University of Idaho
Greenhouse Gas Inventory



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UI Greenhouse Gas Emissions Assessment

"Changes of the magnitude necessary to create an effective response to global warming call for more than incremental adjustments in policy. They will represent a transformation of our economy and our infrastructure in creative and positive ways that will fuel economic growth, protect our communities and the quality of life we cherish, and allow our civilization to flourish."[1]

Purpose of report

This report has been prepared as a step towards meeting University of Idaho's commitment to reduce its carbon footprint. The report establishes a greenhouse gas (GHG) emissions baseline, using data from 2005, the first year for which comprehensive data are available. The report also presents emissions from 2006 and 2007.

In March 2007, UI joined the American College and University Presidents Climate Commitment (ACUPCC)[2] and the Chicago Climate Exchange (CCX)[3]. By doing so, UI committed to reduce its GHG emissions significantly in the short-term, and to dramatically reduce GHG emissions and offset the remainder over the long-term.

By signing ACUPCC, UI committed itself to achieve climate neutrality as soon as is practical. The commitment includes implementing three short-term actions over the first two years of the commitment. These include,

1. Develop a comprehensive plan to achieve climate neutrality as soon as possible.
2. Initiate two or more tangible actions to reduce greenhouse gases in the short term while the more comprehensive plan is being developed. UI chose to implement the following actions:
    a. GREEN BUILDING POLICY: Establish a policy that all new campus construction will be built to at least the U.S. Green Building Council's LEED Silver standard or equivalent.
    b. WASTE MINIMIZATION: Participate in the Waste Minimization component of the national RecycleMania[4] competition and adopt three or more associated measures to reduce waste.
3. Make the action plan, inventory, and periodic progress reports publicly available through the Association for the Advancement of Sustainability in Higher Education (AASHE).

To comply with the ACUPCC agreement, University of Idaho must complete a GHG assessment by September 15, 2008, and a GHG plan to achieve climate neutrality by September 15, 2009. The interim steps listed above need to be initiated by September 15, 2009.

UI also joined the Chicago Climate Exchange (CCX) in March 2007. Through its voluntary membership in CCX, the University of Idaho is legally bound to reduce GHG emissions through emissions trading and

offsets. The University of Idaho is committed to reduce greenhouse gas emissions by 6% by 2010 from a fiscal year 2001 baseline. In order to reach this target, cumulative annual reduction goals of 1.5% from the baseline must be met starting in 2007. If the university fails to meet annual targets it will buy carbon credits to make up the shortfall; on the other hand, if the university exceeds reduction targets, it can sell credits on the carbon market.

UI is not a wealthy university and does not have money to experiment or implement projects on facilities and operations that are not cost-effective. Fortunately many of the actions required to meet these commitments will save the University money over the long term.

UI GHG baseline

Overview of assessment methods

Throughout this assessment, two different calculation methods were used: the World Resources Institute (WRI) Greenhouse Gas Protocol (GHG Protocol)[5], and the Clean Air Cool Planet (CACP) Campus Carbon Calculator v5.0[6]. The Greenhouse Gas Protocol is a collaborative effort between the World Resource Institute and the World Business Council for Sustainable Development, and is the most widely used international accounting tool to quantify and manage greenhouse gas emissions. The Protocol includes a guidance document along with calculation workbooks to quantify emissions. Throughout this assessment we followed the GHG Protocol as fully as possible. The CACP Campus Carbon Calculator provides additional calculation tools specific to higher education, and has a number of features that are more developed than in the GHG Protocol calculators. The CACP calculator was used to supplement the GHG Protocol calculators when needed.

Baseline Year

The University of Idaho ACUPCC GHG emissions baseline year is calendar year 2005. This is the first year that complete data are available for all emissions sources assessed as part of the ACUPCC effort. Additional data for years prior to 2005 will be presented for specific emissions sources to illustrate trends when available, but only on a source by source basis. Throughout the report, fiscal year data have been converted to calendar year when necessary.

Organizational Boundaries

The organizational boundary defines which facilities are included in an emissions baseline. The organizational boundary for this assessment includes the Moscow Campus of UI and operations in approximately a 15 mile radius from the Moscow Campus. The Moscow campus consists of approximately 120 buildings that contain 3,700,839 square feet (Appendix C). The campus population has declined in the last couple of years as enrollment numbers have decreased: in 2005 11,627 students were enrolled, while in 2007 that number fell to 10,549 (Appendix D).

The organizational boundary includes the West Farm, North Farm, Parker Farm and UI Experimental Forest in the Moscow Mountain area. It does not include UI-owned family housing units, which are rented to students. At these apartments, the regional power utility Avista bills residents directly, with

hundreds of separate account numbers during any one year, making data collection difficult. The assessment also does not include spaces at UI Business Incubator, which are leased to non-UI entities. All other UI-owned locations within this area are included.

UI owns buildings at many satellite facilities throughout Idaho which are not included in the organizational baseline. These facilities directly manage and pay for their own energy use, and these data are not collected by the main campus. Efforts are underway to collect data from these satellite facilities, and when the data are available they will be added into the baseline.

Operational Baseline

The operational baseline identifies the emission sources to be included in the emissions assessment. Following the GHG Protocol, these sources are grouped into "scopes." Scope 1 emissions include direct GHG emissions from sources owned or controlled by UI. Scope 2 accounts for GHG emissions associated with the generation of purchased electricity. Scope 2 emissions physically occur at the facility where electricity is generated. Scope 3 allows for the treatment of all other indirect emissions. Scope 3 emissions include those from sources not owned or controlled by the university, or other sources not included in Scopes 1 and 2.

UI Scope 1 Emissions

Scope 1 emissions result from sources owned or controlled by UI: these include stationary combustion, vehicle fuel and fugitive emissions.

Stationary combustion

Stationary combustion at UI includes burning natural gas and wood chips. The main use of stationary combustion on campus is for building space heating and domestic water heating. Seventy-five percent of the campus is heated through steam tunnels connected to a steam plant with biomass and natural gas boilers.

