SUSTAINABILITY *at* UAA

Carbon Emissions Report 2012

University of Alaska Anchorage

University of Alaska Anchorage

3211 Providence Drive

Professional Studies Building, Suite 103C

Anchorage, AK 99508

Paula Williams, Ph.D., Sustainability Director

Tel: 907-786-1515

E-mail: pwilliams@uaa.alaska.edu

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Table of Contents

List of Figures

Page

List of Tables

Page

Summary

This report is submitted in compliance with the American College & University Presidents' Climate Commitment (ACUPCC) signed by University of Alaska Anchorage's (UAA) Chancellor Elaine Maimon in 2007. The ACUPCC requires signatory institutions to complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting and air travel) biennially. University of Alaska Anchorage's first greenhouse gas (GHG) inventory was completed in 2008 for academic year 2007-2008.

This report calculates GHG emissions for the 2011-2012 academic year. Data provided to *Native*Energy were analyzed to estimate emissions from air travel, commutes to and from work/school and surface travel to conduct UAA business. The Clean Air Cool Planet model was used to calculate emissions from fuel, electricity, water and sewer, and natural gas. With a few exceptions noted in the report, this report mimics the methodology used to calculate carbon emissions in the 2010 emission report.

During the 2011-2012 academic year, the sources and amounts of UAA's GHG emissions in metric tonnes of CO_2e included electricity 19,438, natural gas 15,954.6, fuels 576, sewage and water use 15.4, electric losses 1922.4, commutes to and from campus and surface travel for UAA business 17,559, air travel 2,405, and travel on land for business 65.4 for a total of 57,935.8 metric tonnes of CO_2e emitted.

Introduction

The University of Alaska Anchorage (UAA) has a long-standing commitment to sustainability. This is manifest in many ways. In 2004, UAA signed the Talloires Declaration, a statement of principles and practices for using higher education to promote sustainability. University of Alaska Anchorage's Strategic Plan 2017 envisions UAA as "a university of first choice distinguished for its commitment to sustainability and environmental responsibility" and lists sustainability and stewardship as two of its core values.

The ACUPCC, signed by UAA Chancellor Elaine Maimon in 2007, supports the mission of implementing comprehensive plans in the pursuit of carbon neutrality for higher education institutions. The ACUPCC requires signatory institutions to complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting and air travel) at least every other year. Greenhouse

gas emissions are the release of gases to the atmosphere that prevent radiant (infrared) energy from escaping the Earth's atmosphere, causing the Earth to maintain higher surface temperatures than would occur if the gases were absent.

Carbon dioxide (CO_2) is not the only greenhouse gas emitted in the burning of fossil fuels. Carbon dioxide equivalent (CO_2e) has become the standard of measurement against which the impacts of releasing different greenhouse gases are evaluated. Carbon dioxide equivalents for various greenhouse gases are measured using the Global Warming Potential (GWP), a measurement of the impact that a particular gas has on the additional heat/energy that is retained in the Earth's biosphere by the addition of this gas to the atmosphere (also called radiative forcing). The GWP of a given gas describes its effect on climate change relative to an equivalent emission of carbon dioxide.

GAS	ATMOSPHERIC LIFETIME	GWP
Carbon dioxide (CO_2)	50-200	1
Methane (CO_4)	12+/-3	21
Nitrous Oxide (N_2O)	120	310
HFC-23	264	11,700
HFC-134a	14.6	1,300
CF_4	50,000	6,500
C_2F_6	10,000	9,200
SF_6	3,200	23,900

Table 1: GWP Equivalents for Selected Greenhouse Gases
Source: U.S. EPA Climate Change: Global Warming Potential

University of Alaska Anchorage's first carbon emission baseline calculation was completed in 2008 for the 2007/2008 academic year (referred to as the 2008 report). A second report was completed for fiscal year 2010. Later, a 2005 inventory was conducted as a baseline for reports to the Association for Advancement of Sustainability in Higher Education (AASHE). The current report is for fiscal year 2012 and is the fourth carbon emission report generated by UAA.

An inventory of emissions from electricity, heating, water and sewer, transmission losses, business travel, commuting and air travel encompasses scope one and two emissions, as well as some scope three emissions. Scope one emissions are defined as direct GHG emissions occurring from sources that are owned or controlled by the institution. Scope two emissions are indirect emissions generated in the production of energy purchased by the institution. Scope three emissions are indirect emissions that are the consequence of the activities of the institution, but are from sources not owned or controlled by the institution. The emissions calculated for scope one included

gasoline and diesel purchases by the university to fuel fleet vehicles and for use in back-up generators (sources owned or controlled by the institution) and purchases of natural gas. Scope two calculations consist of purchases of electricity and water use and sewage treatment. Scope three calculations are based on emissions from commutes to and from campus as well as surface and air travel as a consequence of activities of the institution. For the 2012 report, scope three calculations also include emissions caused by losses from electricity generation and transmission.

