.25 million gallons of fuel in 2010 and almost 31 million kilowatt hours of electricity. Figure 5 illustrates the local government's 2010 energy use and Figure 6 shows greenhouse gas emissions, each by sector.

[7] Greens Creek's use of hydroelectric power is limited to those times when AEL&P has surplus electricity.

Government facilities, including schools, accounted for 62% of all local government energy consumption in 2010. Transportation, including Capital Transit and the CBJ's vehicle fleet, used 17% of total local government energy, with waste water treatment accounting for 16%. These data instruct that an emphasis on increasing energy efficiency and decreasing fuel consumption related to buildings, transportation, and waste water treatment will be key to reducing both annual government operating expenditures and area-wide GHG emissions in the coming years.



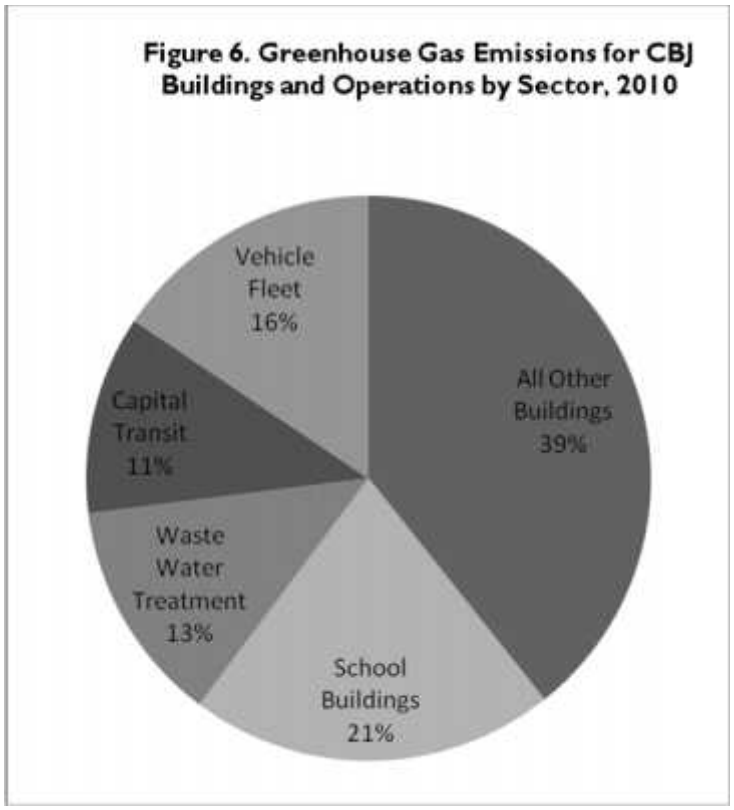


Figure 6 presents City and Borough of Juneau government GHG emissions in 2010. Facilities, schools, and waste water treatment plants produced 73% of government GHG emissions that year. The transportation sector produced 27%, while the CBJ waste water treatment plant alone produced 13% of local government GHG emissions. In contrast, government-operated lighting and water pumping, which run on electricity, contributed essentially nothing to the government's share of area-wide GHG emissions.

Additional information on community and local government emissions for 2010 compared to 2007 is provided in the following sections. Specific emissions factors used in the 2010 inventory update and earlier 2007 study, along with further information on disaggregated energy use and GHG emissions, can be found in the appendices.

3. COMPARISON OF 2007 AND 2010 GREENHOUSE GAS INVENTORIES

Introduction

In this section, information gathered on 2010 energy use and GHG emissions is compared with patterns reported in the 2007 inventory.[8] 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 Local Government Operations Protocol (LGOP) for measuring emissions, variations in economic productivity, differing degree heating days, and the construction or demolition of buildings.

Some specific variables that should be noted when comparing 2007 and 2010 consumption and emissions data for purposes of assessing trends in energy use and GHG emissions in the Juneau area include:

- **Snowfall.** In 2007, more than twice as much snow fell on the area than in 2010. 2007 - 125.7 inches of snow; 2010 - 62.9 inches of snow.[9]
- **Heating degree days (HDDs).** 2010 was warmer, with 8656 HDDs compared with 8074 HDDS in 2010.[10]
- **Reservoir water levels.** Availability of water throughout the year for hydropower generation determines, in part, the amount of diesel generation required to augment hydropower. Due to relatively low reservoir levels in 2007, AEL&P burned significantly more diesel to generate electricity that year than in 2010.
- **Fuel costs.** The 2007 heating fuel cost average for the CBJ area was $2.43/gal; that price increased to $2.86 per gallon in 2010. In 2007, the fleet fuel average for the CBJ government was $2.40/gal; the price increased to an average of $2.97 per gallon in 2010. The price of heating fuel increased by 21% in 2010 over 2007, and the price of fleet fuel (gasoline and diesel) increased 18%.[11]

[8] City & Borough of Juneau Greenhouse Gas Emissions Inventory for 2007, City & Borough of Juneau, March 2009.

[9] *See* NOAA climate database at http://pajk.arh.noaa.gov/cliMap/climap.php.

[10] Each day, AEL&P records the heating degree day (HDD) information from the NOAA weather service. The two numbers cited here represent the total of the HDD values from every day in years 2007 and 2010. HDD is calculated by taking the average of a day's high and low temperatures, subtracting that average from 65, and adding the resulting numbers greater than zero together for the year; the higher the number the colder the year.

[11] Fuel costs are based on the average price per gallon for heating fuel and fleet fuel for CBJ for 2007 and 2010.

- **New facilities and construction projects.** Major undertakings like the Kensington Mine, Thunder Mountain High School, and Lemon Creek overpass construction projects and the Juneau International Airport renovation used high quantities of fuel.
- **Changes in LGOP protocols for measuring emissions.**[12] Although it should be noted that several of the LGOP protocols used to measure emissions changed slightly between the 2007 and the 2010 reports (e.g., increases in stationary diesel, fleet fuel, and heating fuel, and decrease in propane), the overall effect of these adjustments on GHG emission calculations for any sector was minor (less than one percent).
- **Data availability**. Changes in fuel tax structures have resulted in some of the fuel distributors in town altering the way these businesses record and report sales of different fuels. Sources for the data collected in 2010 however remained sufficiently similar to support comparison to the sales-based data in the 2007 report.

Over the years 2007 to 2010, energy conservation and efficiency in the Juneau area improved due in large part to the following developments:

- Reduction in electricity use and other energy consumption habits in the wake of the 2008-2009 avalanches and resulting energy use awareness campaign.
- Decreases in petroleum fuel consumption incentivized by rising fuel prices and the availability of more fuel efficient vehicle choices.
- Tax incentives and rebate programs for energy efficient appliances, commercial and home heating system retrofits, etc.
- Home weatherization incentives, primarily the Alaska Housing Finance Corporation's weatherization rebate program, which has led to a reduction in residential consumption of fossil fuels.

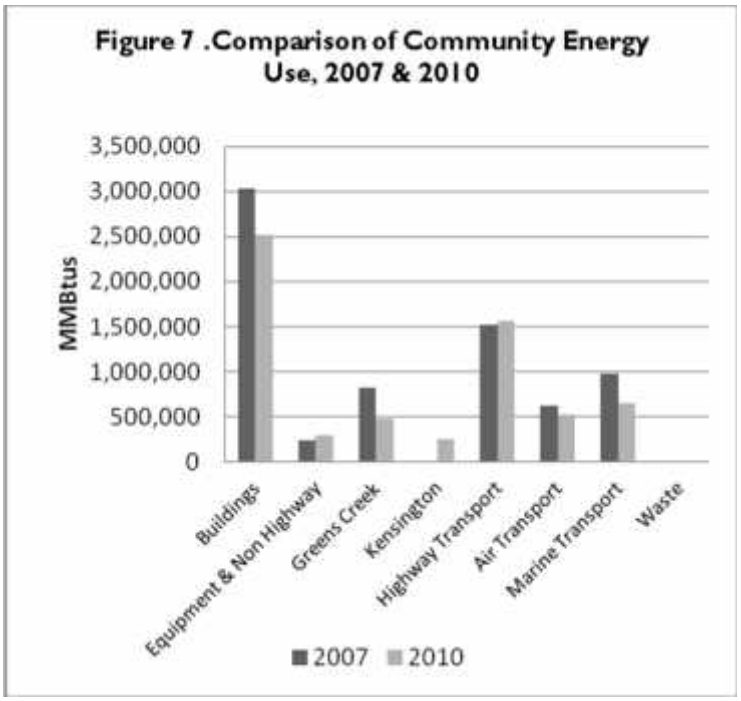
Comparison of 2007 and 2010 Community-Wide Energy Consumption and GHG Emissions

