

**GREENHOUSE GAS EMISSIONS INVENTORY
FOR
THE UNIVERSITY OF WYOMING
Fiscal Year 2017**

By
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For

**The Campus Sustainability Committee of the
University of Wyoming**

And

**The American College and University Presidents Climate
Commitment**

Laramie, Wyoming
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Abstract

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

This document is a narrative report based on UW's GHG Emissions Inventory for the Fiscal Year (FY) 2017. The inventory data is included in Appendix A and includes FY 2002 through FY 2017.

Version 9.1 of the Campus Carbon Calculator, developed by the Sustainability Institute at the University of New Hampshire, was used for this year's calculations.

UW emitted a net total of 15,0382 metric tons (MT) of eCO₂ during FY 2016, a 20.9% increase from FY 2015 (119,019 MT), and a 15.2% increase from FY 2005 (127,518 MT). Since an updated version of the calculator was used this year, the calculated emissions are slightly different from reported values in previous years. However, all data were reentered into the current calculator so the years could be accurately compared.

Acknowledgements

Apart from my efforts, the success of this project depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental for the completion of this project. In particular, my greatest appreciation goes to my supervisors, Matt Peterson, Design Engineer at Facilities Engineering, and Nicole Korfanta, Director, Ruckelshaus Institute. I thank you for your tremendous support.

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 to commit to neutralizing their GHG emissions.

In September 2007, UW President Tom Buchanan signed onto this organization, joining 152 other presidents and chancellors representing higher education institutions across the United States. Signatories to the commitment pledge to complete a series of steps to eliminate their campuses' greenhouse gas emissions and increase sustainability over time. These steps are to:

- Complete an annual emissions inventory
- Choose from a designated list of immediate or short-term actions to reduce GHG emissions
- Complete a Climate Action Plan within two years of signing to achieve carbon neutrality
- Integrate sustainability into the curriculum
- Make the Climate Action Plan, inventory, and progress reports publicly available

UW's Climate Action Plan outlines GHG reduction goals:

"The Climate Action Plan is divided into three phases: Phase I (2010-2015), Phase II (2015-2020), and Phase III (2020-2050). The Phase I target is to reduce carbon emissions to 15 percent below 2005 levels by 2015. The Phase II target is to reduce carbon emissions to 25 percent below 2005 levels by 2020. The Phase III target is to achieve carbon neutrality by 2050."

Progress toward these goals will be discussed in the results and discussion section.

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—in this case the University of Wyoming. Conducting an annual GHG Emissions Inventory provides a measurement by which an institution can monitor the effects of its efforts on GHG emissions.

There are numerous emissions inventory calculators used 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. Almost all GHG emissions calculators convert emissions and energy use data into carbon dioxide equivalent units, or eCO₂. An eCO₂ 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 CO₂ 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 CO₂, which based on wavelength and lifetime, determines the degree to which the gas traps the sun's energy. For instance, the GWP of Methane (CH₄) is 25, so 1 molecule of CH₄ warms the planet to a similar

extent as 25 molecules of CO₂ meaning that emitting 1 kg of CH₄ is equivalent to emitting 25 kg of CO₂. This methodology allows for a standardized unit of comparison between various gases and facilitates meaningful comparisons both within and among measuring entities (IPCC 2007).

Second Nature is the supporting organization for the ACUPCC. Its Climate Leadership Network integrates the goals of carbon neutrality and climate resilience, and provides an opportunity for higher education institutions “to model and innovate climate solutions necessary to preserve a climate conducive to supporting human civilization” (Second Nature year?). Second Nature’s reporting platform allows colleges and universities to track and report their yearly emissions and has 597 active signatories. The Campus Carbon Calculator (CCC), managed by the University of New Hampshire Sustainability Institute (UNHSI), is recommended by the Second Nature Climate Commitment for GHG emissions calculations. Version 9.1 of this calculator was utilized for the University of Wyoming’s FY 2017 GHG inventory.

Physical and Temporal Boundaries

The physical boundaries of this inventory extend beyond the main campus to include off-campus property owned by UW 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 2017 fiscal year (July 1, 2016 through June 30, 2017).

Methodology for Collection of Data

I conducted the FY 2017 GHG emissions inventory for UW with direction and oversight from the university’s Campus Sustainability Committee and UW Operations. We collected data from the main campus and off-campus properties and then entered it into version 9.1 of the University of New Hampshire Campus Carbon Calculator (CCC). In addition to FY 2017 data, we reentered all prior-year data into this version of the CCC and recalculated to ensure a consistent historical comparison.