A wood-fired boiler generates 90% of the steam used on campus. The wood-fired boiler was installed in the mid-1980s and saves UI about $1.5-2 million annually due to significantly lower costs per BTU generated from wood chips in comparison to natural gas or coal. Wood chips are purchased from regional timber mills. The wood-fired boiler results in relatively low carbon dioxide equivalent (CO_2e) emissions from stationary combustion at UI compared to producing the same amount of heat with natural gas or coal. Since wood is considered a renewable, carbon-neutral resource, emissions from wood chips were not included in calculations of CO_2e emissions from stationary combustion.

The other fuel used for stationary combustion on UI campus is natural gas. Sixty percent of the natural gas used by UI is burned in a natural gas boiler at the steam plant during high load periods when campus energy needs exceed the capacity of the biomass boiler. Additional natural gas is used for heating the remaining 25% of the campus not connected to the steam tunnels. In addition to heating, other natural gas uses include backup generators and research laboratories.

Natural gas use has increased by approximately 51% since 2003 (see Table 1). Carbon emissions were calculated using the WRI and WBSCD Calculation tool for Direct Emissions from Stationary Combustion Calculation Worksheets[7], (see Appendix A1). Emissions associated with natural gas amount to 4,370 metric tons of CO_2e for 2005, 4,251 metric tons CO_2e for 2006 and 5,276 metric tons CO_2e for 2007 (Table 1).

	2003	2004	2005	2006	2007
Natural Gas Usage (Therms)	645,629	727,408	806,979	784,997	974,181
NG Emissions (Metric Tons CO_2e)	3,497	3,939	4,370	4,251	5,276
Percent Change		+13%	+11%	-3%	+24%

Table 1: Natural gas use, emissions and percent change at UI

UI vehicle fuel

The second form of direct combustion in UI's scope 1 emissions is vehicle fuel: UI purchases gasoline and diesel to fuel university-owned vehicles and equipment. Fuel expenditure data was collected from the accounts payable department at UI for FY05-FY08. Accounts payable data were used to determine the amount of diesel and gasoline used in calendar years 2005, 2006, and 2007 at UI (Figure 1). This usage data was then entered into the WRI GHG Protocol – Mobile Guide v1.3[8] to determine CO_2e emissions (See Appendix A2). University of Idaho released 2,617 tons of CO_2e related to UI vehicle fuel for 2005, 2,475 tons for 2006 and 2,230 tons for 2007 (Figure 1).

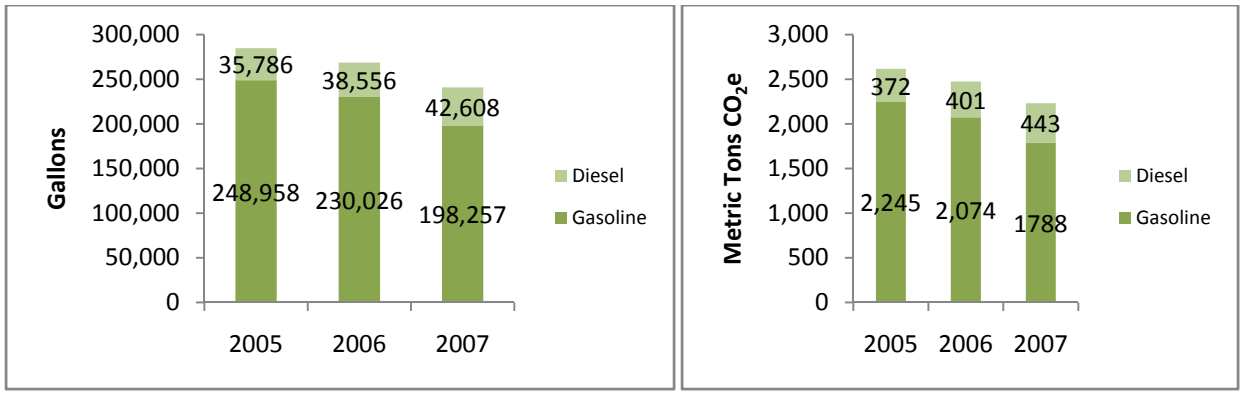

Figure 1: Vehicle fuel used and the resulting emissions for 2005, 2006 and 2007

Fugitive emissions

UI releases chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) as a result of leakage from air-conditioning units and refrigeration systems. The amount of leakage is assumed to be the same as the amount of HCFCs and HFCs needed to recharge the systems as part of repair or maintenance activities. HCFCs and HFCs are greenhouse gases and need to be accounted for as part of the Scope 1 greenhouse gas inventory. CFC emissions were not factored into the greenhouse gas inventory because they are being controlled under the Montreal Protocol.[9] HCFC and HFC emissions were converted into CO_2e (see Appendix A3). Refrigerant emissions for UI amounted to 88 metric tons CO_2e for 2005, 2006 and 2007 (Table 2), approximately 0.2% of total UI annual emissions.

Fugitive Emissions Gases	Amount Used (kg)	Global Warming Potential (GWP)[10]	Emissions (Metric Tons CO_2e)
R-404A	8.2	3,260	10.3
R-22 (HCFC-22)	134.3	1,500	77.9
Total	**142.5**		**88.2**

Table 2: Yearly fugitive emissions for 2005, 2006 and 2007

Cumulative Scope 1 emissions

UI produced 7,075 metric tons of CO_2e associated with natural gas combustion, vehicle fuel use, and fugitive emissions in 2005, 6,814 metric tons of CO_2e in 2006, and 7,594 metric tons of CO_2e in 2007 (Figure 2).