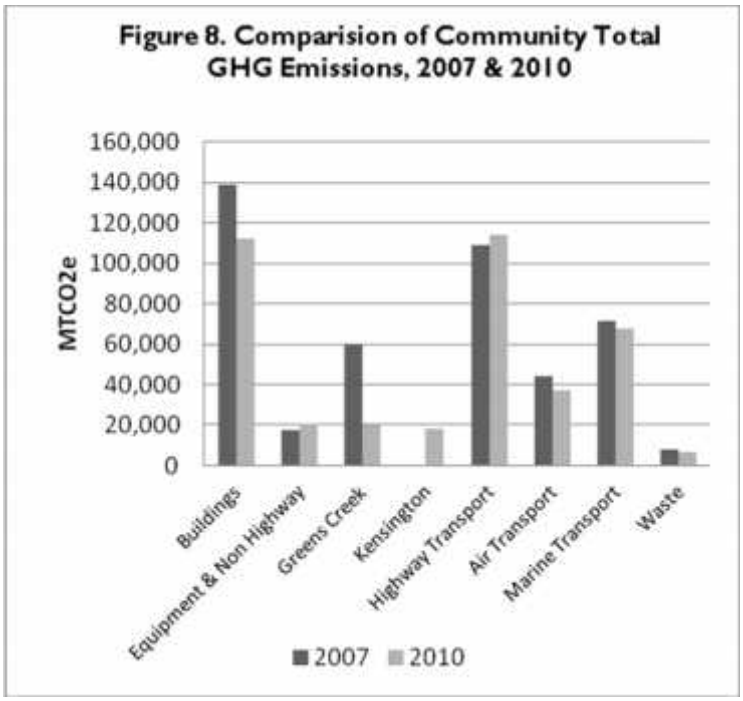
Figures 7 and 8 display comparisons of 2007 and 2010 community-wide energy consumption and greenhouse gas emissions from sources, including government sources, by sector. Overall, the amount of energy consumed by the community at large in 2010, measured in MMBtu[13], decreased approximately 13%, and GHG emissions fell approximately 10% from levels reported in the 2007 inventory. While developments listed in the above Introduction played a role in these reductions, a slowing economy and the substitution of hydropower for diesel sources also made a significant difference. Most notably, Greens Creek reduced its GHG emissions by 67% during this time by converting much of the mine's diesel use to electricity—an

[12] For a detailed comparison of the LGOP emissions factors used in 2007 and 2010, see Appendix I.

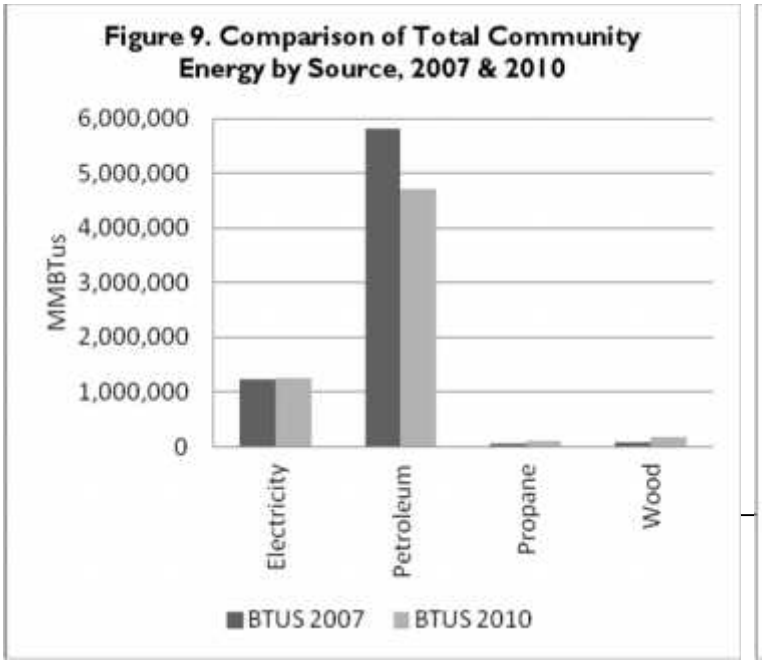
[13] MMBtu is a unit of energy representing one million British thermal units; in this report, units of gallons (fuels), watts (electricity), and cords (wood) have been converted to MMBtu for comparison purposes.

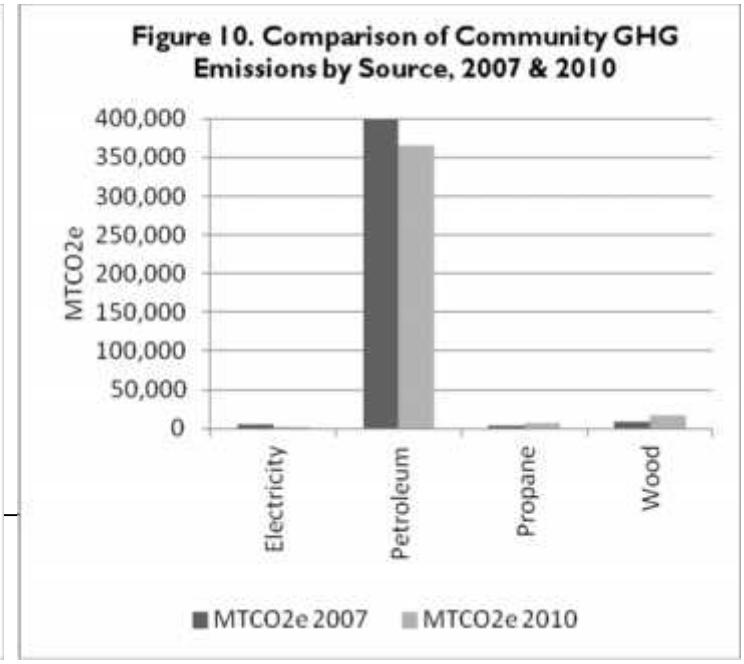
improvement that alone contributed over 6% to the 13% decrease in community-wide GHG emissions between 2007 and 2010.





The buildings sector, including commercial, industrial, and residential structures, contributed about 6% to decreases in total energy used and GHGs emitted. However, the addition of a second large mine and a general increase in highway and equipment energy use offset those gains somewhat.



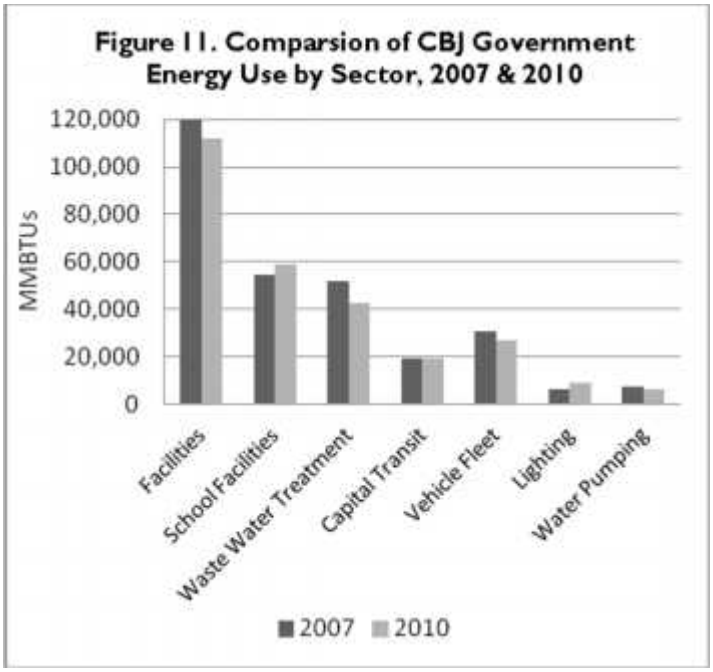


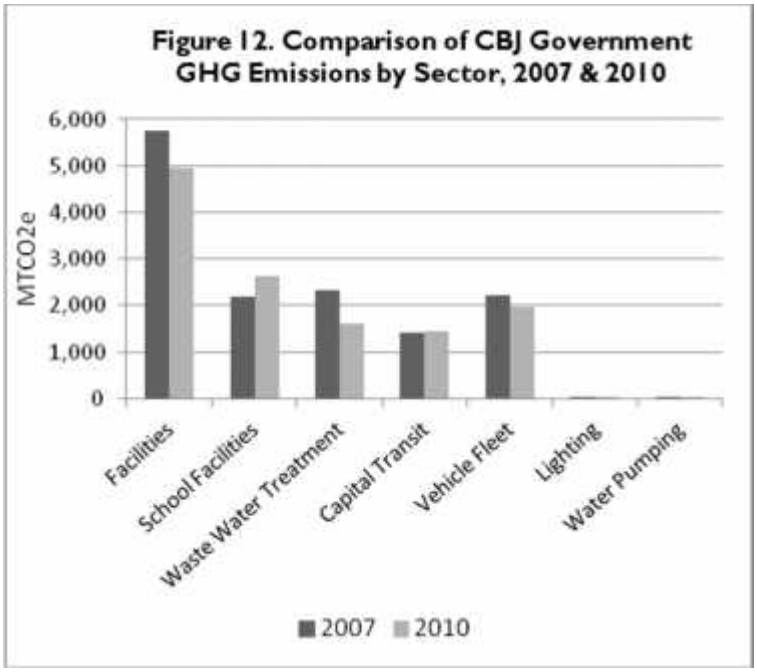
Figures 9 and 10 compare overall energy use and corresponding GHG emissions by type of energy used in 2007 and 2010. For all sources except electricity, a decrease in consumption led to a decrease in GHG emissions. As noted previously, higher dam reservoir levels in 2010 resulted in more hydro-sourced electricity consumption due to the corresponding decrease in the need for diesel generation. The resulting decrease in petroleum fuel consumption by AEL&P appears to have made the greatest contribution to the lower levels of community-wide GHGs recorded in 2010.

Comparison of 2007 and 2010 Local Government-Specific Energy Consumption and GHG Emissions

Juneau's local government activities, as of 2010, accounted for 4.5% of the community's total energy consumption and contributed 3.3% to community GHG emissions. Although government consumption and emissions data have been included in the above community-wide calculations, 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, which updates government-specific findings in the 2007 inventory.