Two separate calculations were generated to complete this report. Scope one and two GHG emissions and electricity losses (scope three) were calculated by Paula Williams using the Clean Air Cool Planet (CA-CP) model. A separate calculation was prepared by *Native*Energy to estimate the levels of three types of scope three GHG emissions: University official air travel, commuting by students and employees, and ground travel for University business.

Scope of the Report Calculating Natural Gas, Electricity, Fuel and Electricity Loss Emissions

Scope one and two emissions were calculated for UAA main campus, housing and other buildings owned by UAA located in Anchorage (referred to as off campus buildings). University of Alaska Anchorage is also associated with five small campuses in locations at a distance to Anchorage. Those campuses are: Kodiak, Prince William Sound (Valdez), Mat Su, Homer and Kenai and these are referred to as "community campuses." Community campus emissions related to business and air travel were included in the calculations, but other sources such as natural gas use, electricity purchases and commutes to campus were not. Figure 1 shows the detailed map of the buildings included in the calculations for UAA main campus. The map can be found at: http://www.uaa.alaska.edu/map/classicersion.cfm.

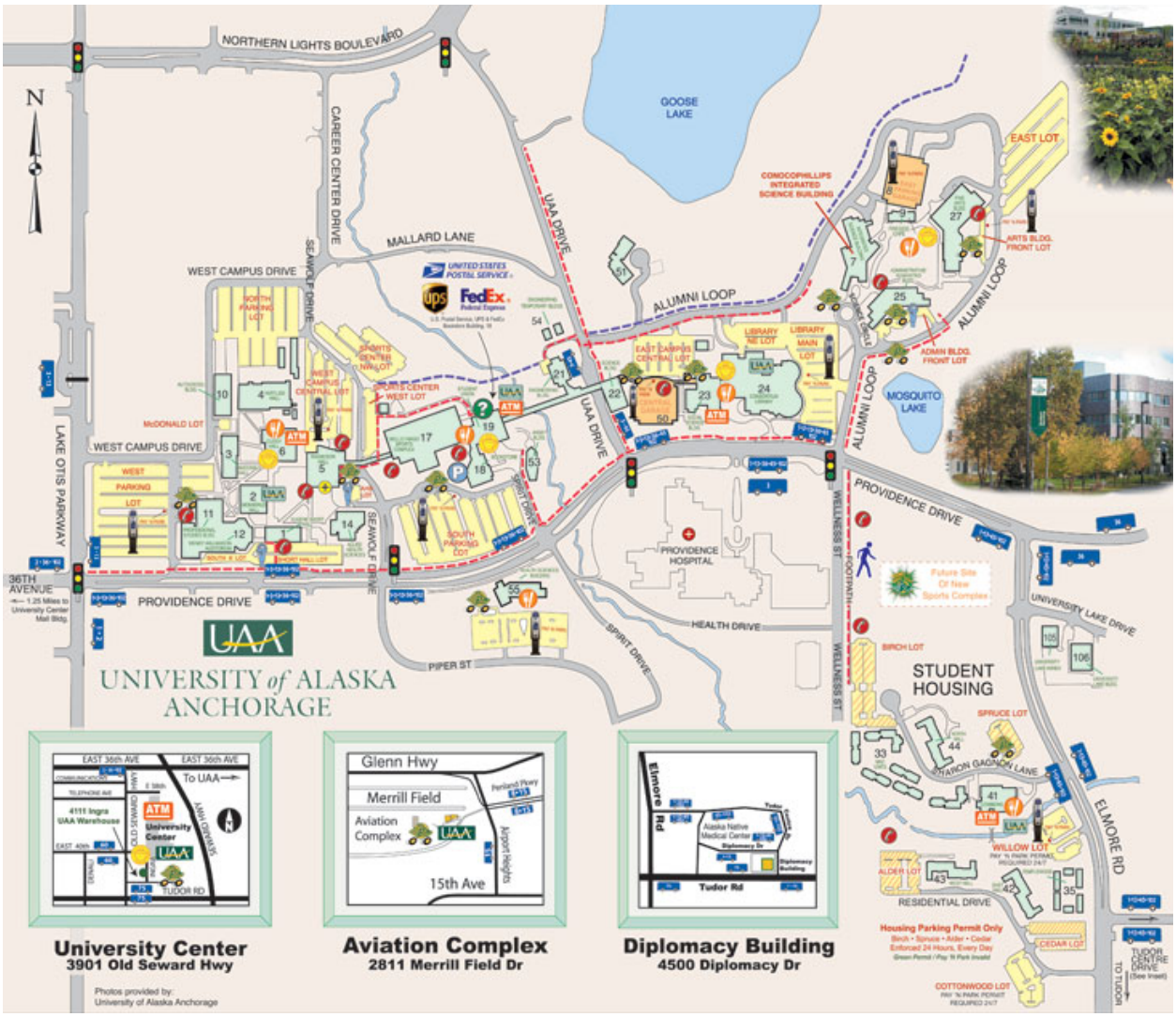

Figure 1. Map of UAA main campus and off-campus buildings.

Scope of the Report Calculating Air and Surface Travel and Commute Emissions

Pursuant to the ACUPCC, this study estimates the levels of three types of scope three GHG emissions: University official air travel, official surface travel, and commuting by students and employees. Two models were developed by *Native*Energy for the 2012 report: a UAA air travel model and a UAA commuter model. Those models are described below.

Methodology

Data collection

In order to determine campus carbon dioxide equivalent emissions, the following steps were completed during the calculation preparation process:

1. Gather all data to determine scope one emissions. This included fossil fuel consumption of all campus owned equipment and activities: heating fuels, emergency generator fuels, fuels used by campus-owned vehicles, and the purchase of natural gas for University heating systems for main campus and off-campus buildings.
2. Gather all data to determine scope two emissions. This requires the collection of the amount of all purchased electricity for main campus and off-campus buildings.
3. Gather data for scope three emissions, including distance and frequency of commutes to and from campus by students and employees, and miles per gallon of vehicles utilized for these commutes; number and range of air and surface miles traveled for UAA business (these emissions included Community Campuses); and electric loss from generation and transmission for UAA main campus.

The methodologies used in the study are built upon and modified from UAA's 2008 and 2010 GHG inventories. Changing data availability and changes in accepted methodologies have necessitated that potions of the methodology be changed. The core of the inventory remains the same, however, and strives to provide a tool for the UAA to understand and analyze its emissions.

Natural Gas Use

An Excel spreadsheet detailing natural gas usage from academic years 2006 through 2012 (academic years run from July 1 to June 30) was provided by UAA's Department of Facilities, Maintenance and Operations. Figure 2 shows the annual natural gas purchased (in ccf - 100 cubic feet) by UAA, for main campus and off-campus buildings. Natural gas bills for housing are kept separate from other campus utility bills, and those were collected for the same fiscal years (2006-2012) and input into an Excel spreadsheet. Figure 2 shows (in brown) natural gas usage from 2006 through June 30, 2012, for all on and off-campus buildings except housing. The natural gas usage in grey represents that used by housing in fiscal years 2006 to 2012. This data was entered into the CACP model to calculate CO_2e emissions.