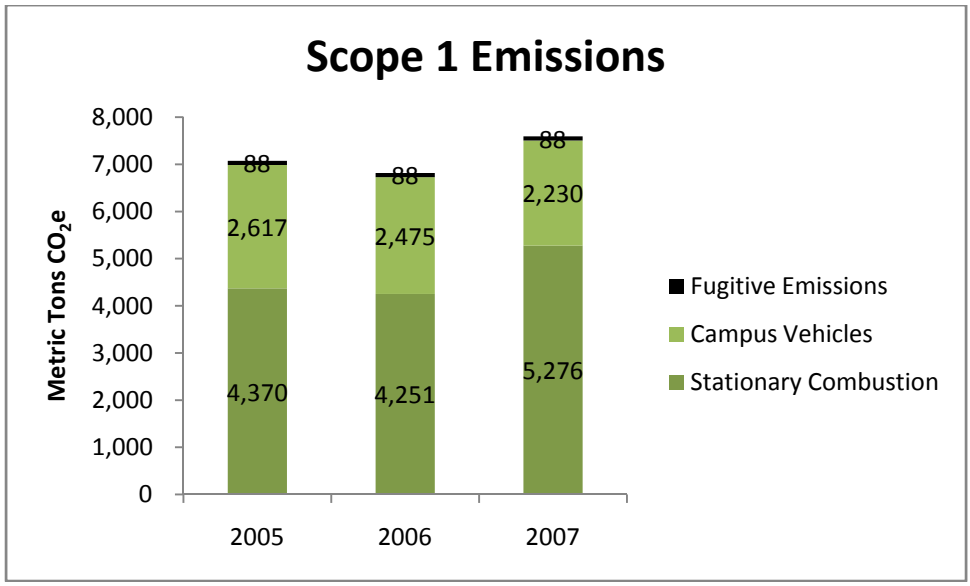

Figure 2: Scope 1 emissions

Scope 2

Scope 2 accounts for GHG emissions associated with the electricity that UI purchases from Avista Utilities. Purchased electricity makes up the majority of UI's non-renewable energy use. Unlike natural gas, electricity usage has slightly decreased by 2% since 2003 due to energy conservation measures and declining enrollment (Table 3).

	2003	2004	2005	2006	2007
Electricity Usage (KWH)	65,482,327	64,916,868	64,514,063	64,006,112	63,885,086
Percent Change		-0.9%	-0.6%	-0.8%	-0.2%

Table 3: Electricity usage for 2003-2007.

The emissions from purchased electricity were calculated using the GHG Protocol Indirect CO_2 Emissions from Purchased Electricity Workbook.[11] The workbook uses a regional emission factor generated by the EPA program E-GRID.[12] E-GRID divides the country into sub regions (Figure 3) based on fuel mix.

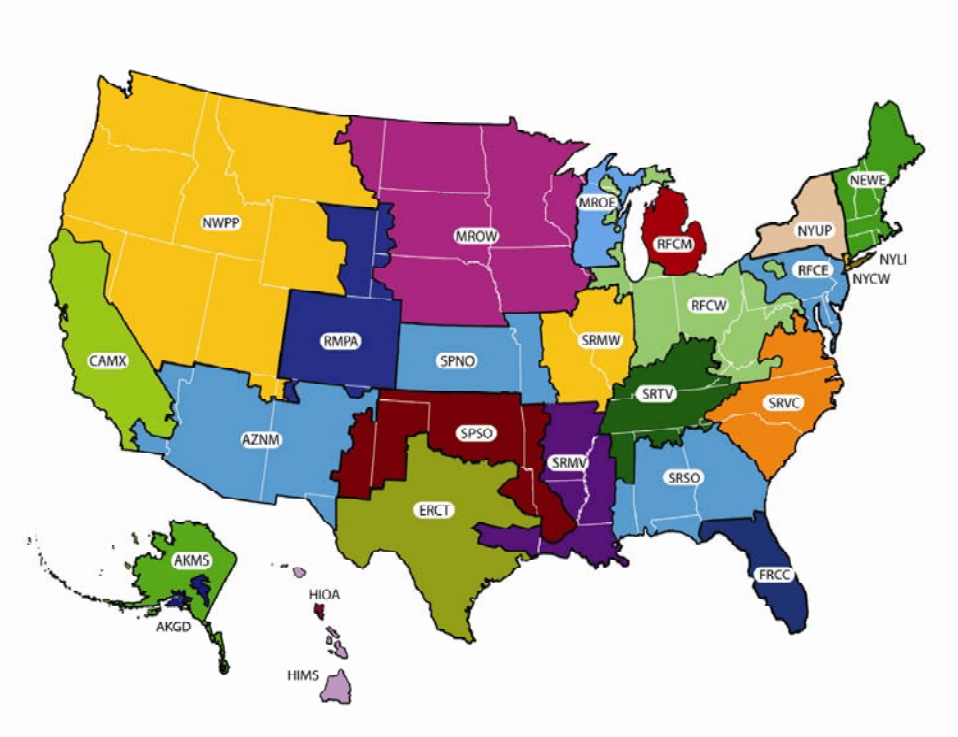

Figure 3: Map of electricity sub-regions from the US EPA E-Grid (2006)

UI is located in the northwest power pool (NWPP), an area where a majority of electricity is generated from hydropower and coal (Figure 4). This regional emissions factor is used to convert electricity usage into CO_2e emissions (see Appendix A4).

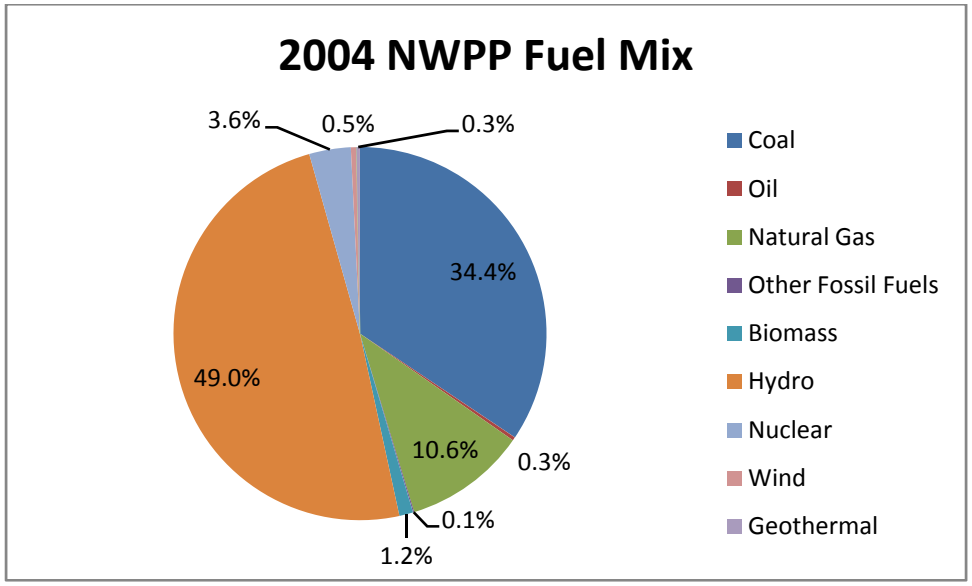

Figure 4: Fuel Mix of the Northwest Power Pool electricity sub-region

Electricity purchases resulted in 26,952 metric tons of CO_2e emissions in 2005, 26,740 metric tons in 2006, and 26,689 metric tons in 2007 (see Figure 5). This represents a 1% percent decrease in electricity-related emissions over the past three years.