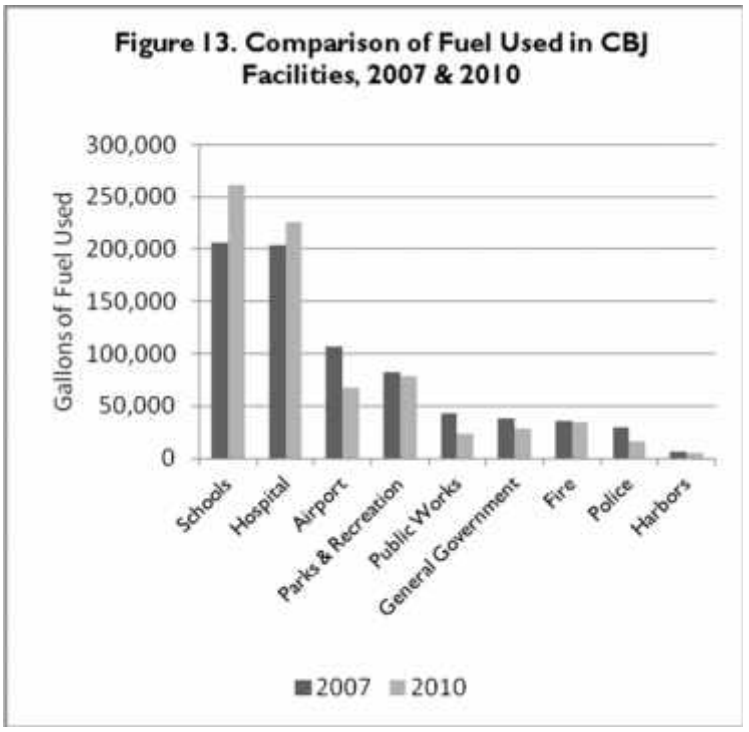
Figures 11 and 12 compare local government's total energy use and emissions by sector, including buildings, stationary equipment, and vehicles, for 2007 and 2010. Energy used for waste water treatment, water pumping, the vehicle fleet, and general city facilities was found to have decreased between these two years, while that used for lighting, school facilities, and mass transit increased. In 2010, overall energy use by Juneau's local government had fallen 6% below that reported in the 2007 inventory.

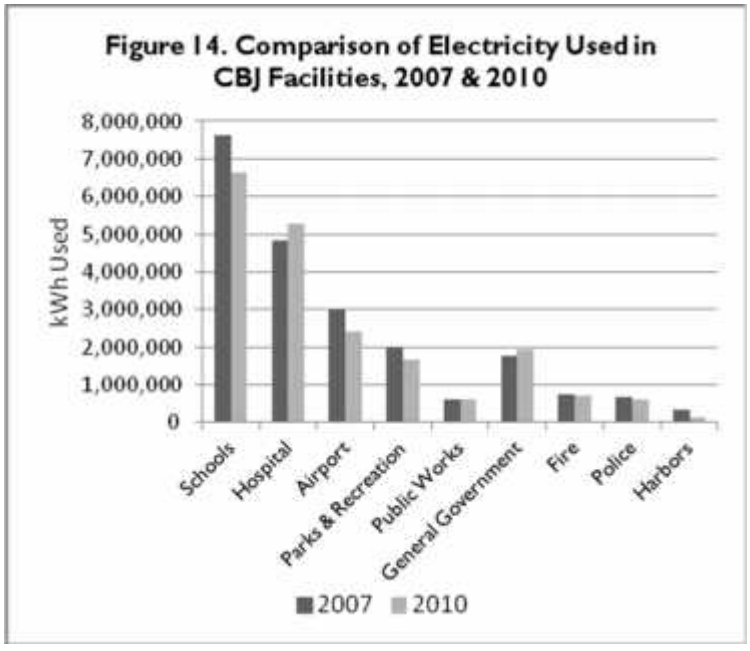


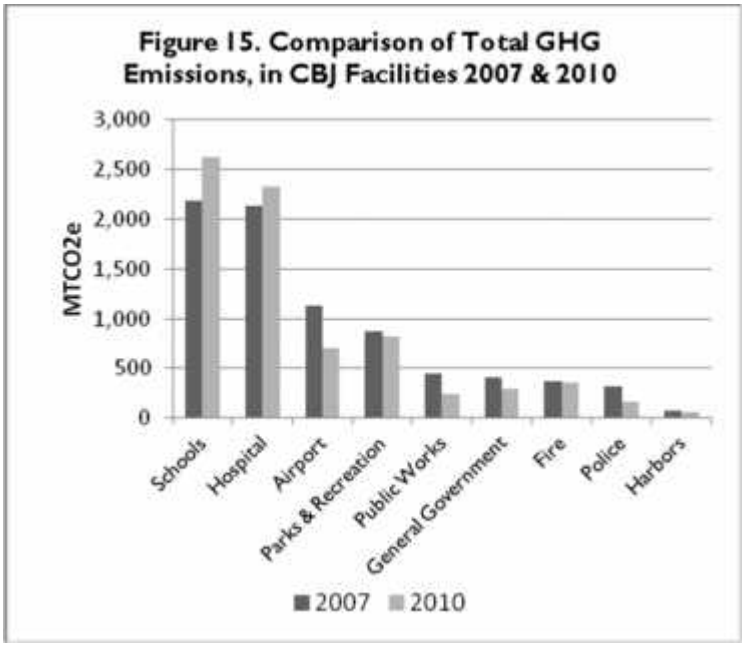


GHG emissions traceable to government-related activities were 10% lower in 2010 than in 2007. The greatest reductions occurred in the facilities and waste water treatment sectors (Figure 12). As noted elsewhere in this report, the 10% decrease in emissions between 2007 and 2010 can largely be attributed to reduced diesel use by the local electrical utility in 2010 rather than affirmative measures taken by the government to reduce its energy consumption and emissions.

Figures 13, 14, and 15 portray local government fuel and electricity consumption and GHG emissions for 2007 and 2010 disaggregated by facilities. These tables elucidate in more detail the facilities categories shown in figures 11 and 12, locating 2010 increases in fuel use and emissions over 2007 levels mainly in two types of facilities: schools and Bartlett Regional Hospital.







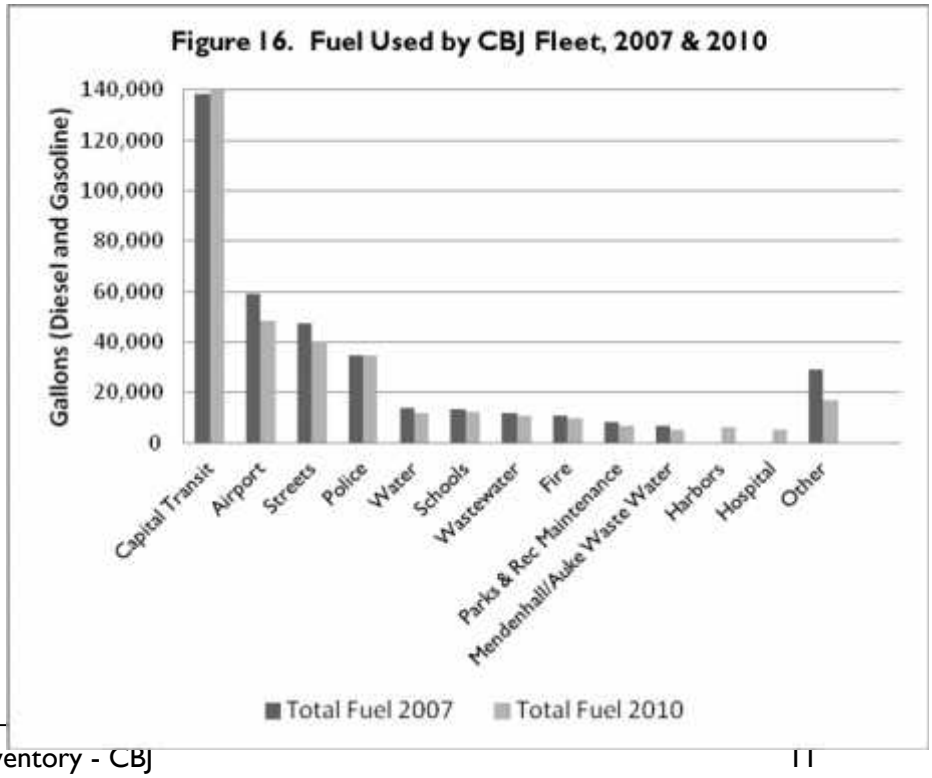
School and Hospital-Related Energy Use and Emissions
GHG emissions from local school facilities were higher in 2010 than those reported in 2007. This increase is almost solely attributable to GHG emissions from the new Thunder Mountain High School, which uses diesel heat. In addition, leading up to 2010, some schools switched from electric dual fuel to fuel oil only. Figure 14 shows the decrease in school-related electricity usage resulting from this change; that decrease was partly offset by an increase in electric use at the new high school. When Thunder Mountain is taken out of the equation, GHG emissions from Juneau's school facilities actually decreased in 2010 from 2007 levels—a result owing at least in part to an energy reduction program implemented by the Juneau School District in the intervening years to reduce school energy costs.

In March 2007, Bartlett Regional Hospital opened a new 55,000 square foot addition. The hospital then completed renovations on another 33,000 square feet in late-2009. This addition of new space and resumed use of space temporarily closed for renovation increased the hospital's energy consumption.

In all, schools and the hospital contributed 66% of the greenhouse gas emissions from local government facilities, as shown in Figure 15.

