GREENHOUSE GAS EMISSIONS INVENTORY FOR THE UNIVERSITY OF WYOMING: Update, Fiscal Year 2008

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For

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Abstract

This document is a narrative report based on the Greenhouse Gas (GHG) Emissions Inventory of the University of Wyoming (UW) for the Fiscal Year (FY) 2008. It is an update to the GHG Emissions Inventory conducted for the university by interns Linse Anderson and Alyssa Wechsler in FY 2007, which served as the first and thus the baseline inventory for this institution and spanned from FY 1997 to FY 2007. The inventory data is included in Appendix A and includes all fiscal years up to the current year. The results of the inventory have not changed dramatically throughout this period, and most discrepancies have resulted from changes in the university's population and new construction projects, fluctuations in weather/temperature that have lead to fluctuations in energy used for heating and additions to data categories in the inventory. Overall, GHG emissions for FY 2008 decreased slightly from the previous year.

UW conducts a GHG Inventory as part of its commitments as a signatory to the *American College and University Presidents Climate Commitment* (ACUPCC), which the UW President Tom Buchanan signed in the fall of 2007.

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Introduction

American College and University Presidents Climate Commitment (ACUPCC)

The ACUPCC was organized in the fall of 2006 and is supported by the Association for the Advancement of Sustainability in Higher Education (AASHE), ecoAmerica and Second Nature. The purpose of this organization is to address global climate change by engaging institutions of higher education not only to commit to neutralizing their GHG emissions, but to realize their unique ability and responsibility in advancing research and education to their students and communities that will provide society with the tools it needs to address all dimensions of global climate change. Signatories to the commitment are pledging to complete a series of steps to eliminate their campuses' greenhouse gas emissions and increase sustainability over time. These steps are to:

- Complete a GHG Emissions Inventory yearly
- Choose from a designated list of immediate or short-term actions to reduce GHG emissions
- Complete a Climate Action Plan for achieving carbon neutrality (within 2 years of signing)
- Integrate sustainability into the curriculum
- Make the Climate Action Plan, GHG Emissions Inventory and progress reports publicly available

Greenhouse Gas Emissions Inventories

A GHG Emissions Inventory is an accounting of the amount of GHGs emitted to or removed from the atmosphere over a specific period of time from a spatially and conceptually defined entity (e.g. UW). Conducting a GHG Emissions Inventory is the first step towards emissions neutrality because it provides a baseline from which to move forward in reducing emissions.

There are numerous emissions inventory calculators in use by governments, businesses, schools and others around the globe. However, the goal to provide a numerical value for an entity's role in contributing to global climate change is still the same. What's more, almost all GHG emissions calculators convert emissions and energy use data into carbon dioxide equivalent units, or $CO_{2e.}$ A CO_{2e} is calculated based on its global warming potential (GWP), which is the ratio of warming that would result from 1 kg of any GHG to x kg of CO_2 in a fixed period of time. The GWP ratio is the radiative forcing (RF) of a given substance being emitted in relation to the RF of CO_2 which, based on wave-length and life-time, determines the degree to which the gas traps the sun's energy. For instance, the GWP of CH_4 is 25, so 1 molecule of CH_4 warms the planet to a similar extent as 25 molecules of CO_2 meaning that emitting 1 kg of CH_4 is equivalent to emitting 25 kg of CO_2. This allows for a standardized unit of comparison both within and among entities (IPCC 2007).

The calculator recommended for and used by the vast majority of the ACUPCC signatories, including UW, is the Campus Carbon Calculator (CCC), which also uses $CO_{2e.}$ The

CCC was developed by Clean-Air Cool Planet (CA-AP) through a project completed by the University of New Hampshire based on workbooks of the International Panel on Climate Change (IPCC). It is a Microsoft Excel-based spreadsheet tool customized to account for the main emission sources on college and university campuses, including on-campus energy production, purchased electricity, transportation, waste, agriculture, and refrigerants (CA-CP 2008).

Global Climate Change

The ACUPCC and its required GHG Emissions Inventory is a mechanism to address global climate change by reducing GHG emissions. This approach to addressing global climate change is due to the fact that the amount of anthropogenically released GHGs, primarily CO_2, has dramatically increased since pre-industrial times, along with global temperature. Today's level of 380 ppm of CO_2 in the atmosphere far exceeds historical variations of 180-300 ppm, as does the rate of global temperature rise. GHGs trap solar radiation in the atmosphere, keeping the planet at a hospitable global average temperature. However, when the concentration of GHGs gets too high and too much solar radiation is trapped, the temperature can get too high, resulting in changes to global climate patterns (Allali et al. 2007). Human activities have greatly increased the concentration of GHGs in the atmosphere by emitting GHGs through activities such as the burning of fossil fuels for electricity production and transportation, to name a few. Thus, mitigation actions must be taken quickly to decrease anthropogenic GHG emissions into the atmosphere, which is the mission of the ACUPCC.

Greenhouse Gas Emissions Inventory

Methodology

The FY 2008 GHG emissions inventory for UW was conducted by UW students, Brent Brouillard and Jamie Wolf, with oversight from the university's Campus Sustainability Committee. Data was collected from the main campus and all of UW's properties and entered into the CCC Excel spreadsheet to be calculated into CO_{2e}.

When collecting data, interns verified with campus sources whether or not the data included or excluded properties outside of the main campus to avoid missing information or double-counting. In the event the data provided did not include UW property outside of the main campus, satellite properties were contacted for the remaining data which was then aggregated with the main campus data before being entered into the CCC spreadsheet for calculation. The resulting data sets include on campus and off campus sources. Appendix C shows each emissions data category and the source/s from which it was obtained.

The ACUPCC identifies three scopes of emissions that the data categories of the CCC inventory calculator fall into:

- Scope 1 emissions are direct GHG emissions from sources either owned or controlled by the institution. These sources include on-campus stationary fossil fuel combustion, fossil fuel combustion by institution-owned or controlled vehicles, and fugitive emissions. Fugitive emissions are either intentional or unintentional GHG

emissions, including HFCs from refrigeration and air conditioning equipment and CH_4s from institution owned livestock.
- Scope 2 emissions are indirect emissions that are generated in the production of electricity which is consumed by the university.
- Scope 3 refers to all other indirect emissions that occur as a consequence of activities of the university from sources not owned or controlled by the university.