When collecting data, we verified with campus sources whether 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, we contacted satellite properties 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 B shows each emission data category and its source.

The ACUPCC identifies three scopes of emissions that the data categories of the CCC inventory calculator fall into (Figure 1):

- Scope 1 emissions are direct GHG emissions from sources either owned or controlled by the institution.

- Scope 2 emissions are indirect emissions that are generated in the production of electricity, steam, and chilled water.
- 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.

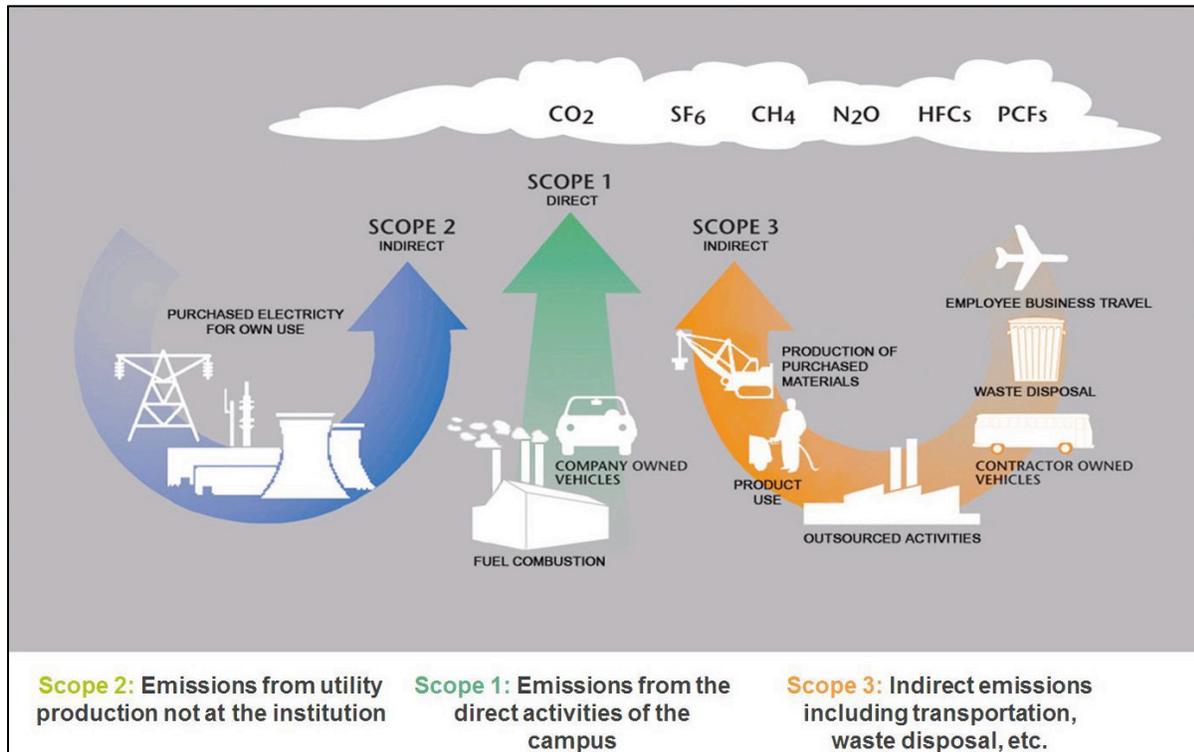


Figure 1. Scope 1, 2, and 3 emissions sources (Clean Air Cool Planet year?).

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 we collected the data for these three categories separately from different entities on campus. The operational budget includes the entire energy budget as well as some of the funds used for research; therefore, 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 Campus Carbon 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 (e.g., 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.

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. The operational budget would include any costs that are associated with new building or facility upgrades, including satellite buildings financed by UW.

Building Space

We retrieved data regarding total building space from the campus master building list. Square footage for total building research space was obtained from UW Real Estate Operations and excludes satellite building space with utilities not paid for by the university.

The demolition of old buildings and addition of new buildings each year effectively alters the building space numbers. 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 calculator guide.

Other On-Campus Stationary Sources

UW does not co-generate, hence this data falls under the Other On-Campus Stationary sources category. When calculating and converting total emissions in metric tons (MT) of eCO₂ from original units, the calculator automatically combines the components of on-campus stationary into one total figure of MT eCO₂.