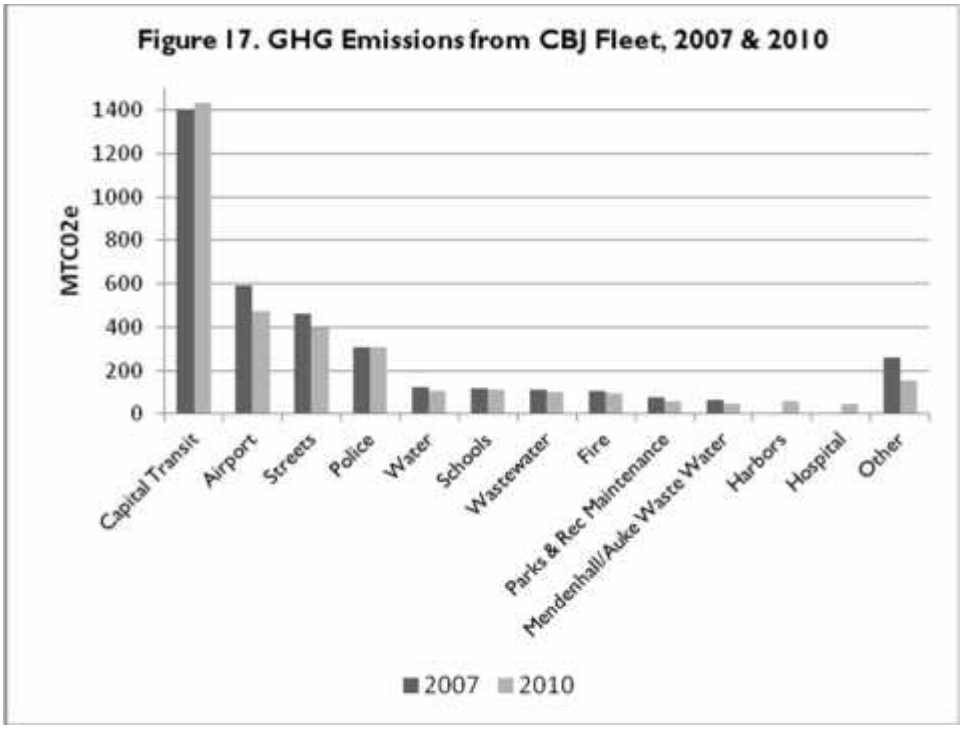
City Vehicle Fleet Fuel Use and Emissions
Figure 16 compares the fuel use of the city's vehicle fleet for 2007 and 2010, between which years fuel use and GHG emissions decreased in all departments except Capital Transit, resulting in an overall GHG reduction of 7%. Of note are reductions in GHG emissions from the vehicle fleets for the Mendenhall and Auke waste water treatment plant, parks and recreation (including park maintenance), and the airport.

"Other" in figures 16 and 17 includes parks and recreation building maintenance and miscellaneous P & R uses, municipal landscaping, the Jensen-Olson Arboretum, the Treadwell ice arena, Eaglecrest Ski Area, and other city departments and programs. It should be noted that in 2007 "Other" included the categories of Harbors and Hospital, which have been separated out in this report; this adjustment explains the sharp decrease in energy consumption and emissions in



the "Other" category between 2007 and 2010.

As shown in Figure 17, GHG emissions decreased in all CBJ government departments, except Capital Transit, from 2007 to 2010. The greatest decreases were achieved by the Mendenhall/Auke waste water facility, parks and recreation maintenance, and the airport, each of which reduced GHG emissions by 20% or more.



4. CONCLUSION AND RECOMMENDATIONS

The 2010 GHG emissions inventory reveals that both energy use and GHG emissions decreased compared to the 2007 inventory. However, while comparing two years of information provides two data reference points, it does not enable us to define a trend. In fact, it appears as though GHG emissions in 2011 may be higher than 2010 based on Greens Creek Mine's increased diesel use due to limited hydro availability and the Kensington Mine's increased diesel use from its first full year of operations.

In order to accurately identify trends in area-wide energy use and the production of GHG emissions, it is recommended that annual 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, it will be possible to determine whether inventories will continue to need to be conducted annually or biennially. Obtaining additional reference points over the coming years will enable the borough to identify areas of lasting improvement more readily than we can here, given the three-year period separating the collected data sets and only two data sets.

As the local, state, and federal governments 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—Government Buildings, Residential Buildings, and Commercial Buildings—in order to better identify and address energy-related dynamics in each of these areas. 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. 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.

The City and Borough of Juneau's local government should determine how to collect more specific (less aggregated) data from local fuel companies, especially for diesel oil. For example, in order to develop and understand energy consumption per square foot for different types of buildings - Residential, Commercial and Government, CBJ will have to be able to collect, from fuel distributor, the fuel consumed by those buildings, either all fuel sold to each type of building or all fuel sold to each building. Collection by type of building would be less time intensive with the cooperation of fuel distributors. Fuel distributors typically track fuel sales according to the type of fuel (e.g., aviation fuel, jet fuel, gasoline, marine gasoline, diesel) and the taxes imposed on fuel types.

Local government should continue to follow through on the Assembly's commitment to ICLEI's Five Milestone Process, including adoption of the longer-term emissions reduction targets **in** the Juneau Climate Action Plan before the end of 2011. Implementation of top recommendations of the Climate Action Plan for both the community and local government should begin in 2012. Borough departments should track and keep records of energy use and

costs and GHG emissions, by department and, where building or system energy audits are completed, by building and/or system. A guide for energy and emissions tracking, monitoring, and reporting by government and the public will be completed by the end of 2011.

The borough should quantify and track external energy use and GHG emissions from those sectors that support Juneau. Water freight transport and airlines represent two high-use areas critical to both sustaining the local community and understanding our total energy use and emissions situation. By the same token, external energy use and GHG emissions by cruise ships should be included in future inventories.

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Appendix I.
CALCULATING GHG EMISSIONS[14]

Global Warming Potential

Converting emissions of non-CO2 gases to units of CO2e allows greenhouse gases (GHGs) to be compared on a common basis: the ability of each GHG to trap heat in the atmosphere. In this report, non-CO2 gases have been converted to CO2e using internationally recognized Global Warming Potential (GWP) factors. The Intergovernmental Panel on Climate Change developed GWPs to represent the heat-trapping ability of each GHG relative to that of CO2. For example, the GWP of methane is 21 because one metric ton of methane has 21 times more ability to trap heat in the atmosphere than one metric ton of carbon dioxide. The GWP of nitrous oxide is 310.

Time Scale

A standardized emissions inventory report comprises all GHG emissions occurring during a calendar year. Among others, the UNFCCC, the Kyoto Protocol, the European Union, The Climate Registry, and the California Climate Action Registry all require GHG inventories to be tracked and reported on a calendar year basis. In addition to conducting a base year inventory of emissions, a comprehensive inventory of emissions should be completed at regular intervals following the base year.

Recalculation

Local governments should develop a base year emissions recalculation policy based on a "significant threshold" to help determine when to recalculate the base year. A significance threshold is a qualitative or quantitative criterion used to define any significant change to the data, inventory boundary, methods, or any other relevant factor. Once a local government has determined its policy on how it will recalculate base year emissions, it should apply this policy in a consistent manner and recalculate base year for both GHG increases and decreases. Between 2007 and 2010, the change in fuel coefficient factors has resulted in less than a 1% difference in total GHG for any sector.

Boundaries

The local government organization boundaries for GHG accounting were established in 2007 and are the boundaries of the City and Borough of Juneau. The Juneau GHG emissions calculation is an internal estimate of GHGs and does not include fuel for cruise ship, barge, or air travel within CBJ limits where the fuel used came from outside Juneau. It does include energy (fuel and electric) use where the energy was obtained locally (e.g., electricity supplied at Juneau's docks and airplane refueling that occurs in Juneau). The 2007 report established the

[14] Information for this appendix is taken from the 2010 Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories, Version 1.1, May 2010.

approach for defining the departments, activities, and operations that constitute Juneau's community and local government for the purpose of reporting GHG emissions. The 2007 inventory approach was duplicated to the extent feasible in the current report. Wherever changes in data reliability, calculation methods, or data display were encountered, they are noted in the text and pertinent appendices.

Inventory Scopes

Scope 1: All direct GHG emissions (with the exception of direct CO2 emissions from biogenic sources) were recorded. Scope 1 emissions from stationary combustion cover seven sectors:

1. Water delivery facilities (CBJ[15]);
2. Power generation facilities (electricity from AEL&P consumed by CBJ and community);
3. Solid waste facilities (Capital Disposal community);
4. Wastewater facilities (CBJ);
5. Port facilities (CBJ, reported as Harbors);
6. Airport facilities (JIA); and
7. All other buildings and facilities (CBJ for local government; fuel distributor community)

Calculating emissions from stationary combustion using fuel use activity data and default emission factors by fuel type involves the following six steps:

1. Determine annual consumption of each fuel combusted at your facilities (CBJ purchasing; fuel distributor community);
2. Determine the appropriate CO2 emission factors for each fuel (LGOP);
3. Determine the appropriate CH4 and N2O emission factors for each fuel (LGOP);
4. Calculate each fuel's CO2 emissions;
5. Calculate each fuel's CH4 and N2O emissions; and
6. Convert CH4 and N2O emissions to MTCO2 equivalent to determine total emissions.