ACUPCC signatories must report on Scope 1 and 2 emissions, as well as some Scope 3 emissions, including commuting and air travel paid for by or through the university.

Emissions data requiring more in depth explanation regarding the methods used will be detailed below:

Budget

For this inventory, data concerning the university budget is divided into three categories: operational budget, research dollars and energy budget. It is important to note that the data for these three categories were collected separately from different entities on campus, but the operational budget does include the entire energy budget, as well as some of the funds used for research.

The energy budget must be subtracted from the operational budget to ensure that it is not counted twice, and this fact must be noted when interpreting data outcomes. Furthermore, the CA-AP calculator instructs users to include the combined costs of purchased electricity, chilled and steamed water and any other purchases for the production of On-Campus Stationary sources of energy (i.e. heating, cooling, etc.). Therefore, UW's current energy budget includes purchased electricity, coal, propane and natural gas. Water is not included because the water used and purchased by the university does not go towards energy production. The rise in the energy budget from previous years can be explained by higher energy prices, inaccurate coal consumption amounts for FYs 2006 and 2007 and exclusion of propane and natural gas from previous years' numbers.

Research dollars are not included in the operational budget. Research funds are separate monetary awards or grants to the University for specific research projects. The research money included in the operational budget is a much lower amount that primarily covers personnel costs which the additional research money does not cover, so there is no double-counting.

All three budget categories include data from UW's satellite locations and properties. Future interns should ensure this is still the case when collecting data on UW's budget.

Building Space

To collect information on UW's building space, we requested data from UW Real Estate Operations through their GIS services. All property, and thus all building space owned by UW, was included and categorized according property type (e.g., research space). The University is experiencing significant facility growth with about eight major projects either recently completed or under construction. Therefore, it is difficult to specifically determine the exact total square footage on line as of the data gathering date. An estimate of 140,000 square foot net increase was used for this report. The research space reported for this year is 33% less than prior years, but we believe this collection process is more accurate than the methods used in the past. Future interns should continue with this methodology. Research space was included in total building

space. This is not considered double counting because the two numbers are graphed separately and this inclusion follows the CA-AP calculator guide.

On-Campus Stationary

When calculating and converting total emissions in Metric Tons (MT) of CO_{2e} from original units, the CA-AP calculator automatically combines the components of on-campus stationary sources (currently including coal, natural gas and propane in UW's case) into one total figure of MT CO_{2e}. In order to calculate and convert the individual components of on-campus stationary sources into MT of $CO_{2e,}$ the emissions factors for coal, natural gas and propane from the CA-AP calculator from the Emission Factors for all On-Campus Stationary Sources sheet were used in a separate spreadsheet to provide calculations useful to the University. Those calculations are shown in Appendix C. The emissions factors are approximations showing the amount of MT of CO_{2e} per given unit of an individual emission source (i.e. MT of CO_{2e} per Short Ton of coal). These emissions factors from the calculator were multiplied by the amount of each on-campus stationary source in its own unit of measure to determine their individual contributions to UW's GHG emissions. This data will provide valuable information to UW in evaluating progress toward energy reduction goals included in the University's Climate Action Plan.

Commercial Air Travel

Commercial airline miles were first calculated by finding the total number of flights paid for by the University. This information was either tracked through departmental receipts kept on record by Accounts Payable or receipts from UW employee debit cards, called the P-Card. The flights paid for with the P-Card gave an accurate value for tickets purchased, but Accounts Payable records all travel reimbursements under the same code regardless of the type of travel. For instance, a flight is recorded under the same code as a rental car or a taxi. Because of this, it is impossible to find an accurate number of flights reimbursed during FY 2008. To estimate, we assumed all reimbursements under the travel code in amounts over $100 dollars were airline tickets. To find the total airline miles traveled, a random sample of 36 flight receipts were used. The average miles flown per ticket for the 36 flights was calculated and multiplied by the total number of flights found through Accounts Payable and the P-Card. This yielded the estimated total amount of commercial airline miles flown for FY 2008. This method is consistent with the method used for calculating commercial air travel for previous fiscal years for the purposes of this inventory. A recommendation is included in a later section of this report to create a separate account code for air travel to facilitate more accurate data gathering in future years.

Forest/Grassland Offsets

UW Real Estate Operations conducted a GIS inventory of UW properties and then categorized them as developed, agricultural, forested upland and herbaceous upland based on the descriptive land-cover classifications of the United States Geological Survey (USGS). The forested and herbaceous uplands are the only sequestering land types owned by UW. UW owns 14,751 acres of herbaceous upland and 381 acres of forested upland. We found that UW's forested uplands sequester approximately 572 tons of CO_{2e} using an approximated calculation provided by the Pew Center on Global Climate Change. We were unable to find a credible calculation for the sequestration abilities of herbaceous uplands or grasslands.

Unfortunately, this information cannot be used as an offset in the CCC. IPCC states that unless the University is enhancing the existing ability of a property to sequester GHGs (e.g., management practices such as planting more vegetation or changing the health or species composition of the property so it offsets more GHGs than without this owner management), it cannot be claimed as an offset. This is known as the Additionality Clause. However, data on the acreage of UW's forested and grassland property is useful as baseline knowledge for what they currently contribute to sequestration and global warming mitigation. Although there is a margin of error in the amount of GHGs actually sequestered from these properties due to a lack of available information on the numerical sequestration abilities and affecting variables such as vegetation age, density, soil, species composition, and other variables, it is still useful to understand that they do have a sequestration value.

Physical and Temporal Boundaries

The physical boundaries of this emissions inventory extended beyond the main campus to include all property owned by UW, all of which lies within the state of Wyoming. The ACUPCC requires participating institutions to calculate and report emissions in periods of one year, either calendar, fiscal, or academic. This inventory calculates and reports data according to the fiscal year (July 1 through June 30).

UW Inventory

The American College and University Presidents Climate Commitment recommends that colleges and universities utilize the CCC to conduct their emissions inventory, although this recommendation is not a requirement since some signatories have already completed emissions inventories utilizing different calculators. Additionally, some institutions are enrolled in programs such as the Chicago Climate Exchange or the California Climate Action Registry, that require emissions be calculated in a specific manner. In light of this, signatories are allowed to use any emissions inventory calculator that is "consistent with the standards of the Greenhouse Gas Protocol" (Dautremont-Smith 2007). As the CCC is in accordance with the GHG Protocol, and it is designed specifically for colleges and universities, those institutions without an inventory already in place are encouraged to utilize the CCC. It is the most common inventory tool for colleges and universities, facilitating comparability and consistency. For these reasons, the CCC v5.0 is the calculator used for the UW GHG emissions inventory.