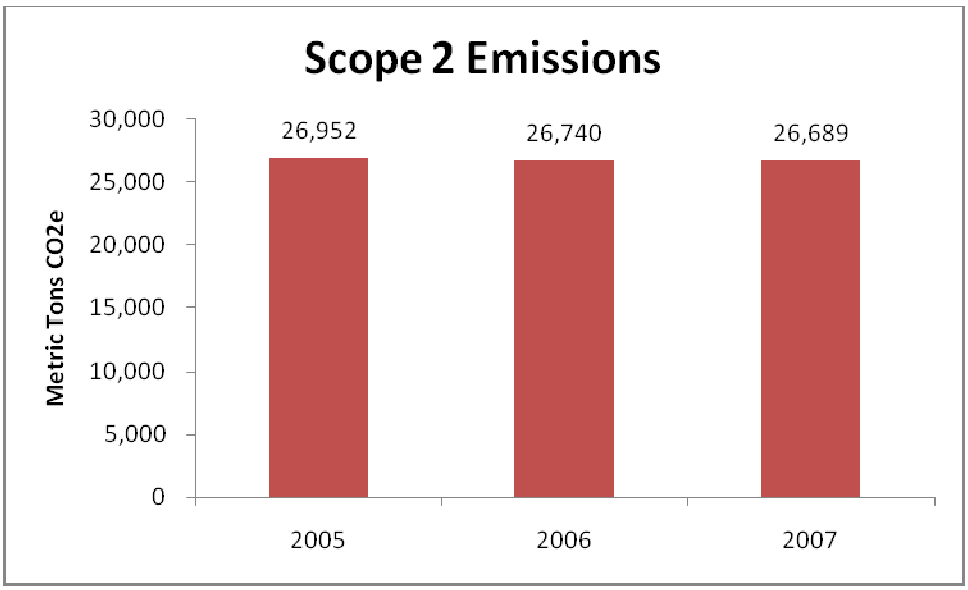

Figure 5: Scope 2 emissions from purchased electricity

Scope 3

Scope 3 emissions calculated included air travel, student, staff and faculty commuter travel, waste-related emissions, and emissions associated with UI-owned livestock.

Air Travel

UI faculty and staff engage in a substantial amount of air travel. Air travel data was only available in monetary values from the accounts payable department, and therefore had to be converted into fuel usage (Figure 6) (see Appendix A5). The data available were from FY05-FY08, enabling the determination of emissions from 2005, 2006, and 2007 (Figure 7).