Scope 2: Indirect GHG emissions associated with the consumption of purchased or acquired electricity, steam, heating, or cooling are irrelevant for Juneau. Since Juneau's electricity supply is produced within the borough's geopolitical boundaries, there are no Scope 2 emissions.

Scope 3: All other indirect emissions not covered in Scope 2, such as emissions resulting from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity (e.g., employee commuting and business travel), air travel, and marine travel. Emissions from cruise ships, barges and some air travel are considered scope 3, but for these modes of transportation this inventory only includes emissions from fuel obtained in Juneau.

In this analysis, most emissions are considered Scope 1. The Scope 3 emissions analyzed herein include those from the following sources: wood use, waste disposal, marine transportation, and air transportation. The distinction between scopes is relevant for reporting emissions at higher levels; however, for this inventory, all scopes are embedded in total Juneau emissions.

[15] In all appendices, "CBJ" refers to the City and Borough of Juneau government.

Calculation-Based Methodologies

We used calculation-based methodologies to quantify most of the community and government-sourced GHG emissions. This methodology involves the calculation of emissions based on "activity data" and "emission factors."

Activity data represent the relevant measurement of energy use, such as fuel consumption by fuel type and metered electricity use. These activity data were used in conjunction with an emission factor to determine emissions, using the following generalized equation:

Activity Data x Emission Factor = Emissions

Emission Factors

Emission factors are calculated ratios relating GHG emissions to a proxy measure of activity at an emissions source. We used the emission factors provided in the Local Government Operations Protocol to convert activity data, like energy usage, into the associated GHG emissions. (See Appendix II for emission factors used in 2010 and 2007.) These emission factors were determined by means of direct measurement, laboratory analyses, or calculations based on representative heat content and carbon content. No site-specific emission factors representative of the technology employed at specific facilities were used.

Calculation Example

This example calculates MTCO2e from Stationary Combustion of fuel in five steps.

1. Calculate CO2 (metric tons):
Fuel Consumed x Emission Factor / 1,000 = CO2 emissions
(gallons) (kgCO2/gallon) (kg/metric ton)

2. Calculate CH4 (metric tons):
Fuel consumed x Emission Factor / 1,000 = CH4 emissions
(gallons) (kg CH4/gallon) (kg/metric ton)

3. Calculate N2O (metric tons)
Fuel Consumed x Emission Factor / 1000 = N2O emissions
(gallons) (kg N2O/gallon) (kg/metric ton)

4. Convert to CO2e to determine total GHG emissions
CO2 Emissions x GWP = MTCO2e
(metric tons CO2) (1) = MTCO2e for CO2
CH4 Emissions x GWP = MTCO2e
(metric tons CH4) (21) = MTCO2e for CH4
N2O Emissions x GWP = MTCO2e
(metric tons N2O) (310) = MTCO2e for N2O

5. Add MTCO2e for CO2, CH4 and N20 = Total MTCO2e

If more than one type of fuel was used, we repeated these calculations for each type of fuel and added the outcomes together. For example, highway transportation includes both gasoline and diesel. We followed these calculations with each fuel type to arrive at total MTCO2e for highway transportation.

Appendix II.
EMISSION FACTORS

This appendix depicts emission factors used in measuring emissions for the 2010 inventory and for comparing 2007 data to 2010 findings. The table is based on Local Government Operating Protocol as revised in 2008.

LGOP Section	Emission Source	Emission	Required Activity Data	Emission Factor 2010 Determination	Emission Factor Used 2010	Emission Factor Used 2007
Facilities	*Stationary Combustion - diesel*	CO2	known fuel use (from distributors)	US Default Factors for Calculating CO2 Emissions from Fossil Fuel Combustion (Table G.1)	#1: 10.18kgCO2/gal #2: 10.21kgCO2/gal	10.15kg/gal
		CH4, N2O	known fuel use (from distributors)	CH4&N2O Emission Factors for Stationary Combustion for Petroleum Products by Fuel Type and Sector (Table G.4 Residential/Commercial)	.0015kgCH4/gal, .0001kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
	Stationary Combustion - propane	CO2	known fuel use (from distributors)	US Default Factors for Calculating CO2 Emissions from Fossil Fuel Combustion (Table G.1)	5.59kgCO2/gal	5.74kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	CH4&N2O Emission Factors for Stationary Combustion for Petroleum Products by Fuel Type and Sector (Table G.4 Residential/Commercial)	.0010kgCH4/gal, .0001kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
	Electricity from diesel	CO2	known electric use & gal diesel (AELP)	US Default Factors for Calculating CO2 Emissions from Fossil Fuel Combustion (Table G.1)	10.21kgCO2/gal	.00368tonsCO2/ MMBtu
		CH4, N2O	known electric use & gal diesel (AELP)	CH4&N2O Emission Factors for Stationary Combustion for Petroleum Products by Fuel Type and Sector (Table G.4 Electric Power)	.0004kgCH4/gal, .0001kgN2O/gal	.07064gCH4/MM Btu .0087gN2O/MMB tu

Vehicle Fleet	*Mobile Combustion-Highway Gasoline*	CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	8.78kgCO2/gal	8.81kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default Emission Factors by Vehicle Type and Fuel Used Based on Model Year (Tables G.12, G.13). ENVIRON determined EF for CBJ and Juneau based on these tables and vehicles model years.	City Fleet: .000438kgCH4/gal .00029kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
					Community Fleet: .000641kgCH4/gal .000638kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
	Mobile combustion Highway Diesel	CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	10.21kgCO2/gal	10.15kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default Emission Factors by Vehicle Type and Fuel Used Based on Model Year (Tables G.12, G.13). ENVIRON determined EF for CBJ and Juneau based on these tables and vehicles model years.	City Fleet: Lt Heavy Duty Trucks - .000019CH4/gal .000029N2O/gal Heavy Heavy Duty Trucks- .000027kgCH4/gal .000026N2O/gal *Used Ave. b/c 50L/50H* .000023CH4/gal .0000275N2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
					Community Fleet: Lt Heavy Duty Trucks - .000018kgCH4/gal .000028kgN2O/gal Heavy Heavy Duty Trucks- .000027kgCH4/gal .000026kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
	Non-Highway/Equipment Diesel Fuel	CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11 or G.1)	10.21kgCO2/gal	10.15kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	DefaultCH4 & N2O EF for Non Highway Vehicles (Table G.14)	.00058kgCH4/gal .00026kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
		CH4, N2O	known fuel use (from distributors)	Default CH4 & N2O EF for Stationary Combustion Residential/Commercial	.0015kgCH4/gal .0001kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal

				(Table G.4)		
Marine	*Gasoline*	CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	8.78kgCO2/gal	8.81kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default CH4 & N2O Emission Factors for Non-Highway Vehicles (Table G.14, Ships & Boats)	.00064kgCH4/gal .00022kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
	Diesel	CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	10.21kgCO2/gal	10.15kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default CH4 & N2O Emission Factors for Non-Highway Vehicles (Table G.14, Ships & Boats)	.00074kgCH4/gal .00026kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
Ave Gas		CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	8.31kgCO2/gal	8.32kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default CH4 & N2O Emission Factors for Non-Highway Vehicles (Table G.14, Aircraft)	.00704kgCH4/gal .0001kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
Jet Fuel		CO2	known fuel use (from distributors)	Default CO2 Emission Factors for Transport Fuels (Table G.11)	9.57kgCO2/gal	9.57kgCO2/gal
		CH4, N2O	known fuel use (from distributors)	Default CH4 & N2O Emission Factors for Non-Highway Vehicles (Table G.14, Aircraft)	.00027kgCH4/gal .0003kgN2O/gal	.0015kgCH4/gal, .0001kgN2O/gal
Wood & Wood Residual		CO2	estimate wood use	Default Factors for Calculating CO2 Emissions from Non-Fossil Fuel Combustion (Table G.2.)	93.80kgCO2/MMBtu	93.87kgCO2/MMBtu
		CH4, N20	estimate wood use	Default CH4 & N2O Emission Factors by Fuel Type and Sector (Table G.#.)	0.316kgCH4/MMBtu 0.0042kgN2O/MMBtu	0.316kgCH4/MMBtu .0042kgN20/MMBtu

Global Warming Potentials	
Greenhouse Gas	**GWP**
CO2	1
CH4	21
N2O	310

Conversion to MMBtu	
Energy Source	**MMBtu**
Gallon Propane	0.091
Gallon Diesel #1	0.139
Gallon Diesel #2	0.138
Gallon Diesel Blend	0.1385
Gallon Gas	0.125
Gallon Ave Gas	0.12
Gallon Jet A	0.135
kWh	0.0034
MWh	3.413
Cord wood	21
From Table G.1. Local Government Operations Protocol, 2010.	

Appendix III.
VEHICLE CH4 AND N2O EMISSION FACTOR

CH4 and N2O emission factors were determined by ENVIRON, Inc. A decision was made to apply the Gasoline Cars emission factors to all gasoline vehicles and to apply the diesel calculation to light and heavy duty trucks based on a weighted average of the vehicles. This was about 50/50 for the local government fleet.

Primary vehicle information collected to determine these factors included CBJ's vehicle count for local government (City and Borough of Juneau Fleet Listing of Capital Assets 11.10.10, wheeled vehicles only) and State of Alaska Division of Motor Vehicles list of vehicles by model year registered in the City and Borough of Juneau on January 2011, per request. In addition, the DMV Vehicle Class Codes were used to determine the number of passenger vehicles and light and heavy duty trucks.