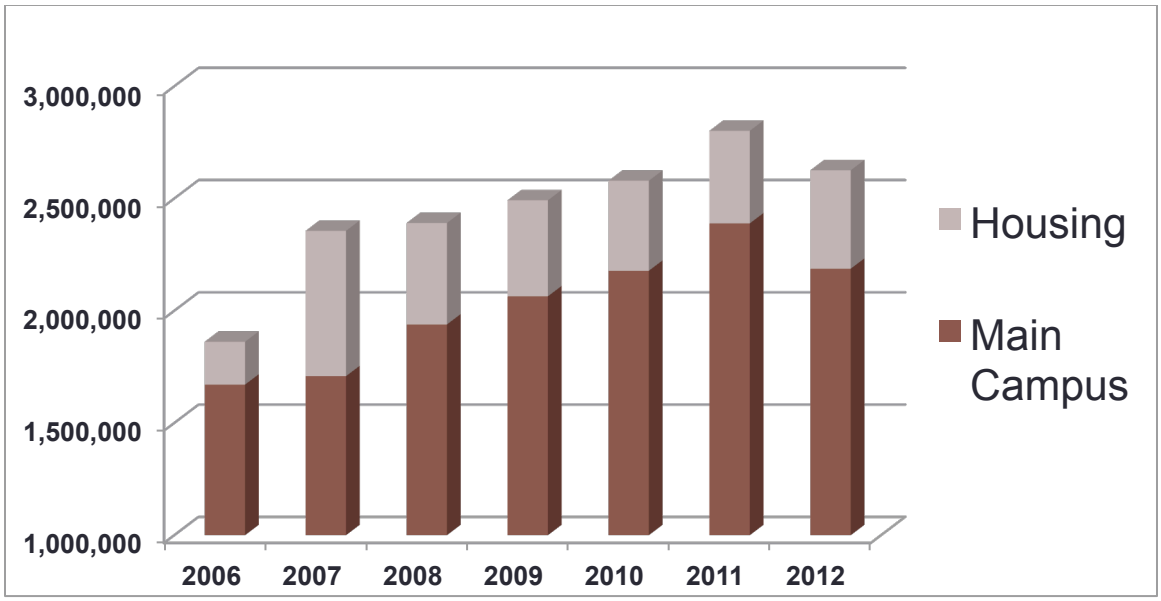

Figure 2. Total ccf natural gas purchased by UAA from 2006- 2012.

The total ccf consumed by UAA on main campus (including buildings owned by UAA in Anchorage) and housing was entered into an Excel spreadsheet. This number was converted to MMBtu and that total was entered into the CA-CP model. The total metric tonnes of CO_2e emitted by UAA in FY 2012 from burning natural gas was 15,954.

Electricity Use

The Excel spreadsheet provided by UAA's Department of Facilities, Maintenance and Operations included electricity use by on and off-campus buildings, except housing, from academic year 2006 through 2012. Figure 4 shows the annual electricity (in kilowatt hours - kWh) purchased by UAA for those buildings. Electricity bills for housing are kept separate from other campus utility bills, and those were collected and entered into an Excel spreadsheet for the same time period. Figure 3 shows (in blue) electricity usage from fiscal year 2006 through 2012, for main campus and off-campus buildings, exclusive of housing. The electricity usage in grey represents that used by housing for the same time period. This data (kWh) was entered into the CACP model to calculate CO_2e emissions. A total of 19,479 metric tonnes of CO_2e were emitted by UAA from electricity generation in FY 2012. Additionally, generation and transmission of electricity results in loss of power due to resistance and other factors. The CA-CP calculates the amount of emissions caused from electricity losses and those totaled 1927 metric tonnes for FY 2012.

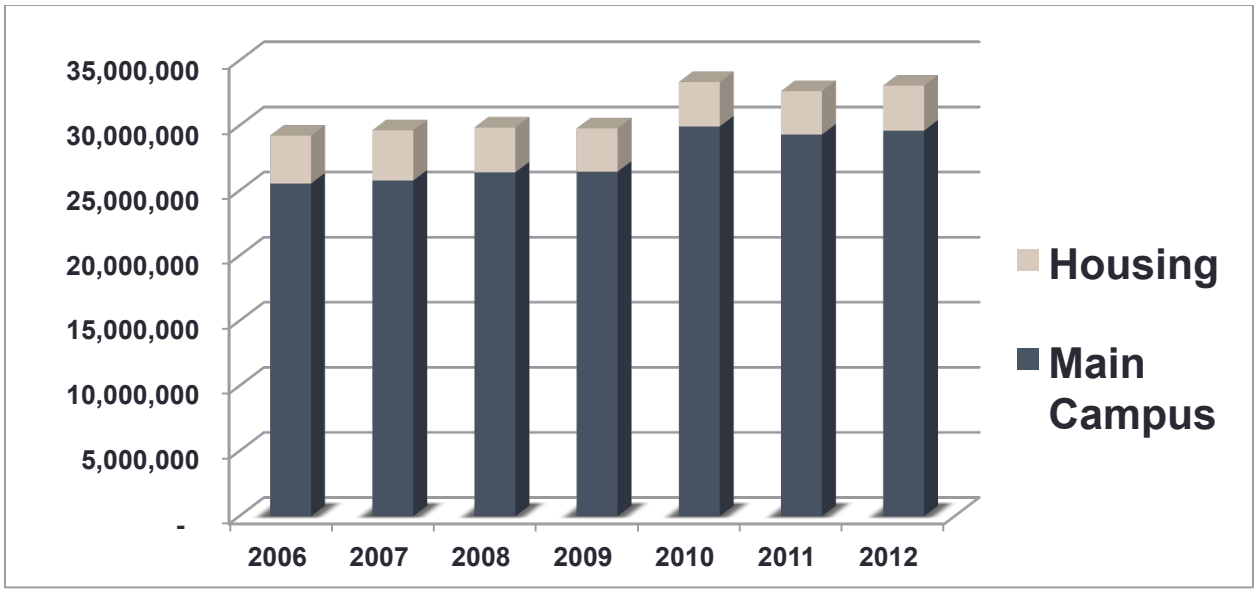

Figure 3. Total kW purchased by UAA 2006-2012.