The main input fields and data sources are listed in Appendix A. Some of the categories are entered solely for reporting and comparison purposes. For instance, the budget data includes input fields for the operating budget, research dollars, and energy budget. This information does not impact the emissions calculations, but is used to generate reports and graphs comparing the budget data to emissions. Likewise, population and physical size are not themselves used in the calculator to determine emissions. Rather, the information is used to generate reports such as per capita emissions.

Findings

During FY 2008, the University of Wyoming emitted a net total of 133,909 metric tons of CO_{2e}. Net emissions are calculated by summing all of UW's emissions, (the calculator identifies these as Gross emissions), which amounted to 133,924 metric tons of $CO_{2e,}$ and then subtracting offsets, which amounted to 15 metric tons of $CO_{2e.}$ This is a very slight decrease in emissions from FY 2007's net total of 134,004 metric tons of $CO_{2e.}$ The net difference of 83 metric tons is a decrease equivalent to less than ½ of 1%. More detail addressing any differences in the distribution of the sources of these emissions will be explained later in this section. Figure 1 below shows the overall trend in UW's net emissions, by source, from 1997-2008.

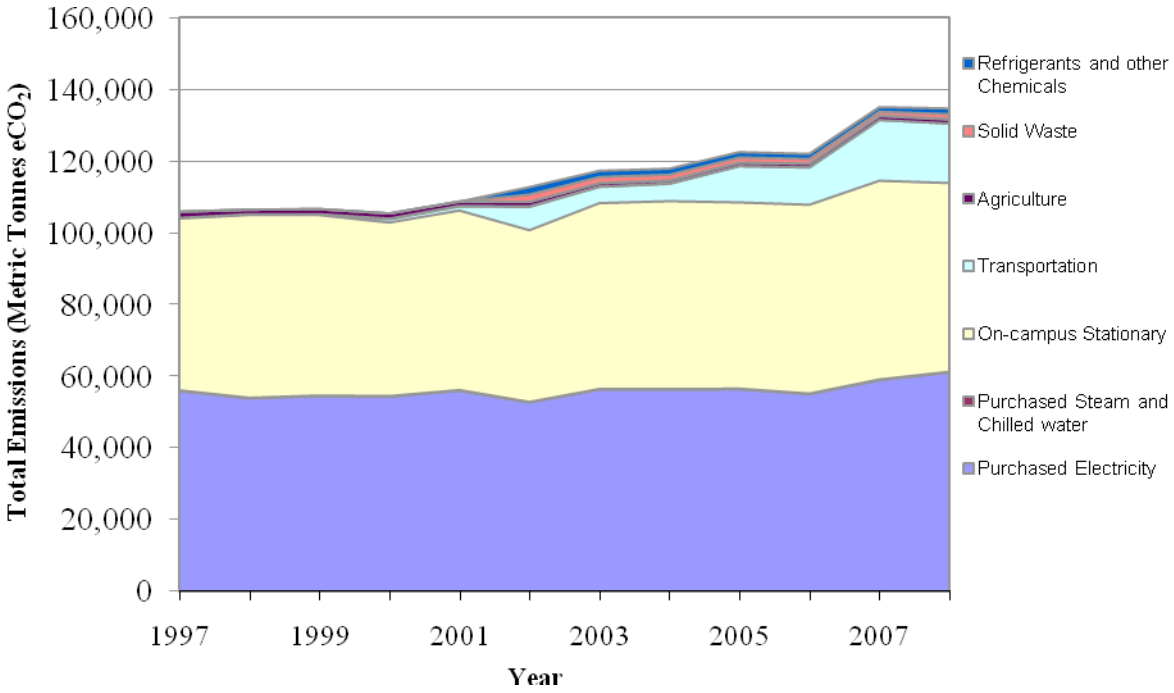

Figure 1. UW greenhouse gas emissions by source, 1997 – 2008, reported as metric tons of CO_{2e}.

Figure 1 shows an overall trend of gradually increasing emissions for UW from all sources. The amount of purchased electricity increased 3.6% from FY 2007 to FY 2008. On-campus stationary emissions decreased approximately 5% from FY 2007-FY 2008. It is important to note that the CA-AP calculator defines on-campus stationary sources as energy sources that generate emissions on campus for the production of heat, cooling, cooking and other campus uses. UW's current on-campus stationary sources include coal, natural gas and propane, with coal being the largest emitter and propane being the smallest. Please see Appendix A on page 20 for the individual unit amounts before they were converted to CO_{2e} and combined into the total on-campus stationary value. This decrease can be explained by natural temperature

variations that occur from year to year rather than a change in behavior. The winter of FY 2007 was colder than that of FY 2008, so greater consumption of coal and natural gas was needed for heating purposes.

Transportation has experienced the largest increase in emissions since this inventory began, somewhat as a result of UW's growth, but primarily due to increases in air travel. However, this has been leveling out over the last few years. From FY 2007 to FY 2008, air travel emissions decreased by approximately 2.4%. The difference could be attributed to natural annual fluctuations in UW faculty air travel, but it is important to keep in mind the potential margin of error associated with calculating emissions from air travel, as explained in the Methodology section of this report.

Agriculture and solid waste have been very steady and rather insignificant relative to UW's total emissions. Refrigerants were included for the first time resulting in a total increase of 602 metric tons of CO_{2e} towards UW's net emissions. UW does not purchase steam or chilled water so that is not included on the graph even though it is in the key.

The percentage of emissions from each CA-AP category source is shown in Figure 2 below to provide a visual breakdown of UW's contributions to GHGs.