Fleet Weighted Average Emissions Factors		(g/mi)		(g/gal)		
		CH_4	N_2O	CH_4	N_2O	Notes
City Fleet	Light Duty Gasoline Cars	0.018	0.012	0.438	0.290	Using Mobile 6 FE
	Light Heavy Duty Trucks	0.001	0.001	0.019	0.029	Using EMFAC FE
	Heavy Heavy Duty Trucks	0.005	0.005	0.027	0.026	Using EMFAC FE
Community Fleet	Light Duty Gasoline Cars	0.027	0.027	0.641	0.638	Using Mobile 6 FE
	Light Heavy Duty Trucks	0.001	0.001	0.018	0.028	Using EMFAC FE
	Heavy Heavy Duty Trucks	0.005	0.005	0.027	0.026	Using EMFAC FE

The table below is taken from the Local Government Operations Protocols for the quantification and reporting of greenhouse gas emissions inventories, Version 1.1, May 2010. The vehicle count columns are from CBJ and State of Alaska data, as described above.

CH_4 and N_2O Emission Factors for Highway Vehicles by Model Year				
Vehicle Type and Model Year	CH_4 (g/mi)	N_2O (g/mi)	Vehicle Count	
			City Fleet	Community Fleet
All Passenger Cars				
1984-1993	0.0704	0.0647	1	2573
1994	0.0531	0.056	0	576
1995	0.0358	0.0473	0	811
1996	0.0272	0.0426	0	622
1997	0.0268	0.0422	2	846
1998	0.0249	0.0393	2	886
1999	0.0216	0.0337	2	991
2000	0.0178	0.0273	2	968
2001	0.011	0.0158	0	1091
2002	0.0107	0.0153	5	1112
2003	0.0114	0.0135	0	1162
2004	0.0145	0.0083	0	941
2005	0.0147	0.0079	5	1080
2006	0.0161	0.0057	4	1050
2007	0.017	0.0041	7	1046
2008	0.0172	0.0038	19	2299
Diesel Light Duty Trucks				
1960-1982	0.0011	0.0017	1	0
1983-1995	0.0009	0.0014	7	2496
1996-2007	0.001	0.0015	125	6987
Diesel Heavy-Duty Vehicles				
All Model Years	0.0051	0.0048	132	2596
Total All Vehicles (passenger cars, light & heavy trucks, buses)			**314**	**30,133**

Source: U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008 (April 2010), Annex 3, Tables A-95 - A-98.

Vehicles in the Passenger Cars category are assumed to use gasoline whether they actually use diesel or gasoline. Vehicles in the light duty trucks and heavy duty trucks categories are assumed to use diesel. These assumptions are made because neither the State nor CBJ collects information on whether a vehicle uses diesel, gasoline, or another fuel. Diesel Light Duty Trucks include SUVs, vans, and pick-up trucks. Diesel Heavy-Duty Vehicles include busses, larger passenger vans, and heavy trucks

In the future, in order to accommodate a more accurate picture of GHG emissions from the CBJ fleet and community fleet, it is recommended that the CBJ:

1. Track annual mileage for each vehicle in addition to the consumption figures currently gathered by the CBJ cost center;
2. Record the type of fuel each vehicle uses; and
3. Work with the State of Alaska Division of Motor Vehicles to include a check-off with all motor vehicle registrations for Juneau that identifies what type of fuel the motor vehicle uses.

Appendix IV.
WOOD EMISSIONS CALCULATIONS

Estimated # of Cords per Household	Estimated # of Pellet lbs per Household	Total Number of CBJ Households	Total Cords Used	Total Pellet lbs Used	Weight (lbs/dry cord)of Juneau Wood	Total Cords	MMBtu	$MTCO_2e$
0.55	117.9	12,974	7,136	1,529,635	2268	7,810	164,010	16,686
(a)	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)

1. A 2007-2008, Mendenhall Valley Home Heating Survey conducted by the Alaska Department of Environmental Conservation determined an estimated number of cords of wood and number of pounds of wood pellets used per household (Alice Edwards, ADEC, personal communication, May 2011).
2. Total number of households in CBJ, 2010. Juneau Economic Development Council 2010 Housing Inventory, page 8.
3. Cords used, determined by multiplying the estimated number of cords per household by the number of households.
4. Total pellet pounds used, determined by multiplying the estimated number of pounds of pellets used per household by the number of households.
5. Weight of Juneau wood (pounds per dry cord), based on 2007 GHG Inventory estimates of 90% spruce and 10% hemlock. These percentages were combined with average weight values per cord of wood type from worksheet at Consumer Energy Center website to determine the weight and energy content of Juneau wood.

Wood	Lbs/Cord (dry)	% Juneau Wood Prototype	Juneau Lbs/Dry Cord
Hemlock	2515	10%	252
Spruce	2240	90%	2016
Total			**2268**

1. The weight of Juneau wood (e) was divided by the total pellet pounds used and added to cords used (c) to determine total cords.
2. Total cords (f) were multiplied by 21 MMBtu/cord (the energy content for Juneau wood prototype determined from the Community Energy Center worksheet) to determine total energy from wood used in MMBtu.
3. Default wood and wood residual emission factors (Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories, May 2010, ICLEI) were multiplied by MMBtu (g) and converted to $MTCO_2e$.

GHG	kg/MMBtu	Global Warming Factor	Emissions Factor
CO2	93.8	1	93.8
CH4	0.316	21	6.636
N2O	0.0042	310	1.302
Total			101.738

Appendix V.
COMMUNITY LANDFILL WASTE AND EMISSIONS

Juneau's solid waste landfill is located in the Lemon Creek area. In 2007, total annual waste added to the landfill was 33,277 tons (equal to 29,949 metric tons). Total waste for 2010 decreased to 28,122 tons (25,310 metric tons).

In 2009, ICLEI changed the methodology for calculating greenhouse gas emissions from solid waste landfills in two significant ways:

1. Instead of including sequestration rates for methane (CH4), the 2009 protocols require that methane released from landfills be included in GHG emissions; and
2. Landfill waste is now to be categorized into five different segments rather than the two used in 2007.

Due to the significance of these changes, we recalculated the 2007 waste emissions for the purpose of comparing 2007 and 2010 data; the results are displayed in the below two tables:

2007 Landfill Waste					
Type of Waste	**Short Tons**	**Metric Tons**	**Methane Coefficient**	**MTCO2e**	**MTCO2e w/flare**
Paper Products	12,645	11,381	2.138	24,332	6,265
Food Waste	4,326	3,893	1.21	4,711	1,213
Plant Debris	3,327	2,995	0.686	2,055	529
Wood or Textiles	1,331	1,198	0.605	725	187
All Other Waste	11,647	10,482	0	0	0
Total	**33,277**	**29,949**		**31,822**	**8,194**

2010 Landfill Waste Emissions					
Type of Waste	**Short Tons**	**Metric Tons**	**Methane Coefficient**	**MTCO2e**	**MTCO2e w/flare**
Paper Products	10,686	9,618	2.138	20,563	5,295
Food Waste	3,656	3,290	1.21	3,981	1,025
Plant Debris	2,812	2,531	0.686	1,736	447
Wood or Textiles	1,125	1,012	0.605	612	158
All Other Waste	9,843	8,858	0	0	0
Total	**28,122**	**25,310**		**26,893**	**6,925**

Total tons of waste (including municipal solid waste and construction debris) were provided by Capital Disposal landfill for 2007 and 2010.[16] These totals were then divided into types of waste (paper products, food waste, plant debris, wood or textiles, and all other waste) using

[16] Personal communication with Eric Vance, Capital Disposal manager.

the CACP and ICLEI default percentages.[17] The metric ton equivalent was determined using the following standard formula: 1 short ton = 0.90 metric tons. The methane coefficients applied for each type of waste are from CACP and ICLEI.[18] 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.[19]

Waste deposited in the Juneau landfill decreased by more than 5,000 tons in 2010 compared to 2007 and future[20] GHG emissions decreased by 15%.

[17] LGOP protocol and personal communication with Justus Steward, ICLEI.

[18] ICLEI CACP 2009 software.

[19] Per EPA's AP-42 Section on Municipal Solid Waste Landfills: http://www.epa.gov/ttn/chief/ap42/ch02/final/c02s04.pdf.

[20] GHG emissions from a landfill are future emissions as landfill materials emit GHG when they decompose.

Appendix VI.
COMMUNITY ENERGY USE AND EMISSIONS

Community energy and emissions analyses were divided into the following sectors: buildings, equipment (includes equipment and non-highway vehicles), transportation, Greens Creek and Kensington mines,[21] and solid waste. The table below provides data on total emissions from Juneau by sector and source (fuel type). The notes on the following page give additional detail about each sector and source. This table and the following notes provide the information used to generate the 2010 community energy use inventory. The energy use information, combined with the emission factor information in Appendix I, was used to generate the GHG emissions figures found here and used in the Juneau Greenhouse Gas Emissions Update.