What gases were included?

When determining the amounts of CO_2e emitted from electricity generation, the mix of fuels used to generate electricity along the electric grid system must be included. The Clean Air Cool Planet model utilizes the Environmental Protection Agency's eGrid calculations of common greenhouse gases, and incorporates them into carbon dioxide equivalent measures, thus all common greenhouse gases are included in calculating emissions from electricity usage. The Clean Air Cool Planet model also calculates full greenhouse gases (not just CO_2) for the other data input into the model, such as sewer and water, and natural gas combustion.

Fleet Fuel Use

In FY 2012, UAA utilized 47,816 gallons of gasoline and 17,030 gallons of diesel fuel to power its fleet vehicles. This data was entered into the CACP model to calculate CO_2e emissions. UAA emitted 576 metric tonnes of CO_2e from this source.

UAA Air Travel GHG Emissions Inventory

As outlined by the ACUPCC, participating institutions must measure and track their greenhouse gas emissions from a variety of sources including air travel. "Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel), . . . and at least every other year thereafter an updated Greenhouse Gas Emissions Inventory." In compliance with this requirement UAA has compiled the following air travel emissions inventory.

Information pertaining to air travel was obtained from UAA travel office's Travel Expense Reports (TERs). Flight information was divided between travel associated with the athletics department and all other air travel. The data used included 100% of the athletic flights and 14% of the non-athletic flights.

There are numerous models available to calculate the emissions associated with air travel. Particularly relevant in the consideration of which model would be appropriate for UAA to use is Clean Air-Cool Planet's (CA-CP) Campus Carbon Calculator. The CA-CP model is suggested by the ACUPCC and is widely used by colleges and universities across the country. The other models that exist all perform the basic function of multiplying the total miles traveled by an emissions factor (CO_2 emitted per passenger mile). As in previous years, UAA has elected to use a custom model. The model used provides a greater level of detail than the CA-CP model would produce. This detail is a result of UAA's flight segments being disaggregated by their length in statute miles. This distinction allows for the use of a more precise emissions factor than would be used if only the total miles traveled were available. A full explanation of the model used to calculate the emissions from air travel can be found in section 2.2.

Air Travel Results

The air travel associated with UAA's general operations and athletics department generated 2,405 metric tonnes of carbon dioxide. These emissions were the result of a cumulative estimated 11,985,990 miles traveled, with an average flight segment length of 1,233 miles.

Table 2

Total Miles	Average Segment distance	Total Tonnes $C0_2$
11,985,990	1,233	2,405

Of the total 2,405 tonnes of emissions resulting from air travel, 40% of those emissions were associated with athletic travel and 60% were associated with non-athletic travel.

Table 3

Athletic Miles	Average Flight Length	Tonnes $C0_2$	Percentage of Total Emissions
4,890,398	1,430	969	40%

Table 4

Non-Athletic Miles	Average Flight Length	Tonnes $C0_2$	Percentage of Total Emissions
7,095,592	1,126	1,436	60%

Non-Athletic Air Travel Model

The UAA air travel model provides an estimate of the total emissions associated with the air travel of UAA's students and employees. These estimations relied on the TERs collected from the UAA Travel Office. The TERs provide a record of all the flight segments associated with each individual round trip. Of the 8,188 total flight segments, 4,767 were associated with general school-related travel and 3,421 were specifically associated with air travel from the athletics program. These two categories of travel were separated and handled with similar but distinct methodologies.

A 14% sample of non-athletic travel data (263 of 1,841 trips) was analyzed. The data was organized alphabetically by origin airport. Entries included the origin airport, destination airport, and every connecting airport in between. For example, a round-trip flight between Anchorage and Los Angeles with a stop in Portland would be recorded as:

ANC PDX LAX PDX ANC

Each entry was then divided into each of its individual flight segments. For example, the round-trip flight recorded above would be re-entered as:

ANC PDX

PDX LAX

LAX PDX

PDX ANC

The distance between each airport was then calculated using a database provided by the Bureau of Transportation Statistics (BTS). The database provides the great-circle distance (the shortest distance between any two points on the surface of a sphere measured along a path on the surface of the sphere) between all airports. This is a departure in methodology from UAA's previous model, which converted each airport code into its geographic coordinates using the coordinates provided by a separate BTS database. The previous model then used the Haversine formula to find the great-circle distance between the two points. Though the two models differ slightly in their methodology, they rely on the same principles and therefore should generate the same results.