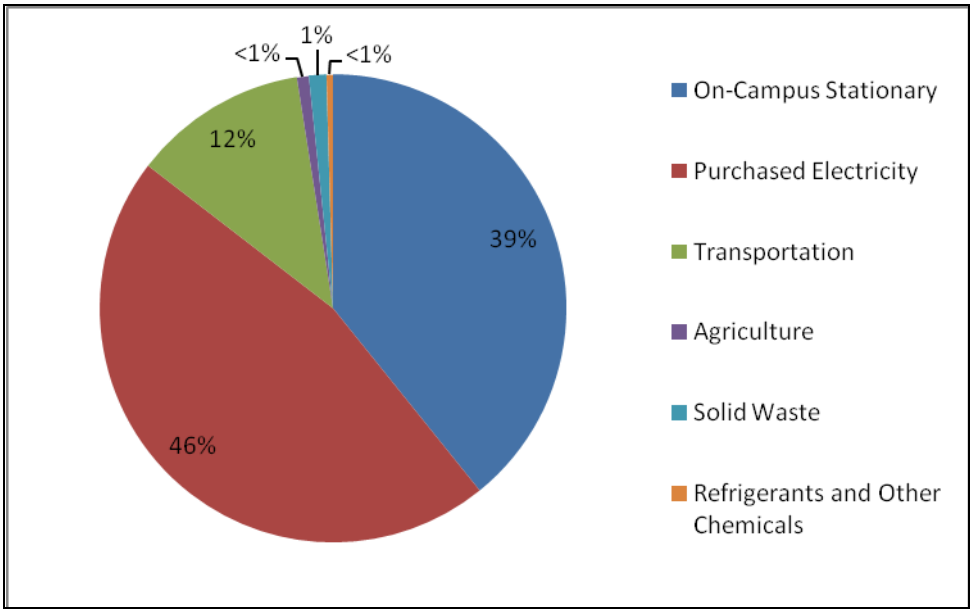

Figure 2. FY 2008 percentage contributions to total GHG emissions by CA-AP category source.

The CA-AP automatically categorizes UW's emissions sources by putting them into categories. Both transportation and on-campus stationary emissions consist of multiple components, as described previously for Figure 1. Figure 3 shows a percentage breakdown of the components for transportation emissions, and Figure 4 shows a percentage breakdown for the components of on-campus stationary emissions.

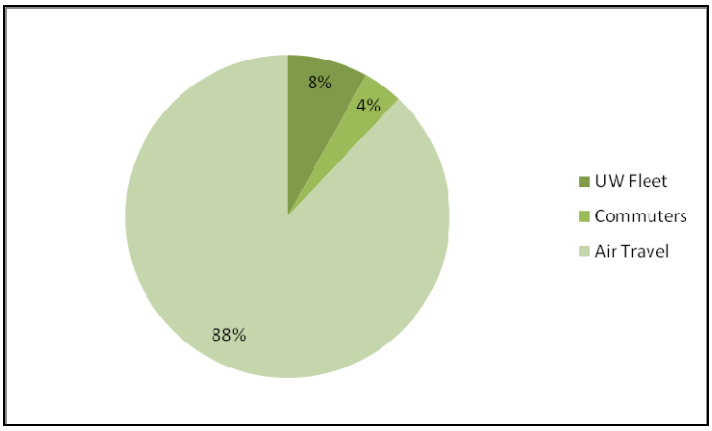

Figure 3. FY 2008 percentage contributions to UW's transportation emissions.

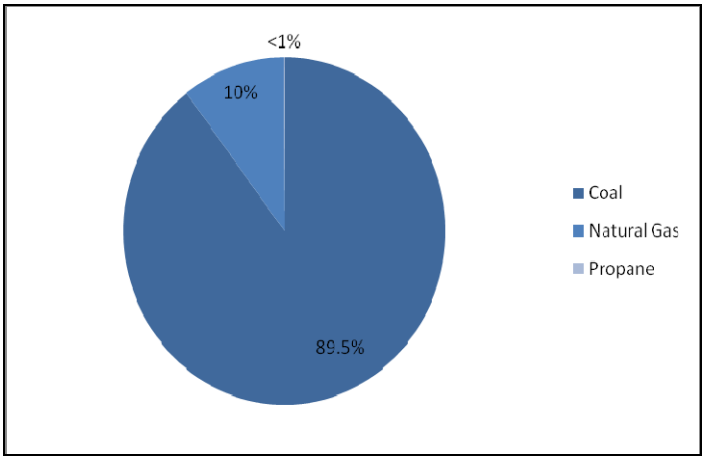

Figure 4. FY 2008 percentage contributions to UW's on-campus stationary emissions.

Figure 5 shows all of UW's emissions sources, including the individual components of both transportation and on-campus stationary emissions, as percentage contributors to UW's total emissions.

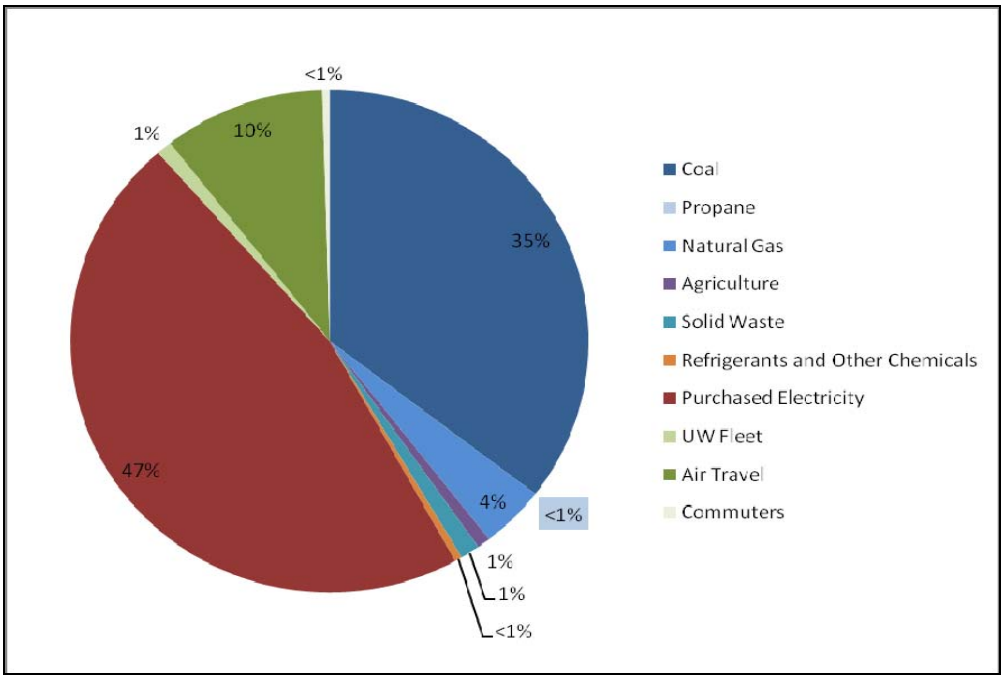

Figure 5. FY2008 percentage contributions to UW's total GHG emissions by source.

