

**GREENHOUSE GAS EMISSIONS INVENTORY  
FOR  
THE UNIVERSITY OF WYOMING  
Fiscal Year 2016**

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 the GHG Emissions Inventory of the University of Wyoming for the Fiscal Year (FY) 2016. The inventory data is included in Appendix A and includes fiscal years 2002 through 2016.

Version 9.0 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 120,453.6 metric tons of eCO<sub>2</sub> during FY 2016, a 1.2% increase from FY 2015 (119,019.3 metric tons), but a 16.1% decrease from FY 2014 (143,556.5 metric tons). 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 was 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

The Climate Action Plan outlines UW's 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 a 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 eCO<sub>2</sub>. An eCO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> which, based on wavelength and lifetime, determines the degree to which the gas traps the sun's energy.

For instance, the GWP of Methane (CH<sub>4</sub>) is 25, so 1 molecule of CH<sub>4</sub> warms the planet to a similar extent as 25 molecules of CO<sub>2</sub> meaning that emitting 1 kg of CH<sub>4</sub> is equivalent to emitting 25 kg of CO<sub>2</sub>. 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). 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 9.0 of this calculator was utilized for the University of Wyoming’s FY 2016 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 2016 fiscal year (July 1, 2015 through June 30, 2016).

## **Methodology for Collection of Data**

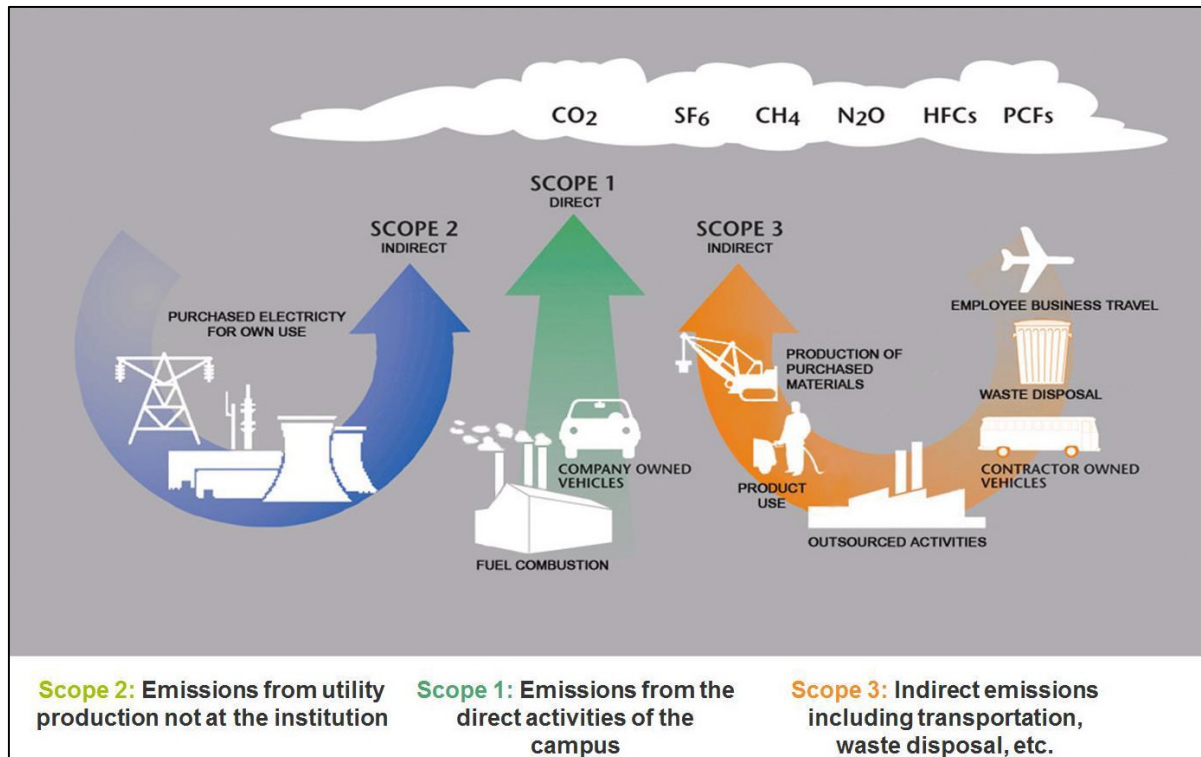
I conducted the FY 2016 GHG emissions inventory for UW with direction and oversight from the University’s Campus Sustainability Committee. We collected data from the main campus and off-campus properties and then entered it into version 9.0 of the University of New Hampshire Campus Carbon Calculator (CCC). In addition to FY 2016 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).