Transportation

The University of Wyoming buys and provides gasoline and diesel for its own fleet, and reimburses personal vehicles for their mileage. We retrieved records of gallons of gas and diesel used in FY 2017 from UW Fleet Services, and records on reimbursed miles from Accounts Payable.

Refrigeration

The reported refrigerants used for FY 2017 included R-404a and HCFC-22.

Electricity

UW purchased 98% of its electricity from Rocky Mountain Power and 2% from Carbon Power & Light. The university does not purchase any steam or chilled water.

Commercial Air Travel

Accounts Payable at the University of Wyoming has recorded commercial air travel mileage data from FY98 to the present (in the form of dollars paid). They tracked this information through departmental receipts kept on record. In order to estimate the total airline miles, we disregarded

Accounts Payable receipts under \$100 that had information designating them as a travel reimbursement for something other than airline travel.

From fiscal year 1998 to fiscal year 2008, the following method was applied. To estimate total airline miles traveled, we used a random sample of 40 flight receipts. We calculated the average miles flown per ticket for the 40 flights and multiplied by the total number of flights found through Accounts Payable. This yielded the estimated total amount of commercial airline miles flown.

For the fiscal year 2009 to the fiscal year 2014 the following method was applied. We obtained the cost per mile for commercial airline travel in FY15 from the Airlines for America Organization's website. The total cost for each FY was found out (extrapolation was used for some of the years) and then the miles travelled were estimated using the cost-per-mile graph. We chose this method because it does not ignore any data, unlike previous years that relied on a sample of flight receipts.

For fiscal year 2015, we updated the previous total cost/cost per mile method by subtracting a fixed baggage fee (\$12.51) and reservation fee (\$10.57) for each account payable data entry. We obtained the fixed fee rate and cost per mile data from the Airlines for America Organization's website.

For fiscal year 2016, we eliminated commercial airline reimbursements from Accounts Payable that were less than \$100, subtracted a fixed baggage fee (\$12.51) and a reservation fee (\$10.57) from each entry like in FY 2015, and obtained a cost per mile (11.5 cents) from Wyman, 2016.

For fiscal year 2017, we eliminated commercial airline reimbursements from Accounts Payable that were less than \$100, subtracted a fixed baggage fee (\$12.51) and a reservation fee (\$10.57) from each entry like 2015 and 2016, and obtained a cost per mile (11.5 cents) like 2016.

Private Air Travel

The University of Wyoming owns two private planes—the N2UW and the N200UW (a transportation plane and a research plane). We obtained the nautical miles travelled for FY 2017 for both aircrafts from the Department of Atmospheric Science.

Solid Waste

UW solid waste generated is taken to a landfill where there is no CH₄ recovery.

Results & Discussion

In FY 2017 the University of Wyoming emitted a gross total of 150,382 MT of eCO₂. This is a 20.9% increase in emissions from FY 2015's gross total of 119,032 MT of eCO₂, and a 15.2% increase in emissions from FY 2005's gross total of 127,518 MT of eCO₂ (Figure 2).