Sector	Fuel Type	Quantity	Units	MMBtu	$MTCO_2e$	% $MTCO_2e$
	Heating Oil	8,598,345	gallons	1,190,515	88,258	22%
	Propane	1,144,803	gallons	104,177	6,459	2%
	Wood	7,810	cords	164,010	16,686	4%
	Electricity	309,825	MWh	1,057,433	560	0%
Buildings	**TOTAL**			**2,516,135**	**111,963**	**28%**
Equipment	Diesel Fuel	1,990,827	gallons	285,772	20,477	5%
	Propane	5,256	gallons	478	30	0%
	Diesel Fuel	1,904,396	gallons	262,807	19,595	5%
	Electricity	61,018	MWh	208,255	110	0%
Greens Creek	**TOTAL**			**471,540**	**19,735**	**5%**
	Propane	28,986	gallons	2,638	163	0%
	Diesel Fuel (stationary use only)	1,769,463	gallons	244,186	18,122	5%
Kensington	**TOTAL**	**1,798,449**		**246,824**	**18,285**	**5%**
Highway Transportation	Gasoline & Diesel	12,332,405	gallons	1,563,245	114,261	29%
Air Transport	Ave Gas & Jet Fuel	3,891,389	gallons	519,836	37,192	9%
Marine Transportation	Gasoline & Diesel	6,669,163	gallons	646,020	67,910	17%
Transportation	**TOTAL**	**22,892,957**		**2,729,101**	**219,363**	**56%**
Waste	Waste	25,310	Metric	0	6,925	2%
Total				**6,249,370**	**396,747**	**100%**

[21] Fuel distributors report "off site" sales to Greens Creek and Kensington mining operations separately from other Juneau sales.

Buildings: Includes electric, diesel, propane, and wood used in residential, commercial, and industrial buildings. Most emissions are from fuel used to heat buildings and provide hot water; however, the gallons total also includes fuel oil used for industrial processes (e.g., fuel oil used to fire the boilers at the Alaskan Brewery) and fuel oil used by AEL&P to generate electricity for street and marina lighting.

- *Heating oil* includes all fuel sold by Delta Western Inc., Petro Marine Services, and Taku Oil as "heating" fuel. This number overestimates the amount used for "heating" alone because it includes gallons sold to industrial companies that may use some portion of it to run industrial operations in addition to space and water heating.
- *Propane* includes all propane sold by local distributors Amerigas and Arrowhead and does not include propane delivered from outside Juneau to either mining operation.
- *Wood* energy and emissions calculations are based on the Alaska Department of Environmental Conservation Mendenhall Valley 2007 wood use survey extrapolated to the rest of the community; however, it is possible that less wood is used in the Mendenhall Valley due to wood burning restrictions in that area of Juneau. Wood energy use and emissions increased from 2007 based on a closer analysis of the work by ADEC. For greater detail on wood emissions, see Appendix III.
- *Electricity* includes almost all electricity sold by AEL&P in 2010, including electricity sold to cruise ships while docked in Juneau. The only exception is electricity sold to Greens Creek that is included below with Greens Creek. In 2010, most electricity was produced by hydroelectric power with less than 1% provided by diesel fuel. MTCO2e emission factor was determined from the Local Government Operations Protocol, May 2010 (ICLEI). *See* Appendix II.

Equipment: Includes gallons of fuel not used by motor vehicles licensed to operate on public ways and fuel for generators and construction equipment. 65,216 gallons were subtracted from this sector for the fuel used by AEL&P in its generators (see above, Buildings: *Electricity*). The majority of remaining fuel in this "equipment" category was used to power large projects off the road system (both for construction and electricity generation), such as the Kensington Mine and the Lake Dorothy Hydro facility.

Greens Creek Mine: The Hecla Greens Creek Mining Company operates on Admiralty Island near Juneau. Greens Creek supplied 2010 consumption information for electricity, propane, and diesel fuel used for equipment and non-highway vehicles, heating, and hot water. (Fuel sales to Greens Creek were not included in data supplied by Juneau fuel distributors as the fuel is barged from outside of Juneau directly to the mine site.

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 on June 24, 2010. Therefore, 2010 data include half a year of production and half a year of pre-production energy use. Total energy use at Kensington is expected to increase in 2011. Kensington supplied information on diesel fuel and propane for stationary use (as reported to the U.S. Environmental Protection Agency). Kensington Mine energy use was not reported separately in 2007. Kensington's reported diesel fuel includes stationary fuel used for generators, non-highway vehicles, heating, and incinerators. Additional fuel used by the

Kensington mine is included in the community-wide fuel figures under the buildings, equipment, and transportation sectors. The mine's reported propane use is for underground heaters.

Highway Transportation: Includes gallons of gasoline sold by Juneau's three distributors and gallons of motor vehicle and highway diesel. Emission factors were specific to diesel #1, diesel #2, and gasoline. CH4 and N2O emissions were determined by ENVIRON, Inc. using State of Alaska Division of Motor Vehicles' list of vehicles by model year, registered in the City and Borough of Juneau on January 2011 and the DMV Vehicle Class Codes to determine the number of passenger cars and light and heavy trucks.

For vehicle emission factor derivation, see Appendix III. Juneau's GHG emissions from highway transportation are based on actual gallons used rather than on vehicle miles traveled (VMT), as most communities must. Due to the lack of roads in or out of Juneau the vast majority of gasoline purchased in Juneau is used within borough boundaries. Using actual gallons rather than VMT to estimate emissions gives a more accurate estimate of GHG emissions from highway transportation modes.

Air Transportation: Includes gallons of aviation gasoline and jet fuel provided by local distributors. Fuel flowage records from the Juneau International Airport (JIA) based on reporting for the CBJ fuel flowage fee charged on all fuel sold at the airport showed 67,525 gallons less than the combined amount from distributors. This difference is primarily due to less aviation gas being pumped at the airport than sold by distributors. These numbers include all Alaska Airlines gallons pumped on site at JIA, but do not include fuel brought aboard outside of the City and Borough of Juneau by Alaska Airlines and other air transporters.

Marine Transportation: Includes all marine gasoline and diesel sold by the three distributors in Juneau. These figures include fuel for the Alaska Marine Highway and other marine fuel pumped in Juneau but does not include the fuel used to ship goods to Juneau or fuel used by cruise ships. (Cruise ship electricity use is included with the buildings sector.)

Waste: Includes municipal solid waste and construction/demolition debris deposited in the Capital Disposal landfill in 2010, amounting to 25,310 metric tons (28,121.6 tons). EPA default waste share percentages were used to divide total tons of waste into five categories. ICLEI software changes in 2009 required recalculation of 2007 waste emissions for comparison purposes. ICLEI changed to zero carbon sequestration for methane from the landfill. The total MTCO2e calculation includes 75% capture of methane through the passive flare system (with 1% of the 75% escaping). When presenting summary data for the community, waste emissions are no longer factored as net zero. See Appendix V for a more complete discussion and calculations.

Appendix VII.
LOCAL GOVERNMENT EMISSIONS

Local government energy consumption and emissions analyses were divided into the following sectors: facilities, school facilities, waste water treatment, capital transit, CBJ vehicle fleet, lighting, and water. The table below 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 2010 government energy use findings. The energy use information, combined with emission factor determinations under the methodology summarized in Appendix I, were used to generate GHG emissions findings for this report.

Electricity and petroleum fuel (oil and gasoline) use in facilities, schools, waste water and water treatment, capital transit, and the vehicle fleet were analyzed. As with the community-scale inventory, most emissions from CBJ operations came from burning fuel oil.

Data for CBJ electric meters was obtained from AEL&P and data for CBJ fuel tanks was obtained from CBJ Purchasing Division's semiannual 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.

Local Government Emissions									
	FUEL			ELECTRICITY					
Sector	Gallons	MMBtu	MT CO_2e	KWh	MMBtu	MT CO_2e	Total MMBtu	Total MTCO_2e	% MTCO_2e
School Facilities	261,040	36,030	2,619	6,645,914	22,683	12	58,706	2,631	21%
OTHER FACILITIES									
Hospital	225,272	31,088	2,314	5,291,651	18,060	10	49,148	2,324	18%
Airport	67,791	9,355	696	2,430,945	8,297	4	17,652	701	6%
Parks & Recreation	79,172	10,952	813	1,667,297	5,690	3	16,642	816	6%
Public Works	23,234	3,209	239	609,587	2,081	1	5,290	240	2%
General Government	28,169	3,891	289	1,940,500	6,623	3	10,514	293	2%
Fire	34,223	4,736	351	719,047	2,454	1	7,191	352	3%
Police	15,549	2,153	160	626,386	2,138	1	4,291	161	1%
Harbors	5,297	733	54	150,756	515	0	1,248	55	0%
Total	478,707	102,148	7,535	20,082,083	68,540	36	111,919	4,940	39%
EQUIPMENT NON FACILITY									
Wastewater	155,477	21,476	1,597	6,164,307	21,039	11	42,495	1,608	13%
Water	1,665	230	17	1,880,743	6,449	3	6,362	20	0%
Lighting	0	0	0	2,653,139	9,055	5	9,055	5	0%
Total	157,142	21,706	1,614	10,706,842	36,542	19	58,248	1,633	13%
FLEET									
Capital Transit	140,503	19,355	1,432	0	0	0	19,355	1,432	11%
Vehicle Fleet	209,136	27,130	1,959	0	0	0	27,130	1,959	16%
Total	349,639	46,485	3,391	0	0	0	46,485	3,391	27%
TOTAL	**1,246,528**	**170,338**	**12,540**	**30,780,272**	**105,083**	**55**	**275,337**	**12,595**	**100%**

School Facilities in 2010 included Thunder Mountain High School. This facility was not operating in 2007. The Juneau School District (JSD) instituted the Community Schools Energy Saving Initiative Program (CSESIP) in 2007. CSESIP focuses on increasing energy efficiency and conservation throughout all JSD buildings, including monitoring behavior of employees and students. Due to the increasing cost of heating fuel (diesel costs for the JSD increased from $2.47/gallon in 2007 to $2.71/gallon in 2010), GHG reductions through heating and hot water energy savings would result in district wide cost savings.