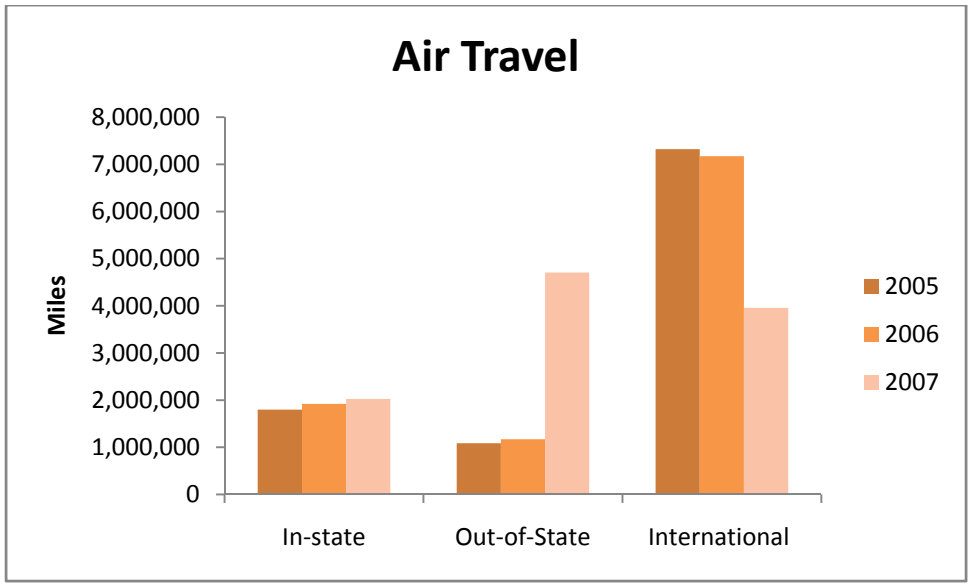

Figure 6: UI sponsored air travel

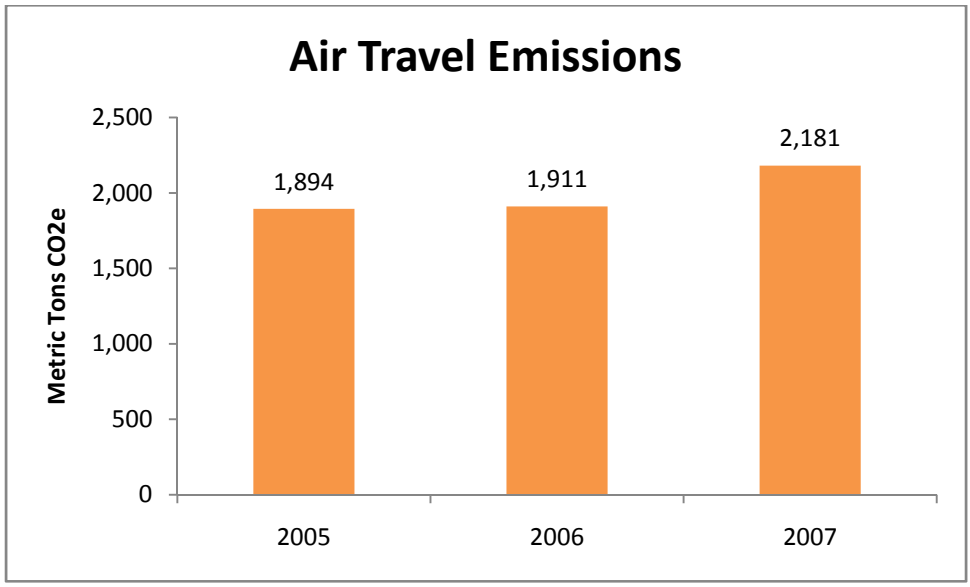

Figure 7: Emissions from UI sponsored air travel

Commuter travel

UI is located in the small and compact town of Moscow, Idaho, resulting in a relatively short commute for students, faculty and staff. The majority of UI employees and students live within the city limits, which means that their commute is less than 10 miles roundtrip. A preliminary survey of student commuter habits was used to estimate emissions. This survey found that about 17% of the student population lives on campus thus eliminating a commute, and of the students that do commute to campus, it was found that 38% use a transportation method other than automobiles. This data was combined with estimations made for faculty and staff commuters to determine the total commuter-related emissions (Figure 8) (see Appendix A6).

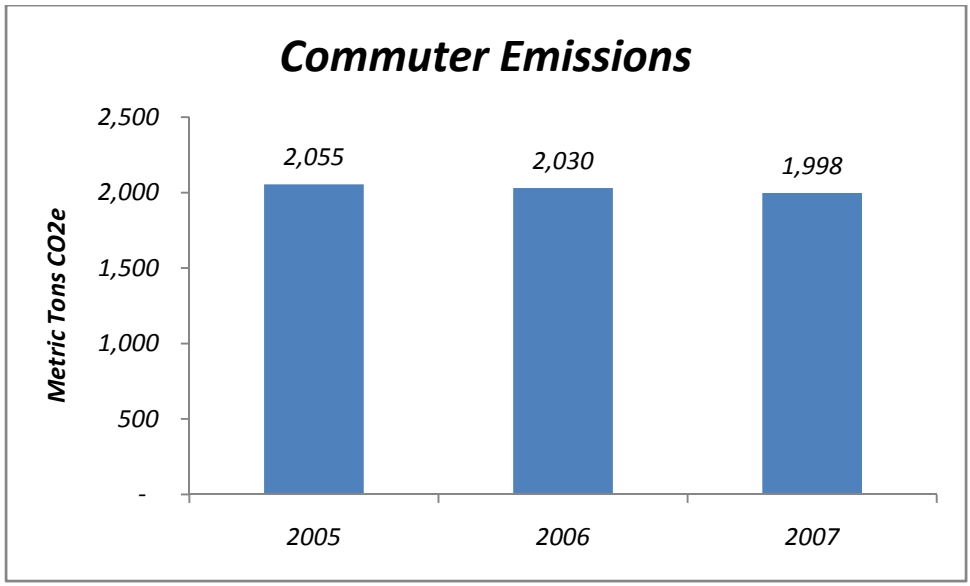

Figure 8: Emissions from the 51% of the student body that commute by automobile and the 80% of faculty and staff.

Waste

Due to the waste collection system in Moscow, Idaho, only costs associated with waste collected at UI are measured, not weights or volumes. UI Facilities estimates that over the past 3 years (2005-2007) UI generated about 1,500 metric tons of waste per year. This waste is picked up by Latah Sanitation and sent to Columbia Ridge Recycling and Landfill located in Arlington, Oregon. In the landfill, UI's waste decomposes, emitting methane (CH_4) a potent greenhouse gas 21 times more powerful than CO_2. In order to quantify the amount of methane released by UI's waste, the Clean Air Cool Planet Campus Carbon Calculator Version 5.0 was used. The calculator determines the amount of methane released based mainly on the type of landfill in which the waste is placed: the Columbia Ridge Landfill has a CH_4 recovery system with electricity generation, which reduces the amount of methane released into the atmosphere. Using the rough estimate of 1,500 metric tons of waste per year, UI waste is responsible for the release of 10.54 metric tons of CH_4 per year into the atmosphere. This number was then translated into CO_2e by multiplying metric tons of CH_4 by the global warming potential of CH_4, resulting in a release of 242 metric tons of CO_2e into the atmosphere from the decomposition of waste (Table 4).

Emissions from the transportation of waste to the landfill in Arlington, Oregon were also calculated (see Appendix A7). The fuel used to transport the waste to Arlington resulted in an additional 102.3 metric tons of CO_2e being emitted per year (Table 4).

Waste Emissions	
Methane Emissions	243 metric tons CO_2e
Transport Emissions	102 metric tons CO_2e
Total Emissions	**345 metric tons CO_2e**

Table 4: Annual waste emissions for 2005, 2006 and 2007

Animals

UI has a small, local population of livestock used for research and educational purposes. As these animals digest their food and excrete waste, they release methane (CH_4). The management of animal waste also results in the release of nitrous oxide (N_2O). In 2007, UI locally owned 136 dairy cows, 196 beef cows, and 79 horses (Table 5). Emissions were calculated using the CACP Calculator. Emissions from livestock at UI amounted to 784 metric tons of CO_2e for 2005 (Figure 9).