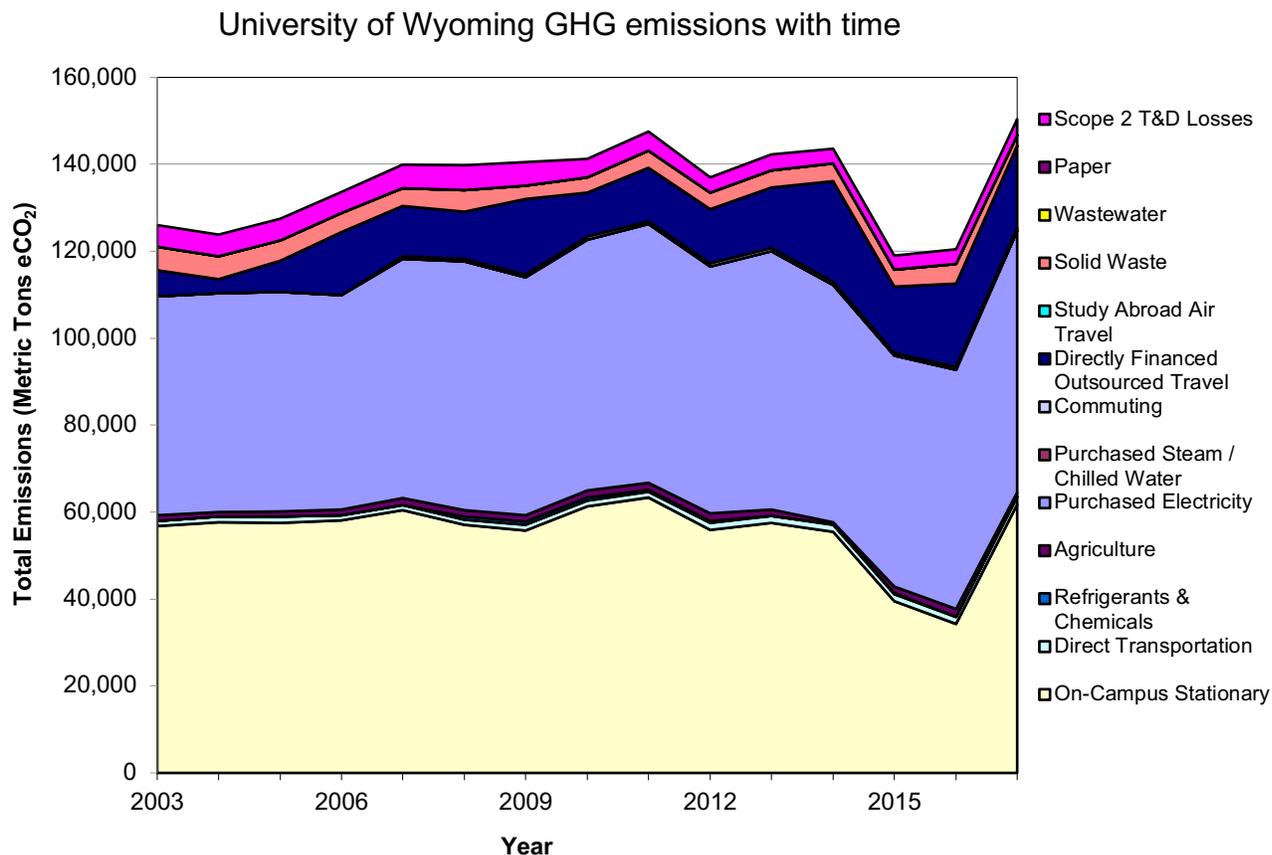


Figure 2. UW greenhouse gas emissions by source, 2003–2017.

The major sources of eCO₂ emission for UW are on-campus stationary sources, purchased electricity, and directly financed outsourced travel (Figure 2). The highest GHG contributor for FY 2017 was other on-campus stationary, with an overall contribution of 41.1%, followed by purchased electricity (40.0%), and directly financed air travel (12.1%) (Figure 5). Other sources contributed to less than 6.8% of the emissions in FY 2017.

The 20.9% increase in GHG emission for FY17 was due to increases in scope 1 and scope 2 emissions decrease in scope 3 emissions, that were not offset by scope 3 emissions (Figure 3). Heating emissions increased due to greater coal use at the Central Energy Plant, and there was an overall emissions increase due to an 8.7% increase in electrical use (Table 1). The electrical suppliers use a large percentage of coal for their electrical generation.