Electricity (47%) and coal (35%) and consumption, followed by air travel (10%), are of the major contributors to $C0_{2e}$ GHG emissions at UW. This distribution is consistent with other colleges and universities that have completed an emissions inventory. Duke University's emissions inventory in 2003 found the top three sources of emissions were purchased electricity (55%), on-campus steam production (25%), and transportation (22%) (Hummel and Barkley, 2004). Oregon State University's 2007 emissions inventory found that the top three sources of emissions were from purchased electricity (61%), on-campus natural gas consumption (20%), and air travel (10%) (Smith and Trelstad, 2008). The University of California, Santa Barbara reported the top three sources of emissions as purchased electricity (63%), on-campus natural gas consumption (35%), and air travel (10%) (Ahmed et al, 2006).

The per capita emissions for the past eleven years for the University of Wyoming community, including students, faculty, and staff, is displayed in Figure 6.

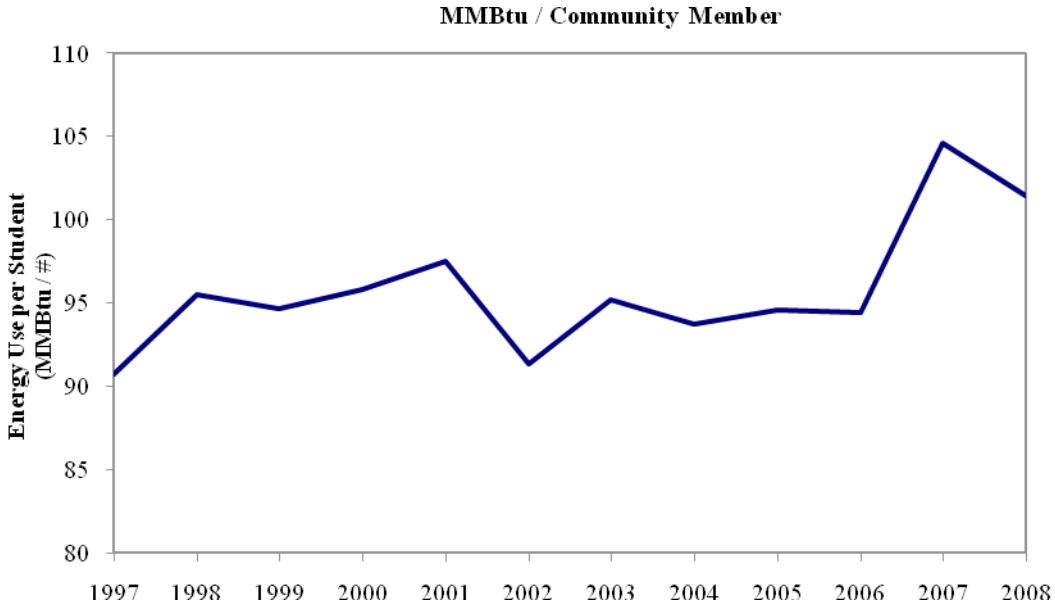

Figure 6. Per capita metric tons of carbon dioxide equivalent greenhouse gas emissions for the UW community, including students, faculty, and staff.

Over the time period, 1997 – 2008, the average emissions per UW community member have increased approximately 17%. The fine scale of the graph on the Y axis makes the results appear to be more dramatic; however, the difference between the lowest and highest FYs (1997 and 2007 respectively) is about 15 MMBTU per UW campus community member, or approximately 14%. FY 2007 data showed the highest emissions ever recorded due to a lower part time student population than surrounding years, resulting in a spike in per capita emissions for that year.

Recommendations

Upon completing the UW GHG inventory for FY 2008, the following recommendations suggest how the inventory may be expanded and/or improved in the future. These recommendations are aimed at improving accuracy of information and comprehensiveness of the report.

- To improve the accuracy of the inventory, customization to conditions at UW should continue to be investigated so that the Custom Fuel Mix feature of the CCC can be used. It is recommended that the heat content value of coal specific to UW's Central Energy Plant be utilized.

- To improve the credibility and accuracy of the report, interns should be always vigilant and investigate any outstanding trends or numbers that are markedly higher or lower than other years. If the data and calculations are found to be correct, an explanation of this change should be included in the narrative report. For example, the on-campus stationary emissions results reported for FYs 2006 and 2007 appeared to be dramatically lower than previous years, yet there was no justification provided for this. After further research, it was found that these numbers were incorrect; an inaccurate version of an earlier draft had been submitted that did not match up with the narrative report or logical trends. Corrections were made, but these mistakes should have been noted and addressed in the previous year to avoid unnecessary work and confusion as well as potentially permanent error in tracking trends for years to come.

- To improve the accuracy of commercial air travel data, UW Accounts Payable should create a code specifically for air travel. This would allow future interns to find the exact amount of flights for a fiscal year instead of making an estimate based on the amount of refunds over $100.

- A commuter survey, designed to gather data required for the GHG inventory, should be conducted every 3 years. An annual survey is considered unnecessary because the commuter contribution to overall emissions is minimal, and surveys can be resource and time-intensive. We believe that commuter rates will not vary significantly from year to year unless there is a major change in either the University's population size or transportation infrastructure. Due to the current and ongoing expansion of the University shuttle system, as well as the fact that a commuter survey has not been conducted since 2007, we recommend that the next survey be conducted during FY 2010. The GHG Protocol tool CO_2 Emissions from Employee Commuting v. 2.0 (WRI 2006) contains an MS Excel-based survey. This employee survey could be modified for students, faculty, and staff at UW and dispersed electronically to the UW community.

- When collecting data from individuals and entities, interns should ensure that no data overlap occurs and that no data are being "double-counted." For example, make sure when collecting fertilizer data that each contact is only providing an amount for their location and not others as well. On the other hand, such as in the case of the UW operational budget, if it is disclosed that the data provided covers all UW locations, note this, and do not seek additional data from the individual components.

- An annual memo should go out thanking data contacts and reminding them that the GHG inventory will be conducted each year. This would ease the process of gathering data both for the interns and the individuals providing the data if contacts were already aware that the information was going to be requested of them for each fiscal year.