	2005	2006	2007
Dairy Cows	134	146	136
Beef Cows	211	211	196
Horses	57	55	79

Table 5: Inventory of UI livestock

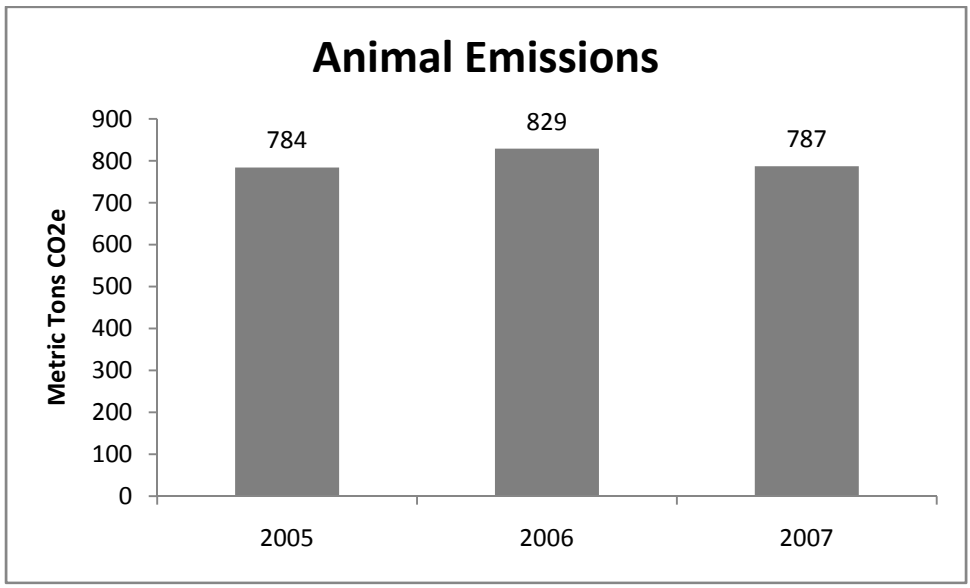

Figure 9: Animal emissions from enteric fermentation and manure management

Cumulative Results of Scope 3 emissions

Total emissions for scope 3 amount to 5,078 metric tons CO_2e in 2005, 5,114 metric tons CO_2e in 2006 and 5,311 metric tons of CO_2e in 2007. Air travel and commuter-related emissions are the two largest contributors to scope 3 emissions (Figure 10).

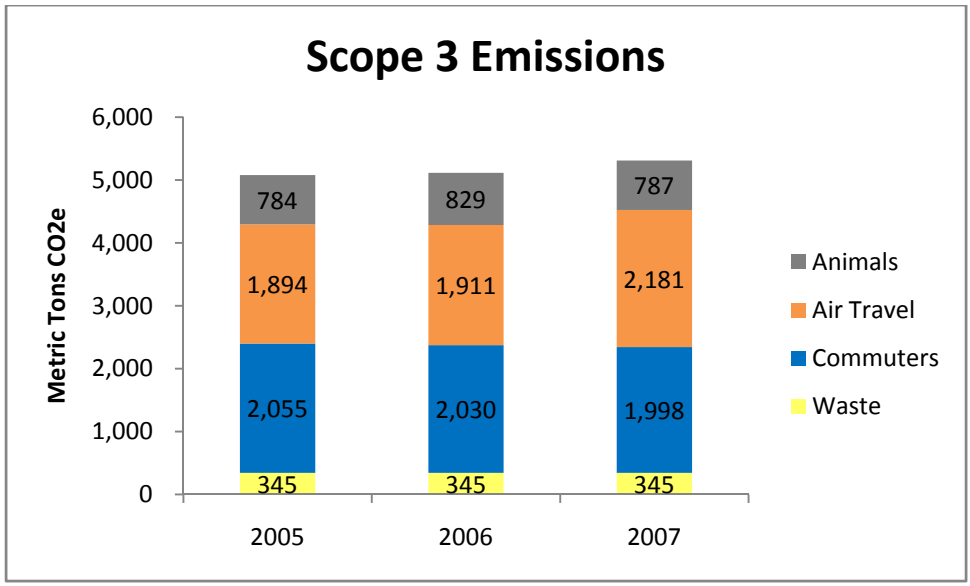

Figure 10: Scope 3 Emissions

Cumulative UI emissions profile

UI GHG emissions baseline, using 2005 as the baseline year, amounted to 39,105 metric tons CO_2e (Figure 11). UI emitted 38,668 metric tons CO_2e for 2006 and 39,594 metric tons CO_2e for 2007 (Figure 11). Scope 2 emissions from purchased electricity contributed the majority of emissions in the baseline (Figure 12).