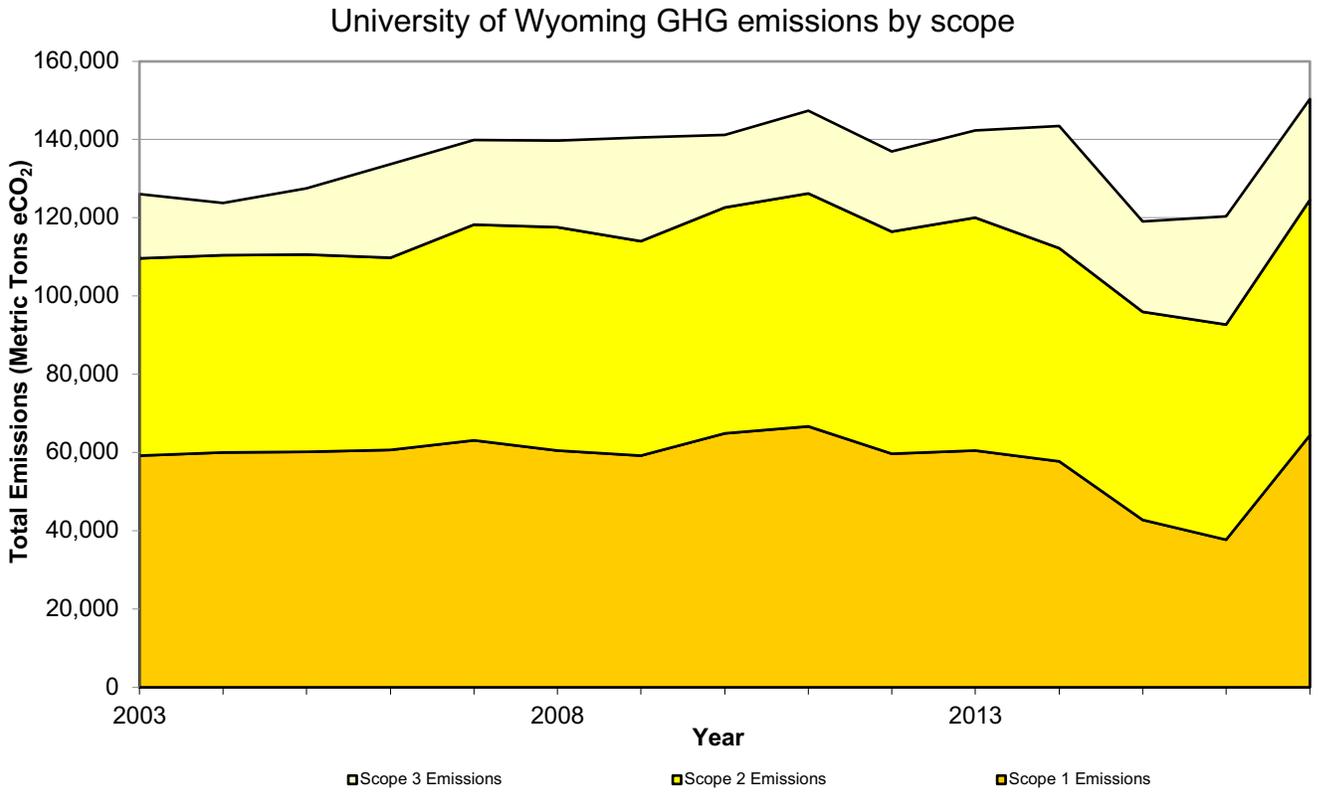


Figure 3. Total emissions for Scope 1, 2, and 3.

Table 1. Fuel sources for on-campus stationary sources FY07–FY17. Natural gas, propane, and coal are scope 1 and electricity is scope 2.

Fiscal Year	Natural Gas	LPG (Propane)	Coal (Steam Coal)	Electricity
	MMBtu	Gallons	Short Tons	kWh
2007	107,146	6,841	25,864	63,602,733
2008	113,269	8,867	24,510	65,921,694
2009	113,076	6,416	23,749	66,024,455
2010	120,815	5,418	27,137	66,990,963
2011	102,949	6,565	27,529	69,113,643
2012	89,637	6,712	25,269	68,607,169
2013	84,566	6,876	26,255	71,865,545
2014	119,494	8,117	24,282	65,875,211
2015	213,460	4,892	14,165	64,054,126
2016	451,794	4,355	5,161	66,386,071
2017	251,879	4,750	10,722	66,047,070

Scope 2 T&D losses deal with the transmission and distribution losses associated with purchased utilities such as electricity, chilled water, steam etc. Since UW only purchases electricity, the emissions from this come only from the purchased electricity. If UW does decide to purchase other utilities, then Scope 2 T&D losses would be much higher, while Scope 1 emissions would decline.