Other Facilities:

- *Airport*. Since 2007, the airport has been renovated, with geothermal heating installed, moving this facility to greater electricity and decreasing the fuel needed for heating.

- *General government* under this category includes Centennial Hall, City Hall, libraries, and miscellaneous other city facilities such as the engineering department's quarry and the Thane warehouse.

Equipment & Non-Facility lighting and water are powered solely by electricity and therefore release very few GHG emissions. Lighting under this category includes street lighting, traffic signals, and all docks and harbors meters– both dock/marina lighting and private boat electricity use.

Fleet: Includes all fuel use (diesel and gasoline), provided by CBJ, Consumption Statistics by Cost Center, an internal database tracking gallons of diesel and gasoline used in 2010 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 LGOP Table G.11 (*see* Appendix I) and CH4 and N2O from calculations by ENVIRON (*see* Appendix II). The CH4 and N2O calculations are based on LGOP Table G.12 combined with a list of local government wheeled vehicles provided by CBJ. This list includes both on-road and off-road vehicles such as automobiles, trucks, Capital Transit buses, and construction equipment.

Fire: Capital City Fire and Rescue's energy use was reduced between 2007 and 2010 due to reduced travel within the borough, utilizing vehicles that are on the road near the location, limited apparatus idling, older apparatus being retired (new apparatus meets most current emissions standards and uses an exhaust re-burning system). In buildings, thermostats are turned down, lights turned off when not needed, older florescent fixtures replaced with newer smaller ones, and the heat at training center reduced to just above freezing. CIP to replace windows at Auke Bay Station and exploring wind turbine, similar to USCG station, for downtown fire station to supplement electrical needs; also exploring new sloped roof for Auke Bay station to increase insulation.

Appendix VIII.
DATA USED TO GENERATE PIE AND BAR GRAPHS

The following tables contain the data used to generate the pie and bar graphs used in figures in the body of the report.

Comparison of Community Total Energy Use and Emissions by Sector, 2007 & 2010 (used for Figures 1, 2, 7, and 8)							
	2007			2010			% Change
Sector	MMBtu	$MTCO_2e$	$\%MTCO_2e$	MMBtu	$MTCO_2e$	$\%MTCO_2e$	$MTCO_2e$
Buildings	3,038,553	138,704	31%	2,516,135	111,963	28%	-25%
Equipment & non-Highway	237,425	17,410	4%	285,772	20,477	5%	18%
Greens Creek	819,391	60,203	13%	471,540	19,735	5%	-67%
Kensington	0	0	0	246,824	18,285	5%	5%
Highway Transport	1,525,939	108,794	24%	1,563,245	114,261	29%	5%
Air Transport	620,626	44,164	10%	519,836	37,192	9%	-16%
Marine Transport	970,247	71,224	16%	646,020	67,910	17%	-5%
Waste[22]		(3,546)	2%		6,925	2%	0%
TOTAL	7,212,181	440,545	100%	6,249,370	396,747	100%	-10%

Comparison of Community Total Emissions and Energy, by Source, 2007 & 2010 (used for Figures 3,4, 9, and 10)								
	2007		2010				% Change	
Source	MMBtu	$MTCO_2e$	MMBtu	% MMBtu	$MTCO_2e$	% $MTCO_2e$	MMBtu	$MTCO_2e$
Electricity	1,236,029	4,358	1,265,687	20%	670	0%	2%	-85%
Petroleum	5,822,076	399,303	4,712,380	75%	365,815	92%	-19%	-8%
Propane	63,800	4,032	107,293	2%	6,652	2%	68%	65%
Wood	90,276	9,081	164,010	3%	16,686	4%	2%	3%
Waste			0	0	6,925	2%		
TOTAL	**7,212,181**	**416,775**	**6,249,370**	**100%**	**396,747**	**100%**	**-13%**	**-8%**

[22] See Appendix III for discussion of waste-related emissions.

Local Government Total Emissions by Sector, 2007 & 2010 (used for Figures 5,6,11, and 12)							
	2007			2010			
Sector	**MMBtu**	**$MTCO_2e$**	**% $MTCO_2e$**	**MMBtu**	**$MTCO_2e$**	**% $MTCO_2e$**	**% Change in $MTCO_2e$**
Facilities	121,756	5,749	41%	111,919	4,940	39%	-14%
School Facilities	54,598	2,186	16%	58,706	2,631	21%	20%
Waste Water Treatment	52,044	2,315	17%	42,495	1,608	13%	-31%
Capital Transit	19,141	1,407	10%	19,354	1,432	11%	2%
Vehicle Fleet	30,814	2,222	116%	27,130	1,959	16%	-12%
Lighting	6,443	22	0%	9,055	5	0%	-77%
Water Pumping	7,243	24	0%	6,362	20	0%	-17%
Total Local Govt Emissions	**292,038**	**13,925**	**100%**	**275,337**	**12,595**	**100%**	**-10%**

Local Government Facilities Emissions by Department, 2010 (Used for Figures 13,14, and 15)							
	Fuel		Electricity				
Department	**$MTCO_2e$**	**Gallons**	**$MTCO_2e$**	**kWh**	**Total $MTCO_2e$**	**% $MTCO_2e$**	**% Change $MTCO_2e$**
Schools	2,619	261,040	12	6,645,914	2,631	35%	20%
Hospital	2,314	225,272	10	5,291,651	2,324	31%	9%
Airport	696	67,791	4	2,430,945	701	9%	-38%
Parks & Recreation	813	79,172	3	1,667,297	816	11%	-6%
Public Works	239	23,234	1	609,587	240	3%	-46%
General Government	289	28,169	3	1,940,500	293	4%	-28%
Fire	351	34,223	1	719,047	352	5%	-6%
Police	160	15,549	1	626,386	161	2%	-49%
Harbors	54	5,297	0	150,756	55	1%	-23%
Total	**7,535**	**739,747**	**36**	**20,082,083**	**7,571**	**100%**	**-4%**

Local Government Facilities Emissions by Department, 2007 (used for Figures 13,14, and 15)						
	Fuel		Electricity			
Department	MTCO2e	Gallons	MTCO2e	kWh	Total MTCO2e	% MTCO2e
Schools	2,099	205,641	87	7,633,498	2,186	28%
Hospital	2,079	203,630	55	4,817,569	2,134	27%
Airport	1,091	106,884	34	2,978,771	1,125	14%
Parks & Recreation	843	82,620	23	1,996,810	866	11%
Public Works	439	43,030	7	610,547	446	6%
General Government	385	37,709	20	1,757,733	405	5%
Fire	366	35,861	9	752,470	375	5%
Police	307	30,027	8	692,282	314	4%
Harbors	67	6,531	4	340,665	71	1%
Total	**7,676**	**751,933**	**246**	**21,580,345**	**7,922**	**100%**

Local Government Vehicle Fleet Emissions by Department (used for Figures 16 and 17)								
	2007			2010				
Department	Diesel (gal)	Gasoline (gal)	$MTCO_2e$	Diesel (gal)	Gasoline (gal)	$MTCO_2e$	% $MTCO_2e$	% Change $MTCO_2e$
Capital Transit	135,670	2,467	1,407	137,784	2,719	1,432	42%	2%
Airport	50,623	8,524	592	30,636	17,868	472	14%	-20%
Streets	31,500	16,069	464	25,338	15,159	394	12%	-15%
Police	21	34,597	307	21	34,670	308	9%	0%
Water	1,233	12,655	125	765	11,310	108	3%	-13%
Schools	767	12,415	118	967	11,509	112	3%	-5%
Wastewater	2,463	9,422	109	2,090	8,973	101	3%	-7%
Fire	5,901	4,987	104	4,984	4,831	94	3%	-10%
Parks & Rec Maint.	1,828	6,487	76	1,277	5,401	61	2%	-20%
Mendenhall/ Auke Waste Water	4,475	2,230	65	3,177	1,895	49	1%	-24%
Harbors				2,861	3,438	60	2%	
Hospital				914	4,249	47	1%	
Other[23]	4,425	24,486	262	3,005	13,798	153	5%	-1%[24]
Total	**238,906**	**134,339**	**3,629**	**213,819**	**135,820**	**3,391**	**100%**	**-7%**

[23] "Other" includes P&R Building Maintenance, Landscape, Recreation, Jensen-Olson Arboretum, and Treadwell Ice Arena; Eaglecrest; CDD Building Division; JD Treatment; Fleet Maintenance; Engineering; Assessors; Police Community Service; Public works/Administration; Streets-downtown sweeping; CDD administration; Risk management/Human Resources; Emergency Program Management; Solid Waste Management.

[24] Includes Other, Harbors, Hospital

Appendix IX.
PUBLIC MEETINGS

The following meetings were held during the development of the Juneau Climate Action Plan.

Juneau Commission on Sustainability
March 2, 2011
April 6, 2011
July 6, 2011
September 7, 2011

Juneau Commission on Sustainability – GHG Sub-Committee
January 27, 2011
February 10, 2011
February 28, 1011
March 14, 2011
March 28, 2011
April 11, 2011
April 26, 2011
May 17, 2011
September 28, 2011

CBJ Green Team
February 6, 2011
April 20, 2011
September 21, 2011

Public Meetings
May 25, 2011
October 5, 2011

CBJ Assembly Committee of the Whole
August 1, 2011
October 31, 2011