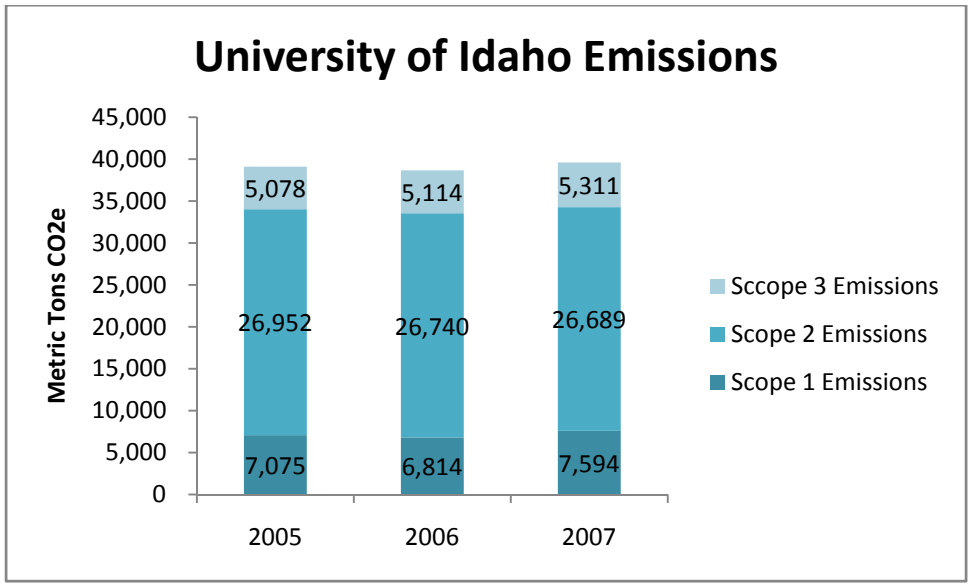

Figure 11: Cumulative GHG emissions for UI

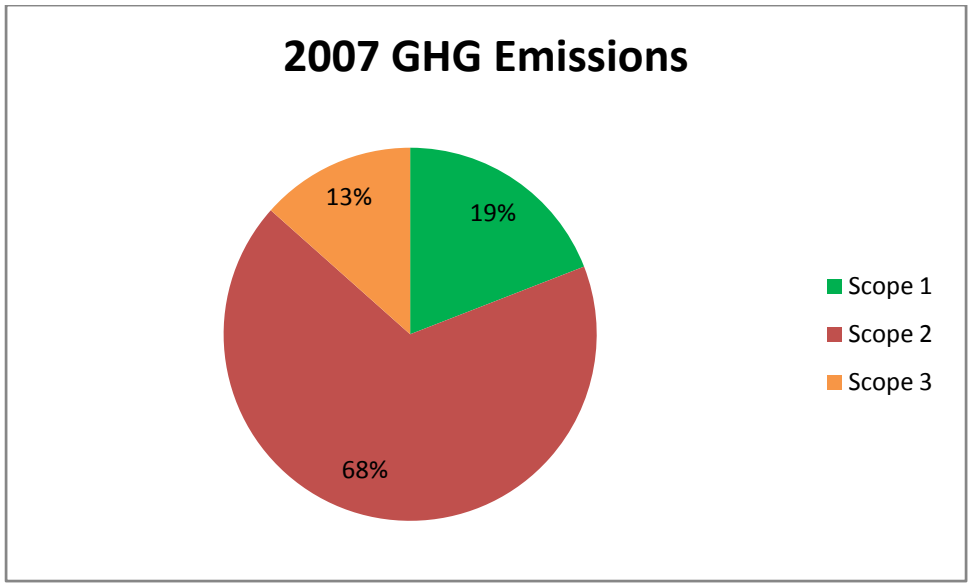

Figure 12: 2007 GHG emissions by scope

To compare GHG emissions from UI to those of other higher education institutions, total emissions are converted to emissions per square foot of building space and to per student emissions. UI produced approximately 23 pounds of CO_2e per square foot of building space in 2005, 2006 and 2007 (Figure 13). Emissions per student amounted to 3.36 metric tons per student for 2005, 3.50 per student in 2006 and 3.64 metric tons per student in 2007 (Figure 14).

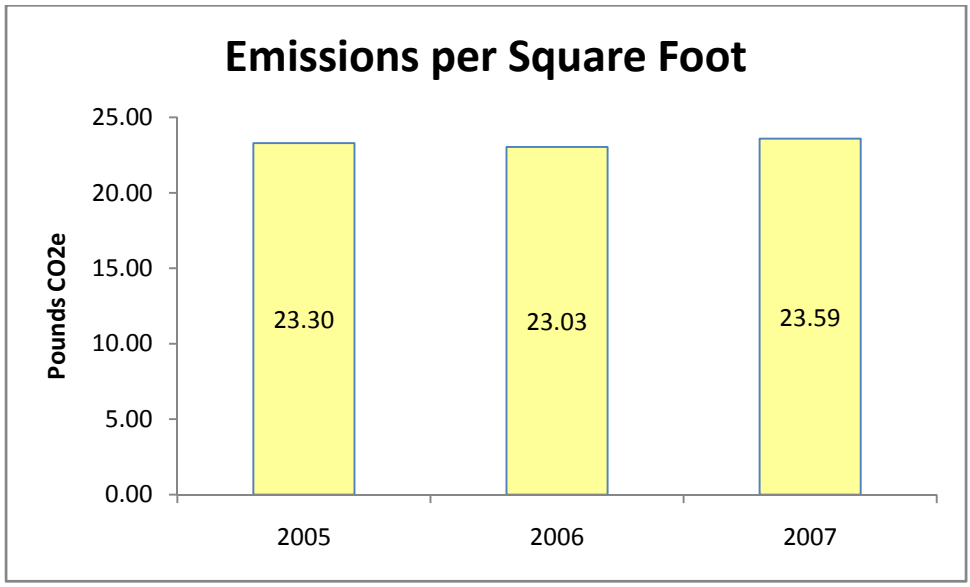

Figure 13: Emissions per square foot

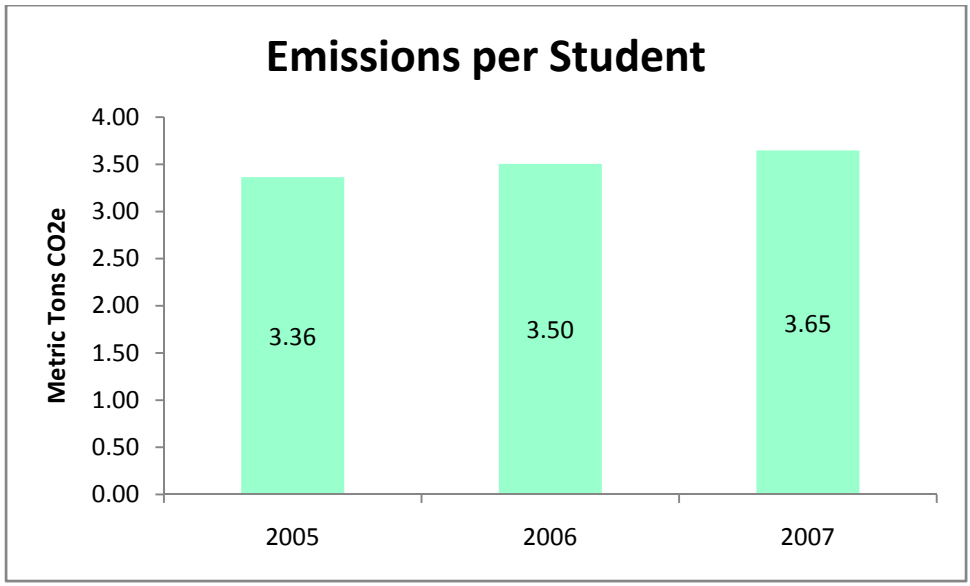

Figure 14: Emissions per student

Comparison to other institutions of higher education

Compared to other universities, UI has a small carbon footprint, well below the average found for other colleges and universities of 6.7 metric tons per student (see Table 6).