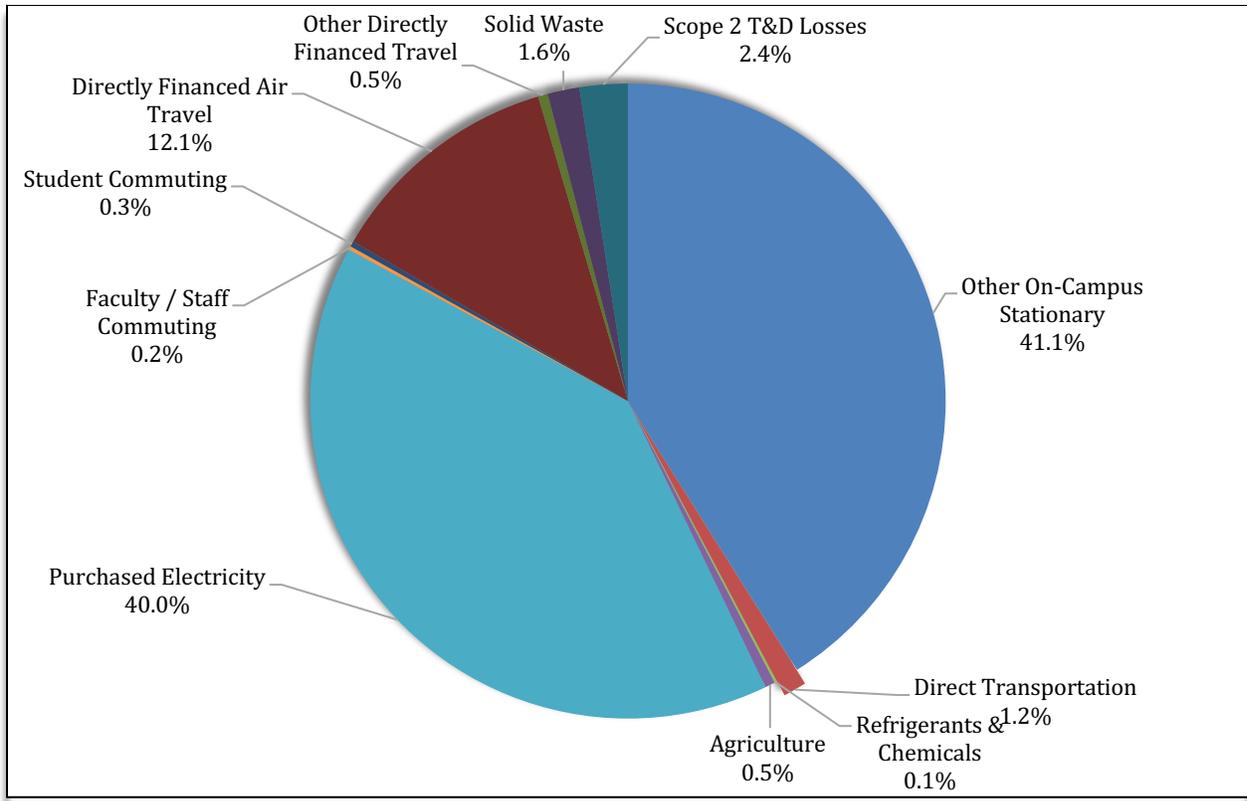


Figure 5. FY 2017 percentage contributions to UW’s total GHG emissions by source.

Some of the data that were input into the calculator do not affect the results of this report, including the budget, population, research space, and building space. Those are included primarily for explaining trends in emissions. For example, if the building space increased drastically during a fiscal year then emissions increased as more electricity and other utilities would be used. Hence it can be used to see if there are any trends between particular statistics and increased emissions.

Recommendations

The University of Wyoming signed the ACUPCC to demonstrate its commitment to reducing GHG emissions in a way that is compatible with the economy of the state and the university. The Campus Sustainability Committee, through the Climate Action Plan, has devised ways to achieve that goal. Additional recommendations to reduce emissions include:

- Updating the accounts payable airfare reporting system to include actual miles traveled will greatly improve the accuracy of emission inventory.
- Reducing unnecessary travel expenditures whenever possible.
- Continue efforts on the implementation of building automation systems. Examples include but are not limited to the installation of VFDs, lighting control systems, digital controls,

scheduling, temperature set points and monitoring.

- Transition fuel usage at the Central Energy Plant from coal to natural gas, as long as economically feasible.
- Pursue satellite boiler and chiller plants, which would utilize efficient modular boilers and chillers.

There continue to be financial reasons why the University of Wyoming uses fossil fuels to generate on-campus stationary energy. In such cases, there can be a balance between being environmentally friendly and financially viable. The EF_eCO2 sheet of the carbon calculator provides a summary of the emission factor for every source and is very helpful if one wants to consider replacing a particular source or to increase the use of another.