Breaking down the TERs by individual flight segments generated 900 separate flights segments in the 14% sample size. The flight segments were then organized in ascending order of trip length. Finally, the distances were multiplied by the appropriate emissions factor. The emissions factor provides the CO_2 emitted per passenger mile of travel. To reflect the unique rates of fuel consumption relative to the distance, three distinct emissions factors for three different flight lengths were used: under 490 miles, 490-2,300 miles, and more than 2,300 miles. The emissions factors used present a change from UAA's previous air emissions inventory. In the previous inventory, emissions factors were taken from the Clean Air Conservancy, which is no longer in existence. This year's calculations used emissions factors from the United Kingdom's Department of Environment, Food and Rural Affairs (DEFRA), as suggested by the World Resource Institute (WRI). Those factors were: 165.1 gCO_2/pkm, 94.3 gCO_2/pkm and 107.9 gCO_2/pkm respectively.

Athletic Department Air Travel Model

The air travel emissions associated with the Athletics Department were calculated separately from the air travel associated with the other aspects of UAA's operations. The basic methodology of the athletic model is the same as the non-athletic travel model with differences in the sampling size and organization of the data. For the athletic travel, 100% of the flight information was used in order to capture the number of people taking the flights. Flights were organized by individual flight segment with a corresponding number of travelers associated with each flight segment. Most flight segments had numerous UAA travelers, as teams of athletes traveled on the flights together.

As in the non-athletic flight calculation, flights were organized alphabetically by origin city. Mileage was then calculated using the same BTS database that was used in the non-athletic calculations. The flight miles were then multiplied by the same DEFRA emissions factor used in the previous calculation. The resulting emissions were then multiplied by the total UAA passengers on each flight segment to reflect UAA's total emissions from each flight segment.

Comparison with Previous Inventory

Previous years' air travel inventories followed the same basic methodology as the 2010 inventory with the exception of the deviations outlined below:

1. In the previous inventory, each airport was converted to its geographic coordinates, the distance between the two points was then calculated using the

Haversine formula; the formula calculates the great-circle distance between the two points. This year, a BTS database was used to calculate the great-circle distance between every airport. This change in methodology should not affect the results as both methods calculate the great-circle distance between the origin and destination airports for each flight segment.

2. In the previous report, the air travel emission factors for athletic and non-athletic travel were taken from the Clean Air Conservancy. As previously discussed, the Clean Air Conservancy is no longer in existence. This year's inventory used updated emission factors from the DEFRA, as suggested by the WRI GHG Protocol.

Recommendations

Further GHG inventories would benefit from an increase in the accessibility of TER data. This inventory used a sample size of 14% for non-athletic travel. A sample was used because data had to be manually copied from the TER reports into an Excel sheet before it could be analyzed. A streamlined electronic TER system would make using a 100% sample size feasible and eliminate the chance for human error in the transcribing process.

UAA Commuter/Ground Travel Emissions Inventory

UAA's commitment to the ACUPCC requires UAA to calculate and track the emissions associated with the commuting of their students and employees to campus. Also included in this inventory are the emissions associated with automobile travel from UAA sponsored travel. The data used for the commuting portion of the inventory was gathered from information collected in the parking permit application process. Data for the additional UAA business ground travel was pulled from Mileage Reports.

The methodology for the calculations was based off of the 2010 inventory, with adjustments made as a result of a decrease in the detail of information available. A full discussion of the model used can be found below.

Commuter/Ground Travel Model Results

The total emissions associated with commuting and UAA-financed ground travel were 17,624 metric tonnes of carbon dioxide. These emissions were a result of an estimated 20,280,210 total miles traveled. Out of the total emissions approximately 1%

was associated with UAA ground travel, while the vast majority was attributed to the commuting of UAA students and staff.

Table 5

Transportation Type	Total Miles	Tonnes C02
Commuting	20,130,393	17,559
UAA Ground Travel	149,817	65.4
Total	**20,280,210**	**17,624**

UAA Commuter Inventory Model

The data used in the commuting model was provided by UAA Parking Services and provided data for all parking permits issued for the 2011/2012 school year. The information came from a form that students and faculty completed before receiving their parking pass. The information in the survey that was used in the emissions inventory included:

- Permit Type (Annual, Fall, Spring, or summer)
- Zip code commuted from
- Number of times commuted to campus per week
- Automobile year of manufacture
- Automobile make
- Automobile model

Calculating each commuting distance was the first step in estimating the total emissions from commuting. The model used the zip codes provided in the parking permit information. Using Google Maps, we measured the distance from the center point of each zip code to the UAA campus. Google Maps was used to reflect local travel patterns and the likely route taken by each commuter. A distribution of the commuting distances can be found in the table below.