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World Resource Institute. 2006. CO_2 emissions from employee commuting, version 2.0 [Internet]. [downloaded 2008 Apr 1]. Available from www.ghgprotocol.org.

Appendix A. GHG Emissions Inventory CA-AP Calculator Data Sheets

(Note: FY 2007 was the first year UW conducted a GHG inventory and historical data was collected to provide a ten year analysis period. In some cases data was accessible for FYs prior to 1997, the earliest being 1990. Data is shown from the earliest year collected and recorded to provide for as much trend analysis as possible. Blanks indicate missing/unknown data, as opposed to 0, which indicates no (known) quantity exists for UW. Numbers in bold indicate estimates filled in for missing data fields from FY 2007, with the purpose of ensuring accurate data trends.)

Institutional Data			
Fiscal Year	**Budget**		
	Operating Budget	Research Dollars	Energy Budget
	$	$	$
1990	$ 208,973,119.60	$ 33,022,071.60	
1991	$ 217,516,856.84	$ 32,661,922.80	
1992	$ 221,826,669.61	$ 36,819,266.41	
1993	$ 226,048,398.16	$ 37,141,138.11	
1994	$ 222,061,833.91	$ 37,592,041.92	
1995	$ 238,043,475.34	$ 39,193,534.46	
1996	$ 241,125,554.86	$ 41,691,894.15	
1997	$ 251,121,159.84	$ 44,005,861.50	
1998	$ 243,262,153.52	$ 44,917,073.08	
1999	$ 255,011,589.19	$ 45,355,906.91	
2000	$ 246,901,889.87	$ 45,515,521.17	
2001	$ 258,261,695.02	$ 49,189,616.92	$ 831,624.39
2002	$ 259,603,997.22	$ 50,818,310.09	$ 778,673.90
2003	$ 280,791,523.00	$ 54,005,147.00	$ 3,051,924.50
2004	$ 280,524,727.43	$ 60,224,918.00	$ 3,308,729.28
2005	$ 302,707,265.99	$ 63,369,136.61	$ 3,817,988.13
2006	$ 299,264,785.09	$ 67,237,328.37	$ 4,018,446.31
2007	$ 331,344,309.67	**$ 68,000,000.00**	$ 4,448,758.32
2008	$ 346,333,564.94	$ 70,869,254.11	$ 5,247,420.44

Fiscal Year	Population				
	Full Time Students	Part-Time Students	Summer School Students	Faculty	Staff
	#	#	#	#	#
1990	8797	4723	3474	612	1920
1991	8682	4921	3877	613	1920
1992	8698	4761	3761	635	1920
1993	8584	4474	3466	600	1920
1994	8551	4076	3241	591	2073
1995	8564	3953	3106	635	2073
1996	8412	3477	2700	626	2035
1997	8354	3524	2622	620	2035
1998	8139	3336	2579	615	2024
1999	8230	3315	2536	612	2024
2000	8111	3223	2488	606	1926
2001	8147	3628	2831	596	1926
2002	8435	4037	3098	604	1907
2003	8580	4208	3171	612	1907
2004	8610	4384	3204	624	2122
2005	8744	4287	3369	643	2122
2006	8620	4306	3106	651	2182
2007	8659	3606	3080	**1115**	**1750**
2008	8798	4,172	2,811	1,044	1,736

Fiscal Year	Physical Size	
	Total Building Space	Total Research Building Space
	Square feet	Square feet
1997	6718146	1,171,187
1998	6718652	1,171,693
1999	6718652	1,171,693
2000	6718652	1,171,693
2001	6796102	1,172,597
2002	6799145	1,172,597
2003	6802745	1,172,597
2004	6813324	1,172,597
2005	6925267	1,224,617
2006	6913471	1,224,617
2007	7068817	1,218,098
2008	**7208817**	797,032

Purchased Electricity	Puchased Steam / Chilled Water		
Fiscal Year	Electric produced off-campus	Steam and Chilled water produced off-campus	
	All users: Click to select your electric region or "custom" if you know your electric fuel mix	Purchased Steam	Purchased Chilled Water
	WECC Rockies	Go to EF_Steam to set steam fuel mix	Go to EF_Water to set fuel mix
	kWh	MMBtu	MMBtu
1992	53,445,897	0	0
1993	53,941,369	0	0
1994	52,184,047	0	0
1995	56,167,979	0	0
1996	46,972,247	0	0
1997	60,338,399	0	0
1998	58,092,656	0	0
1999	58,793,723	0	0
2000	58,604,939	0	0
2001	60,436,600	0	0
2002	56,858,767	0	0
2003	60,759,668	0	0
2004	60,748,033	0	0
2005	60,840,819	0	0
2006	59,372,098	0	0
2007	63,602,733	0	0
2008	65,921,694	0	0

On Campus Stationary Sources										
Fiscal Year	This category includes all stationary sources of emissions on campus (heating, cooling, cooking, laboratories, etc)									
	Residual Oil (#5 - #6)	Distillate Oil (#1 - #4)	Natural Gas	Propane	Incinerated Waste	Coal	Other A (#2 diesel for gensets)	Other B	Other C	Solar / Wind / Biomass
	Gallons	Gallons	MMBtu	Gallons	MMBtu	Short Ton	MMBtu	MMBtu	MMBtu	MMBtu
1995	0	0			0	20233	0			0
1996	0	0			0	19443	0			0
1997	0	0	58,807		0	22717	0			0
1998	0	0	104,822		0	22995	0			0
1999	0	0	98,058		0	22892	0			0
2000	0	0	96,486		0	21963	0			0
2001	0	0	103,020		0	22787	0			0
2002	0	0	102,155		0	21864	0			0
2003	0	0	104,706		0	23958	0			0
2004	0	0	115,315		0	24097	0			0
2005	0	0	108,453		0	24059	0			0
2006	0	0	113,063		0	24297	0			0
2007	0	0	107,146	6,841	0	25864	0			0
2008	0	0	103,403	8,867	0	24510	0			0