Appendix A: Major Sources of Emission in Metric Tons eCO2

Fiscal Year	Agriculture	On-Campus Stationary	Purchased Electricity	Solid Waste	Directly Financed Airfare	Direct Transportation
	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2	MT eCO2
2002	1653	53626	47166	6543	5306	1100
2003	1268	56832	50402	5473	5939	1190
2004	1089	57635	50392	5258	3113	1309
2005	1216	57584	50469	4737	7149	1371
2006	1312	58089	49251	4443	14490	1228
2007	1489	60445	55111	4014	11577	1218
2008	1515	57037	57120	4938	10902	1273
2009	1469	55819	54767	3095	17323	1290
2010	1597	61250	57763	3406	10217	1400
2011	1553	63308	59594	3944	11563	1346
2012	1672	55896	56851	3779	11815	1610
2013	1350	57453	59551	4064	13199	1690
2014	511	55510	54588	4064	22806	1632
2015	1404	39535	53078	3913	14586	1564
2016	1794	34304	55011	4480	18562	1600
2017	766	61754	60222	2432	18131	1781

Appendix B: Data Request Contact Personnel

Main Campus			
Category	Subcategory	Contact Office	Contact Person
Budget	Operating Budget	Budget Office, 307-766-5766, http://uwadmnweb.uwyo.edu/administration/budget.asp	P.J. Shumway 307 766-4183 shumway@uwyo.edu
Budget	Research Dollars	Office of Research, 307-766-5353, http://uwacadweb.uwyo.edu/Research/	Amanda Larson 307-766-2074 amanda.larson@uwyo.edu
Budget	Energy Budget	Physical Plant, Utilities Management, 307-766-2077, http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 fselmer@uwyo.edu
Population	# students, faculty and staff	Office of Institutional Analyses, 307-766-2898, http://oia.uwyo.edu	Suzanne Koller Associate Director Office of Institutional Analyses 307-766-2896 ssavor@uwyo.edu OR Suzie Waggoner scash@uwyo.edu
Physical Size	Total Building Space	Real Estate Operations, 307-766-2936, http://uwacadweb.uwyo.edu/REALESTATE/	Christina Maki Merica Hall 307-766-2648 cmaki1@uwyo.edu
	Research Building Space	Real Estate Operations, 307-766-2936, http://uwacadweb.uwyo.edu/REALESTATE/	Christina Maki Merica Hall 307-766-2648 cmaki1@uwyo.edu
Purchased Energy	--	Physical Plant, Utilities Management, 307-766-2077, http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 fselmer@uwyo.edu
On-Campus Stationary Sources	--	Physical Plant, Utilities Management, 307-766-2077, http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 fselmer@uwyo.edu

Transportation	Fleet Services	Fleet Services, 307-766-3229, http://uwadmnweb.uwyo.edu/FLEET/	Shawn Fletcher sfletche@uwyo.edu Fleet Services & Auto Shop/Car Rental Services 307-766-3334
	Private Air Travel	Department of Atmospheric Science, 307-766-3245, http://www-das.uwyo.edu/	Nicole N. Lawrence Dept. Atmospheric Science nlawren2@uwyo.edu
	Commercial Air Travel	Accounting Office (Accounts Payable) 307-766-5296 http://www.uwyo.edu/FINOPS/Payables/payables.htm	Jon D. Kelly Accounts Payable Supervisor jkelly1@uwyo.edu 307-766-5776 Old Main Rm. 101
	Commuter Info	Stantec Consulting http://www.stantec.com/	Paul Kunkel Transportation Department 307-766-9802 paul.kunkel@uwyo.edu
Agriculture	Fertilizer Application: Grounds	University Physical Plant 307-766-6225 http://uwadmnweb.uwyo.edu/PPLWEB/	Andy Smith Main Campus Fertilizer Manager flowers@uwyo.edu
	Fertilizer Application: Athletic Facilities	University Physical Plant 307-766-6225 http://uwadmnweb.uwyo.edu/PPLWEB/	Tyson Drew Athletics Fertilizer tdrew@uwyo.edu 307-766-2007
	Fertilizer Application: Res Life	Residence Life and Dining 307-766-3175 http://uwadmnweb.uwyo.edu/reslife-dining/	Kim Zafft Res Life Fertilizer zafft@uwyo.edu 307-766-3763
	Fertilizer Application: Plant Sciences	Agriculture Experiment Station, 307-766-3112, http://uwadmnweb.uwyo.edu/UWEXPSTN	Joe Jensen Golf/Grounds Fertilizer 307-766-4359 joej@uwyo.edu
Solid Waste	Historical Data	Physical Plant, Facilities Services, Waste Services, 307-766-6225, http://uwadmnweb.uwyo.edu/PPLWEB/services/index.asp	Forrest (Frosty) Selmer Deputy Director Utilities Management fselmer@uwyo.edu 307-766-2077

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