Table 6

Miles Traveled	Total Commuters	Percent of Total	Tonnes C02	Percent of Total Emissions
1-10 Miles	6717	58%	4185.7	24%
10-20 Miles	4185	36%	8533	49%
20-50 Miles	599	5%	3095	18%
Over 50 Miles	131	1%	1745	10%

To estimate the fuel use of each commuter, fuel efficiency data was collected for the year, make and model of each commuter's automobile. Fuel efficiency data was gathered from www.fueleconomy.org, a resource provided by the U.S. Department of Energy and the U.S. Environmental Protection Agency. The database provides combined highway and city miles per gallon (MPG) data for vehicles organized by make and model. In a few cases, information was not available at that website. In those cases, fuelly.com was used to determine an average mpg for the year, make and model of vehicle. The information provided from UAA Parking Services was organized by make and model and then by year and the corresponding MPG was recorded for each vehicle.

The data was then aggregated by parking permit type. This allowed the MPG to be averaged for the Annual, Fall, Spring, and Summer parking passes. A breakdown of the MPG by parking permit type can be found in the chart below.

Table 7

Parking Pass Type	Annual	Fall	Spring	Summer
Average MPG	20.35	20.37	20.10	20.64

The total weeks commuted annually for each permit type was determined based on information collected from UAA's academic schedule. The percentage of the calendar year that each parking pass group was estimated to be commuting to campus can be seen in the table below.

Table 8

Parking Pass Type	Annual	Fall	Spring	Summer
Percent of Year on Campus	93%	45%	45%	10%

The data used in the calculation was reported by students and faculty when applying for their parking passes. The total number of entries in the original document received from Parking Services was 11,910. Naturally in such a large pool of data there was a percentage of missing and inaccurate data. The table below outlines the frequency of each type of data error. By far the most common type was neglect on the part of the responders to report how many times they commuted to UAA each week. This is covered under the "Missing Data" category. These missing entries were replaced with the dataset average of 4.5 commutes per week. The "Outside Commuting Distance" category shows data entries that clearly were outside of the area from which it was reasonable to assume the person was commuting, and/or not

on a road system. These entries include students who listed their location as being in other states such as Washington or in remote parts of Alaska. For these entries it was assumed that the student listed the zip codes of their homes, but that during the school year the students lived in Anchorage. An average distance for other Anchorage commuters was applied to these entries.

Table 9

Entry Type	Total Entries	Percent of Total
Missing Data	2650	22.7%
Outside Commuting Distance	410	3.5%
Total	3060	26.2%

Finally, the total annual miles traveled by each parking pass holder were divided by the appropriate MPG figure to get gallons of gasoline used in UAA commuter vehicles. The gallons of gasoline used was then summed and multiplied by the emissions factor provided by the Energy Information Administration (EIA) for gasoline.

Ground Travel Model

The data used to calculate the emissions from UAA ground travel was gathered from Mileage Reports. The reports list the total miles traveled for each approved trip. This mileage was simply summed to calculate the total miles traveled, which was then divided by the average MPG (as calculated from the commuting survey) to give the total gallons of gasoline used. The average MPG was used because the Mileage Reports did not include the vehicle type.

As in the commuting survey, the total gallons of gasoline used were then multiplied by the emissions factor for gasoline as provided by the EIA. This resulted in the total emissions associated with the UAA ground travel.

Comparison with Previous Inventory

The methodology used in this model deviated from the previous years' methodologies in several ways. These changes were a result of several changes in available data. The changes in the data that were collected necessitated that the model be changed accordingly. The changes are outlined below:

1. The previous year's inventory utilized the address of each individual commuter and converted it to its geographic coordinates. This year's data did not include street addresses of each commuter, instead only the commuter's zip code was provided. The model took the center point of each zip code and measured the distance from the center point to the UAA campus using Google Maps. Google Maps was used in an attempt to reflect the likely route taken by the commuter.

2. The 2010 inventory took into consideration the change in fuel efficiency depending on whether a vehicle is driven in city traffic or on highways. The inventory then applied these distinct efficiency ratings to each vehicle depending on whether the commuter lived within or outside Anchorage. This level of detail in fuel efficiency was not available this year; instead an average city/highway MPG rating was applied to each vehicle based on its year, make and model.

Conclusion

In FY 2012, UAA emitted a total of 57,986 metric tonnes of CO_2. As shown in Figure 4 below, the three largest sources of emissions were electricity used on campus which emitted 19,479 metric tonnes, followed by emissions from commutes at 17,559, and from combustion of natural gas at 15,954. Smaller sources of CO_2 emissions included air travel at 2,405 metric tonnes, electricity losses accounted for 1,927, use of fuel by UAA fleet vehicles emitted 576 metric tonnes, ground travel for University business 65, and water and sewer emissions totaled 21 metric tonnes.