Emission data and institutional data obtained for UW are explained below. Also, data requiring more in depth analysis is explained.

### 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 (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.

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 finance 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 eCO<sub>2</sub> from original units, the calculator automatically combines the components of on-campus stationary into one total figure of MT eCO<sub>2</sub>.

### 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 2016 from UW Fleet Services, and reimbursed miles from Accounts Payable.

### Refrigeration

The reported refrigerants used for FY 2016 included only HCFC-22.

### Electricity

UW purchased 98% of its electricity from Rocky Mountain Power and 2% from Carbon Power & Light. The college 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 the fiscal year 1998 to the 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.

### 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 2016 for both aircrafts from the Department of Atmospheric Science.

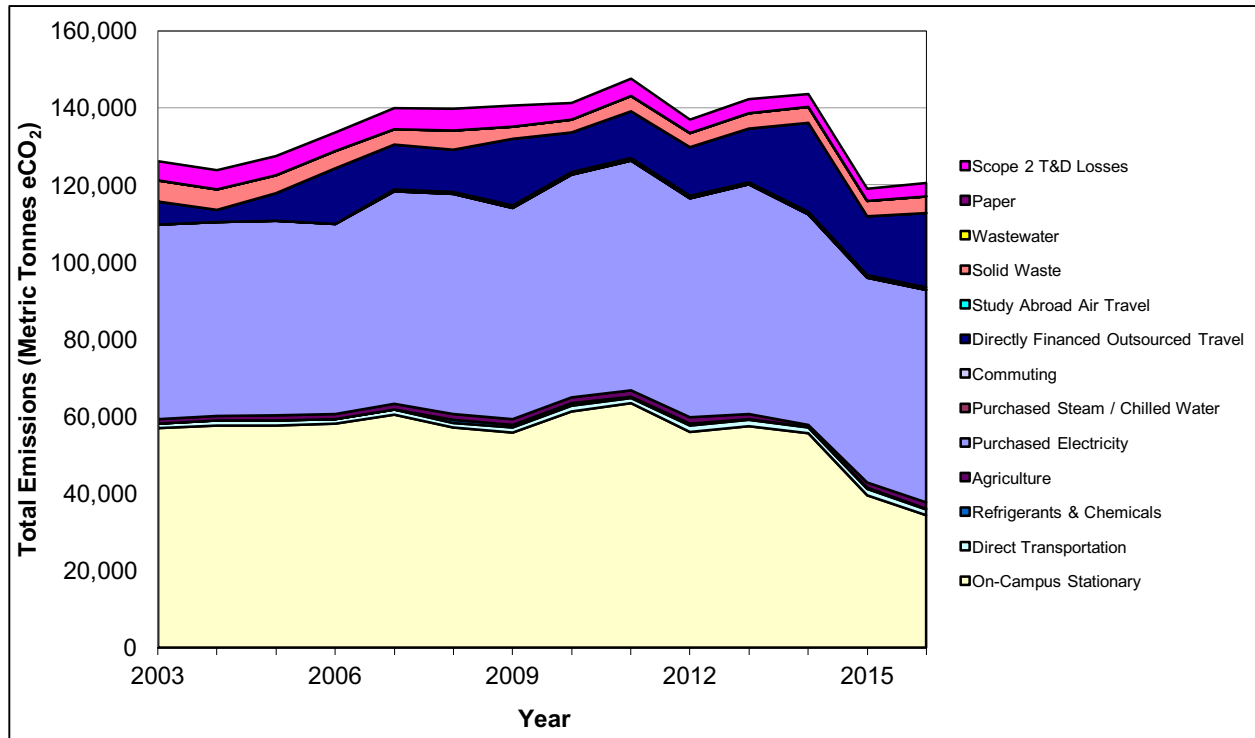
### Solid Waste

UW solid waste generated is taken to a landfill where there is no CH<sub>4</sub> recovery.