Transportation													
Fiscal Year	University Fleet					Air Travel		Commuters					
	Gasoline Fleet	Diesel Fleet	Natural Gas Fleet	Electric Fleet	Other Fleet	Faculty / Staff Business	Student Programs	Faculty / Staff Gasoline	Students Gasoline	Faculty / Staff Diesel	Students Diesel	Faculty / Staff Electric	Students Electric
								DO NOT ENTER DATA IN THESE COLUMNS; USE "INPUT_COMMUTER" WORKSHEET.					
	Gallons	Gallons	MMBtu	kWh	MMBtu	Miles	Miles	Gallons	Gallons	Gallons	Gallons	kWh	kWh
1997			0	0	0								
1998			0	0	0	16,100							
1999			0	0	0	66,240							
2000	81,930	12,987	0	0	0	36,000							
2001	101,363	16,520	0	0	0	78,433							
2002	99,005	19,805	0	0	0	6,903,773							
2003	97,870	29,686	0	0	0	4,291,792							
2004	103,370	36,341	0	0	0	4,506,532							
2005	104,362	41,560	0	0	0	11,167,532							
2006	96,069	34,851	0	0	0	11,722,533							
2007	94,888	35,091	0	0	0	19,351,563		44,007	33,731	542	8,378		
2008	98,304	38,386	0	0	0	18,877,452		33,890	35,316	476	11,704		

Agriculture											
Fiscal Year	Includes all agriculture and animal husbandry run by the university										
	Fertilizer Application				Animal Agriculture						
	Synthetic	% Nitrogen	Organic	% Nitrogen	Dairy Cows	Beef Cows	Swine	Goats	Sheep	Horses	Poultry
	Pounds	%	Pounds	%	#	#	#	#	#	#	#
1994					152	1,168	346	0	1,559	11	0
1995					156	926	159	0	1,524	11	0
1996					163	858	199	0	1,855	11	0
1997					146	788	116	1	1,422	7	0
1998					0	909	99	1	1,189	6	0
1999					0	1,016	207	1	1,184	6	0
2000					0	1,023	268	1	1,142	6	0
2001					0	853	180	1	976	5	0
2002					0	880	238	1	850	4	0
2003					0	652	97	1	851	4	0
2004					0	537	143	1	788	4	0
2005					0	629	159	1	681	4	0
2006					0	646	128	0	964	4	0
2007	30,746	**21%**	0	0%	0	705	137	0	1,103	4	0
2008	33,456	21%	0	0%	0	728	92	0	1,118	3	0

Solid Was Solid Waste					
Fiscal Year	Includes all solid waste produced by campus except waste composted, recycled or burned on campus for power				
	Incinerated Waste (waste to energy plant) not used for school power		Landfilled Waste with no CH_4 Recovery	Landfilled Waste with CH_4 Recovery and Flaring	Landfilled Waste with CH_4 Recovery and Electric Generation
	Mass Burn Incinerator	Refuse Derived Fuel (RDF) Incinerator			
	Short Tons	Short Tons	Short Tons	Short Tons	Short Tons
1997	0	0		0	0
1998	0	0		0	0
1999	0	0		0	0
2000	0	0		0	0
2001	0	0		0	0
2002	0	0	2,111	0	0
2003	0	0	1,766	0	0
2004	0	0	1,696	0	0
2005	0	0	1,528	0	0
2006	0	0	1,433	0	0
2007	0	0	1,295	0	0
2008	0	0	1,593	0	0

Refrigeration and other Chemicals (PFCs, HFCs, SF6)						
All other greenhouse gases (click chemical name below to select)						
HFC-134a	HFC-404a	HCFC-22	HCFE-235da2	Others	HG-10	Sum
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	kg
						0
						0
						0
						0
						0
						0
						0
						0
						0
						0
33	190	390				1348.6

Offsets		
Actions taken to offset emissions		
Renewable Energy Credits	Composting	Forest Preservation
kWh	Short Tons Compost	Metric Tonnes CO_2
0		
0		
0		
0		
0		
0		
0		
0		
0		
0		
16,200		

Appendix B. GHG Emissions Inventory Data After Conversion to Metric Tons of CO_{2e}

(Note: All amounts are in Metric Tons of CO_{2e})

Fiscal Year	Purchased Electricity	Purchased Steam and Chilled water	On-campus Stationary	Transportation				
			Total	Total	Fleet	Student Commuters	Faculty/Staff Commuters	Air Travel
1990		0						
1991		0						
1992	49,622	0						
1993	50,082	0						
1994	48,451	0						
1995	52,150	0	40,405					
1996	43,612	0	38,662					
1997	56,022	0	48,096					
1998	53,937	0	51,193	13				13
1999	54,587	0	50,494	53				53
2000	54,412	0	48,593	890	862			28
2001	56,113	0	50,231	1,132	1,071			61
2002	52,791	0	48,100	6,447	1,083			5,363
2003	56,413	0	51,974	4,506	1,172			3,334
2004	56,402	0	52,550	4,790	1,290			3,501
2005	56,488	0	52,114	10,027	1,351			8,676
2006	55,124	0	52,817	10,316	1,210			9,107
2007	59,052	0	55,563	17,020	1,202	386	399	15,033
2008	61,205	0	52,766	16,672	1,265	434	308	14,665

Fiscal Year	Agriculture	Solid Waste	Refrigerants and other Chemicals
1994	2,279		
1995	1,970		
1996	1,968		
1997	1,731		
1998	1,292		
1999	1,457		
2000	1,477		
2001	1,220		
2002	1,246	2,090	
2003	938	1,748	
2004	813	1,679	
2005	902	1,513	
2006	965	1,419	
2007	1,087	1,282	
2008	1,102	1,577	602

Fiscal Year	Total Emissions (MT eCO_2)	Renewable Energy Credits	Total Offsets (MT eCO_2)	SCOPE 1 Emissions	SCOPE 2 Emissions	SCOPE 3 Emissions	Net Emissions (MT eCO_2)
1990							
1991							
1992	49,622				49,622		49,622
1993	50,082				50,082		50,082
1994	50,730			2,279	48,451		50,730
1995	94,525			42,375	52,150		94,525
1996	84,242			40,630	43,612		84,242
1997	105,849			49,827	56,022		105,849
1998	106,434			52,484	53,937	13	106,434
1999	106,591			51,951	54,587	53	106,591
2000	105,372			50,932	54,412	28	105,372
2001	108,696			52,522	56,113	61	108,696
2002	110,674			50,430	52,791	7,453	110,674
2003	115,580			54,085	56,413	5,082	115,580
2004	116,235			54,653	56,402	5,180	116,235
2005	121,043			54,367	56,488	10,188	121,043
2006	120,641			54,991	55,124	10,526	120,641
2007	134,004			57,852	59,052	17,100	134,004
2008	133,924	(15)	(15)	55,735	61,190	16,983	133,909