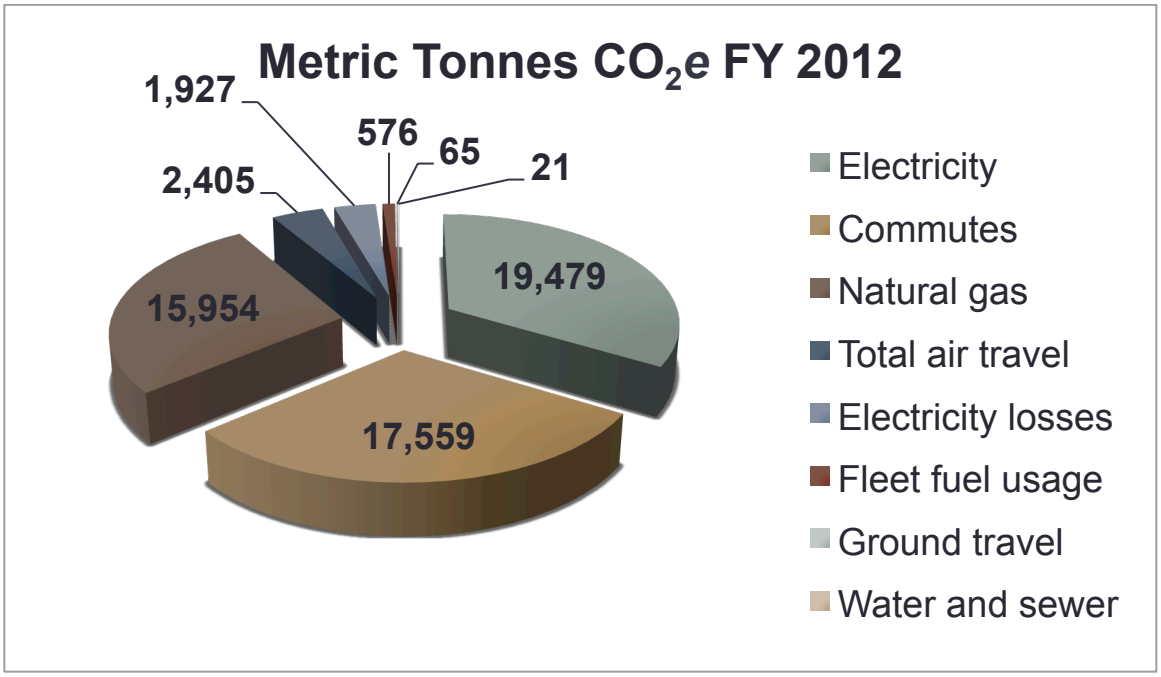

Figure 4: Metric Tonnes of CO2e emitted by UAA in FY 2012 by source

As described above, methods of calculating UAA's scope one, two, and three emissions changed enough between our report in 2010 and our current report to make comparisons inaccurate. Nonetheless, in 2010 UAA reported a total of 13,164 metric tonnes attributable to burning natural gas. In 2012, that totaled 15,954, which is a significant increase compared to 2010. Calculations between reports were similar and it is fair to say that UAA's carbon emissions from natural gas have increased.

Electricity CO_2e emissions in 2010 were reported to be 18,950 metric tonnes. In 2012 our emissions from this source were 19,479, which is also an increase. Emissions from fleet fuel usage were 516 metric tons CO_2e emissions in 2010 and 576 in 2012. Emissions from electricity losses accounted for 1,839 metric tons of CO_2e in 2010 and for 1,927 in 2012 (reflecting the higher use of electricity between those two periods).

Emissions from air travel were reported to be 2,641 metric tonnes in 2010, and 2,405 in 2012. The methodology used in both reports is similar enough to allow a reasonable comparison, so it appears that UAA has reduced its emissions from air travel.

The 2010 report calculating emissions from commutes to campus (generated by ISER) estimated auto commute emissions to have totaled almost 7,800 metric tons of emissions from commutes. The data used in this report are less refined as zip codes of origin (rather than addresses) were used to calculate commute distances. The total emissions from commutes were calculated to be 17,559 metric tonnes, a significant increase over those reported in 2010. The increase is probably at least partly explained by the differences in data used in the two reports.

The 2010 report also calculated emissions from ground travel for UAA business purposes to be 1,700 metric tons. In 2012, the calculation indicated 65 metric tonnes were emitted from ground travel. Ground travel emissions between the two time periods were significantly lower.

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