## **Results & Discussion**

In FY 2016 the University of Wyoming emitted a gross total of 120,453.6 metric tons of eCO<sub>2</sub>. This is a 1.2% increase in emissions from FY 2015's gross total of 119,031.7 metric tons of eCO<sub>2</sub>, but a 16.1% decrease in emissions from FY 2014's gross total of 143,556.5 metric tons of eCO<sub>2</sub>.

Figure 2 shows the overall trend in UW’s net emissions, by source, from 2003 to 2016.

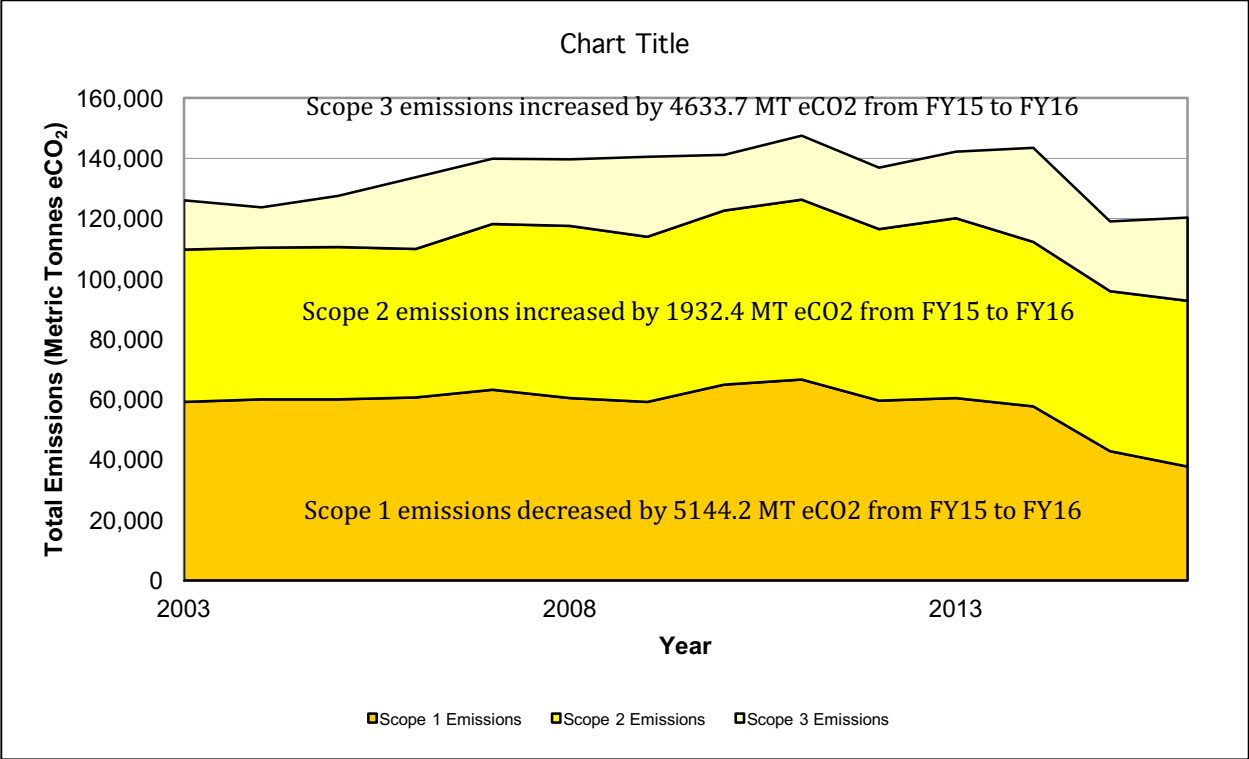


**Figure 2.** UW greenhouse gas emissions by source, 2003 – 2016, reported as metric tons of eCO<sub>2</sub>.

The major sources of eCO<sub>2</sub> emission for UW are on-campus stationary sources, purchased electricity, and directly financed outsourced travel (Figure 2).