Appendix C. GHG Emissions Factors for On-Campus Stationary

Coal								
Fiscal Year	MMBtu / Short Ton	kg CO_2 / MMBtu	kg CH_4 / MMBtu	kg N_2O / MMBtu	kg CO_2 / Short Ton	kg CH_4 / Short Ton	kg N_2O / Short Ton	MT eCO2 / ShortTon
1990	21.20	94.09	0.01055	0.00148	1,994	0.22363	0.03131	2.009
1991	21.12	95.47	0.01055	0.00148	2,016	0.22282	0.03119	2.031
1992	21.07	95.90	0.01055	0.00148	2,021	0.22227	0.03112	2.035
1993	21.01	95.07	0.01055	0.00148	1,997	0.22166	0.03103	2.012
1994	20.93	94.82	0.01055	0.00148	1,984	0.22080	0.03091	1.999
1995	20.88	94.96	0.01055	0.00148	1,983	0.22028	0.03084	1.997
1996	20.87	94.60	0.01055	0.00148	1,974	0.22018	0.03082	1.988
1997	20.83	94.38	0.01055	0.00148	1,966	0.21976	0.03077	1.980
1998	20.88	94.38	0.01055	0.00148	1,971	0.22029	0.03084	1.985
1999	20.82	94.38	0.01055	0.00148	1,965	0.21963	0.03075	1.979
2000	20.83	94.38	0.01055	0.00148	1,966	0.21974	0.03076	1.980
2001	20.67	94.38	0.01055	0.00148	1,951	0.21808	0.03053	1.965
2002	20.54	94.38	0.01055	0.00148	1,939	0.21671	0.03034	1.953
2003	20.39	94.38	0.01055	0.00148	1,924	0.21508	0.03011	1.938
2004	20.28	94.38	0.01055	0.00148	1,914	0.21391	0.02995	1.927
2005	20.28	94.38	0.01055	0.00148	1,914	0.21391	0.02995	1.927
2006	20.28	94.38	0.01055	0.00148	1,914	0.21391	0.02995	1.927
2007	20.28	94.38	0.01055	0.00148	1,914	0.21391	0.02995	1.927
2008	20.28	94.38	0.01055	0.00148	1,914	0.21391	0.02995	1.927

Natural Gas				
Fiscal Year	kg CO_2 / Mmbtu	kg CH_4 / MMBtu	kg N_2O / MMBtu	MT eCO2 / MMBtu
1990	52.7914	0.00528	0.00011	0.052944
1991	52.79	0.00528	0.00011	0.053
1992	52.79	0.00528	0.00011	0.053
1993	52.79	0.00528	0.00011	0.053
1994	52.79	0.00528	0.00011	0.053
1995	52.79	0.00528	0.00011	0.053
1996	52.79	0.00528	0.00011	0.053
1997	52.79	0.00528	0.00011	0.053
1998	52.79	0.00528	0.00011	0.053
1999	52.79	0.00528	0.00011	0.053
2000	52.79	0.00528	0.00011	0.053
2001	52.79	0.00528	0.00011	0.053
2002	52.79	0.00528	0.00011	0.053
2003	52.79	0.00528	0.00011	0.053
2004	52.79	0.00528	0.00011	0.053
2005	52.79	0.00528	0.00011	0.053
2006	52.79	0.00528	0.00011	0.053
2007	52.79	0.00528	0.00011	0.053
2008	52.79	0.00528	0.00011	0.053

	Propane							
Fiscal Year	MMBtu / gallon	kg CO_2 / Mmbtu	kg CH_4 / MMBtu	kg N_2O / MMBtu	kg CO_2 / gallon	kg CH_4 / gallon	kg N_2O / gallon	MT eCO2 / gallon
1990	0.09	62.79	0.01055	0.000633	5.42	0.000911	0.000055	0.005
1991	0.09	62.79	0.01055	0.000633	5.40	0.000908	0.000054	0.005
1992	0.09	62.79	0.01055	0.000633	5.42	0.000910	0.000055	0.005
1993	0.09	62.82	0.01055	0.000633	5.39	0.000906	0.000054	0.005
1994	0.09	62.82	0.01055	0.000633	5.44	0.000913	0.000055	0.005
1995	0.09	62.75	0.01055	0.000633	5.41	0.000910	0.000055	0.005
1996	0.09	62.75	0.01055	0.000633	5.40	0.000908	0.000054	0.005
1997	0.09	62.68	0.01055	0.000633	5.40	0.000908	0.000054	0.005
1998	0.09	62.86	0.01055	0.000633	5.41	0.000908	0.000054	0.005
1999	0.09	62.93	0.01055	0.000633	5.42	0.000908	0.000054	0.005
2000	0.09	62.75	0.01055	0.000633	5.39	0.000906	0.000054	0.005
2001	0.09	62.79	0.01055	0.000633	5.40	0.000908	0.000054	0.005
2002	0.09	62.75	0.01055	0.000633	5.40	0.000908	0.000054	0.005
2003	0.09	62.79	0.01055	0.000633	5.43	0.000912	0.000055	0.005
2004	0.09	62.75	0.01055	0.000633	5.41	0.000909	0.000055	0.005
2005	0.09	62.75	0.01055	0.000633	5.41	0.000909	0.000055	0.005
2006	0.09	62.75	0.01055	0.000633	5.41	0.000909	0.000055	0.005
2007	0.09	62.75	0.01055	0.000633	5.41	0.000909	0.000055	0.005
2008	0.09	62.75	0.01055	0.000633	5.41	0.000909	0.000055	0.005

Appendix D. List of Contacts

Input	University of Wyoming Source
Institutional data	
Budget	
Operating	Budget Office
Research	Office of Research and Economic Development
Energy	Physical Plant
Population	Office of Institutional Analysis
Physical Size	Real Estate Operations
Purchased electricity	Physical Plant
Purchased steam/chilled water	N/A
On-campus cogeneration plant	N/A
Stationary sources of emissions on campus	Physical Plant
University fleet	Fleet Services
Air travel	Accounts Payable
Commuting	Stantec Consulting survey
Agriculture	Various
Solid waste	Physical Plant
Refrigeration and other chemicals	Physical Plant
Offsets	Real Estate Operations and Physical Plant