The 1.2% increase in GHG emission for FY16 was due to a decrease in scope 1 emissions, but an increase in scope 2 and scope 3 emissions (Figure 3). Heating emissions dropped due to more natural gas and less coal being used as fuel for the steam plant, but there was an overall emissions increase due to a 3.6% increase in electrical use (Figure 4). The electrical suppliers use a large percentage of coal for their electrical generation.





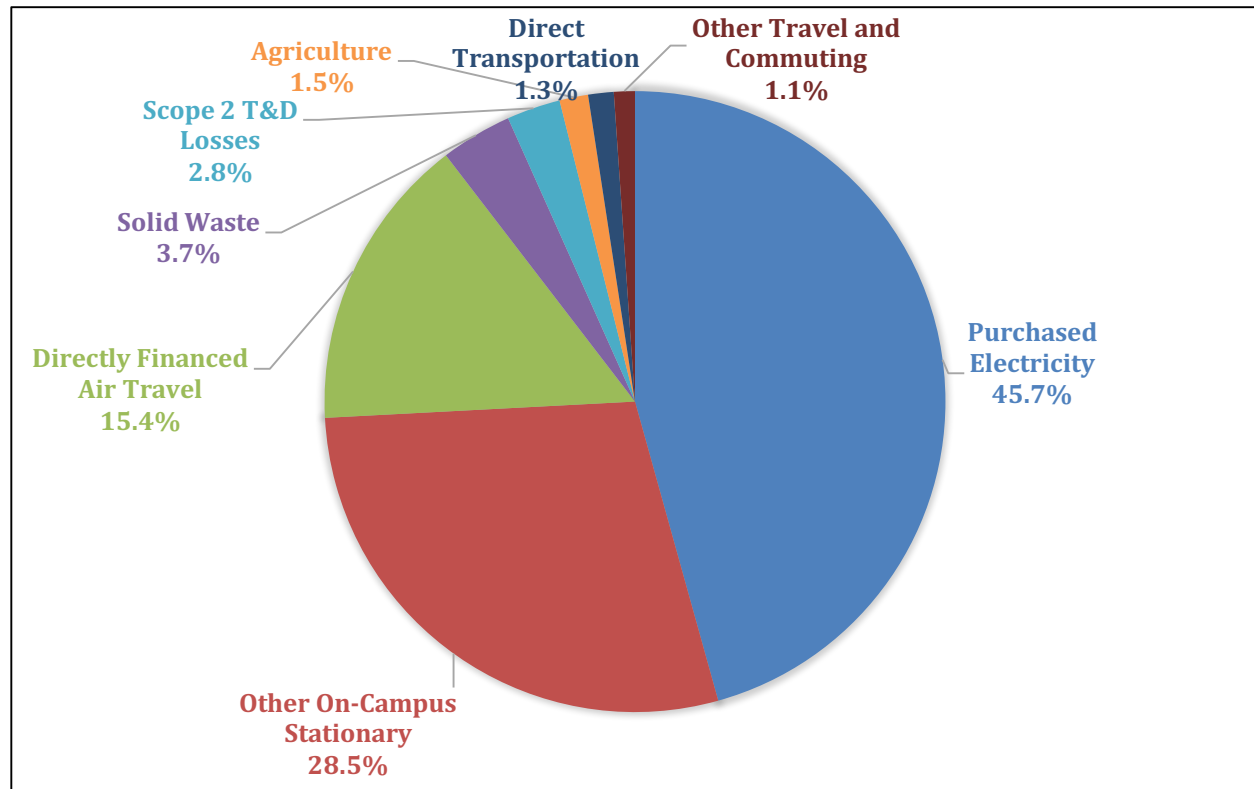
**Figure 3.** Total emissions for each Scope 1, 2, and 3.

Fiscal Year	Natural Gas MMBtu	LPG (Propane) Gallons	Coal (Steam Coal) Short Tons	Purchased Electricity 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

**Figure 4.** Fuel sources for on campus stationary sources FY07-FY16. Natural gas, propane and coal are scope 1 and electricity is scope 2.

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.

The highest GHG contributor for FY 2016 was purchased electricity, with an overall contribution of 45.7%, followed by other on-campus stationary (28.5%), and directly financed air travel (15.4%) (Figure 5). Other sources contributed to less than 11% of the emissions in FY 2016.



**Figure 5.** FY 2016 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 it would make sense that emissions increased as more electricity and other utilities would be used. Hence it can be used for individual research purposes to see if there are any trends between particular statistics and increased emissions.

Progress has been made toward the goals set in the Climate Action Plan. The 2005 baseline for carbon emissions is 127,518 MT eCO<sub>2</sub>. The 2015 target (phase I) was to reduce emissions by 15% relative to this 2005 baseline. In 2015, an actual reduction of 6.7% was made with a net emission of 119,019 MT eCO<sub>2</sub>. The 2020 target (phase II) is to reduce emissions relative to the 2005 baseline by 25%. In FY 2016, 120,454 MT eCO<sub>2</sub> were emitted, so over the next 3 years, 24,815 MT eCO<sub>2</sub> will need to be eliminated. Phase III is to become carbon neutral by 2050.

## 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.
- 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. A very important sheet in the calculator is the one titled EF\_eCO<sub>2</sub>. This gives 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

## Appendix B: Data Request Contact Personnel

		<b>Main Campus</b>	
<b>Category</b>	<b>Subcategory</b>	<b>Contact Office</b>	<b>Contact Person</b>
Budget	Operating Budget	Budget Office, 307-766-5766, <a href="http://uwadmnweb.uwyo.edu/administration/budget.asp">http://uwadmnweb.uwyo.edu/administration/budget.asp</a>	P.J. Shumway 307 766-4183 <a href="mailto:shumway@uwyo.edu">shumway@uwyo.edu</a>
Budget	Research Dollars	Office of Research, 307-766-5353, <a href="http://uwacadweb.uwyo.edu/Research/">http://uwacadweb.uwyo.edu/Research/</a>	Shauna Anna Bury 307-766-2074 <a href="mailto:Shauna@uwyo.edu">Shauna@uwyo.edu</a>
Budget	Energy Budget	Physical Plant, Utilities Management, 307-766-2077, <a href="http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp">http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp</a>	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 <a href="mailto:fselmer@uwyo.edu">fselmer@uwyo.edu</a>
Population	# students, faculty and staff	Office of Institutional Analyses, 307-766-2898, <a href="http://oia.uwyo.edu">http://oia.uwyo.edu</a>	Suzanne Koller Associate Director Office of Institutional Analyses 307-766-2896 <a href="mailto:ssavor@uwyo.edu">ssavor@uwyo.edu</a> OR Suzie Waggoner scash@uwyo.edu
Physical Size	Total Building Space	Real Estate Operations, 307-766-2936, <a href="http://uwacadweb.uwyo.edu/REALESTATE/">http://uwacadweb.uwyo.edu/REALESTATE/</a>	Christina Maki Merica Hall 307-766-2648 <a href="mailto:cmakil@uwyo.edu">cmakil@uwyo.edu</a>
	Research Building Space	Real Estate Operations, 307-766-2936, <a href="http://uwacadweb.uwyo.edu/REALESTATE/">http://uwacadweb.uwyo.edu/REALESTATE/</a>	Christina Maki Merica Hall 307-766-2648 <a href="mailto:cmakil@uwyo.edu">cmakil@uwyo.edu</a>
Purchased Energy	--	Physical Plant, Utilities Management, 307-766-2077, <a href="http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp">http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp</a>	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 <a href="mailto:fselmer@uwyo.edu">fselmer@uwyo.edu</a>
On-Campus Stationary Sources	--	Physical Plant, Utilities Management, 307-766-2077, <a href="http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp">http://uwadmnweb.uwyo.edu/PPLWEB/utilities/index.asp</a>	Forrest (Frosty) Selmer Deputy Director Utilities Management 307-766-2077 <a href="mailto:fselmer@uwyo.edu">fselmer@uwyo.edu</a>
Transportation	Fleet Services	Fleet Services, 307-766-3229, <a href="http://uwadmnweb.uwyo.edu/FLEET/">http://uwadmnweb.uwyo.edu/FLEET/</a>	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, <a href="http://www-das.uwyo.edu/">http://www-das.uwyo.edu/</a>	Nicole N. Lawrence Dept. Atmospheric Science <a href="mailto:nlawren2@uwyo.edu">nlawren2@uwyo.edu</a>
	Commercial Air Travel	Accounting Office (Accounts Payable) 307-766-5296 <a href="http://www.uwyo.edu/FINOPS/Payables/payables.htm">http://www.uwyo.edu/FINOPS/Payables/payables.htm</a>	Jon D. Kelly Accounts Payable Supervisor <a href="mailto:jkelly1@uwyo.edu">jkelly1@uwyo.edu</a> 307-766-5776 Old Main Rm. 101
	Commuter Info	Stantec Consulting <a href="http://www.stantec.com/">http://www.stantec.com/</a>	Paul Kunkel Transportation Department 307-766-9802 <a href="mailto:paul.kunkel@uwyo.edu">paul.kunkel@uwyo.edu</a>
Agriculture	Fertilizer Application: Grounds	University Physical Plant 307-766-6225 <a href="http://uwadmnweb.uwyo.edu/PPLWEB/">http://uwadmnweb.uwyo.edu/PPLWEB/</a>	ANDY SMITH Main Campus Fertilizer Manager <a href="mailto:flowers@uwyo.edu">flowers@uwyo.edu</a>
	Fertilizer Application: Athletic Facilities	University Physical Plant 307-766-6225 <a href="http://uwadmnweb.uwyo.edu/PPLWEB/">http://uwadmnweb.uwyo.edu/PPLWEB/</a>	Tyson Drew Athletics Fertilizer <a href="mailto:tdrew@uwyo.edu">tdrew@uwyo.edu</a> 307-766-2007
	Fertilizer Application: Res Life	Residence Life and Dining 307-766-3175 <a href="http://uwadmnweb.uwyo.edu/reslife-dining/">http://uwadmnweb.uwyo.edu/reslife-dining/</a>	<i>Kim Zafft</i> Res Life Fertilizer <a href="mailto:zafft@uwyo.edu">zafft@uwyo.edu</a> 307-766-3763
	Fertilizer Application: Plant Sciences	Agriculture Experiment Station, 307-766-3112, <a href="http://uwadmnweb.uwyo.edu/UWEXPSTN">http://uwadmnweb.uwyo.edu/UWEXPSTN</a>	<i>Joe Jensen</i> Golf/Grounds Fertilizer 307-766-4359 <a href="mailto:joej@uwyo.edu">joej@uwyo.edu</a>
Solid Waste	Historical Data	Physical Plant, Facilities Services, Waste Services, 307-766-6225, <a href="http://uwadmnweb.uwyo.edu/PPLWEB/services/index.asp">http://uwadmnweb.uwyo.edu/PPLWEB/services/index.asp</a>	Forrest (Frosty) Selmer Deputy Director Utilities Management <a href="mailto:fselmer@uwyo.edu">fselmer@uwyo.edu</a> 307-766-2077

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