Institution	Year	Per Student Emissions (metric tons/ student)
University of Oregon *	2004	1.3
Portland State University*	2004	1.8
San Francisco State University	2005	2.1
Marymount Manhattan College	2007	2.2
University of California, Santa Barbara	2004	2.2
University of Central Florida	2006	2.5
Boise State University	2006	2.7
College of Charleston	2001	3.5
Cal POLY Pomona	2005	3.6
University of Idaho	2007	3.6
Tulane University	2000	4.1
University of California, Berkley	2006	4.4
Evergreen State College	2006	5.1
University of New Hampshire	2003	5.4
Lewis and Clark College	2003	5.8
Connecticut College	2006	6.0
Oregon State University*	2007	6.1
Utah State University	2007	6.6
University of Minnesota Morris	2006	7.1

University of Vermont	2005	7.3
University of Connecticut	2005	7.5
University of Pennsylvania*	2006	7.6
University of Iowa	2005	8.1
Harvard University*	2006	8.8
University of Maryland, College Park	2007	10.8
University of Illinois at Chicago	2006	11.0
Pomona College	2006	11.7
Smith College	2004	11.8
Carleton College	2004	11.8
Michigan State University	2000	12.4
Oberlin College	2000	16.8
Yale University	2006	19.2

* Denotes that these universities used student and faculty population in order to determine per capita emissions.

Table 6: Comparison of UI's per student emissions to other American colleges and universities. References can be found in Appendix F.

There are several reasons why UI's carbon footprint is relatively small:

1) UI's main campus uses wood waste as its main fuel source in the central steam plant, with natural gas as a backup fuel. Since wood is a renewable fuel, emissions produced by burning waste wood are not counted in an emissions assessment. The conversion to a biomass boiler has resulted in 84% of UI's heating energy being produced with zero net CO_2e emissions. This has reduced UI's overall carbon footprint by 11,500 metric tons per year that would have been produced if all heating energy had been produced using natural gas. This equates to a 22% reduction in 2007 GHG emissions.

2) UI is positioned in the Northwest Power Pool section of the US EPA E-Grid document. Since almost half of the NWPP electricity is generated from hydropower, the university's emissions from electricity use is lower than the national average (Figure 4).

3) UI Facilities has an active energy conservation program designed to minimize energy use on campus. This program has helped significantly reduce annual heating energy use and has maintained a flat electric energy use profile since Fiscal Year 2003, despite growth in conditioned building space.

4) UI administration and students (through student fees) supplement local transit budgets to increase in-town and regional transit options. This has helped reduce commuter-related emissions.

Next steps for GHG assessment

Scope 3 emissions contain a number of estimates that reduce the accuracy of scope 3 results. Commuter emissions, in particular, are based on insufficient data. A more thorough and organized commuter survey is planned for fall 2008 to provide better and more expansive data. Scope 3 emissions will need to be refigured accordingly once the results have been completed.

The conversion of air travel data from fiscal data to emissions data is also a crude process with current calculation tools. Additional work needs to be done to refine this estimate, including developing a more accurate way to collect data at UI.

UI owns over 8,000 acres of forest lands. Currently data on these lands is not available to calculate the carbon sequestration taking place. UI forests are managed sustainably, and meet most criteria for including at least a portion of them as carbon offsets. Unfortunately, more data needs to be collected on the forests before this will be possible.

Notes

[1] American Colleges and Universities Presidents Climate Commitment (ACUPCC), 2007. Overview & Examples of Climate Action Plans. http://www.presidentsclimatecommitment.org/html/overview.php

[2] American Colleges and Universities Presidents Climate Commitment (ACUPCC), 2007. Implementation Guide: Information and Resources for Participating Institutions. http://www.presidentsclimatecommitment.org/

[3] Chicago Climate Exchange (CCX), 2003. Overview. http://www.chicagoclimateexchange.com/

[4] Recyclemania. http://www.recyclemaniacs.org/Index.htm

[5] World Resources Institute (WRI) and World Business Council for Sustainable Development, 2004. The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition). http://www.ghgprotocol.org/

[6] Clean Air Cool Planet (CACP), 2006. Clean Air Cool Planet Campus Carbon Calculator v5.0. http://www.cleanair-coolplanet.org/toolkit/

[7] World Resources Institute (WRI) and World Business Council for Sustainable Development (WBSCD), 2007. Calculation Tool for Direct Emissions from Stationary Combustion Calculation Worksheets Version 3.1. http://www.ghgprotocol.org/

[8] World Resources Institute (WRI) and World Business Council for Sustainable Development (WBSCD), 2005. Mobile Combustion CO2 Emissions Calculation Tool Version 1.3. http://www.ghgprotocol.org/

[9] United Nations Environment Programme (UNEP), 2006. Ozone Secretariat. ozone.unep.org

[10] Environmental Protection Department and Electrical and Mechanical Services Department (China), 2008. Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings of Commericial, Residential, or Institutional Purposes in Hong Kong. http://www.epd.gov.hk/epd/english/boards/advisory_council/files/Draft_Guidelines_080507A.pdf

[11] World Resources Institute (WRI), 2007. Indirect CO2 Emissions from Purchased Electricity Version 3.0. http://www.ghgprotocol.org/

[12] U.S. Environmental Protection Agency, 2007. The Emissions and Generation Resource Integrated Database for 2006. http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

Appendix A: Calculation Methods

1. Stationary combustion methods

Direct CO_2e emissions from stationary combustion were calculated using the Calculation Tool for Direct Emissions from Stationary Combustion provided by the World Resource Institute (WRI, 2005). The process began with collecting natural gas (NG) use data from Avista Corporation. This data was in the form of therms and needed to be converted into gigajoules (Gj). This conversion was completed by multiplying the data in therms by 0.1055 to result in Gjs. The Gjs of NG were then entered into the calculation tool, where it was multiplied by the carbon content of NG (14) and the oxidation factor of NG (100%), which are both important in determining the exact amount of CO_2 released from the combustion of natural gas. The carbon content refers to the fraction or mass of carbon atoms relative to the number of atoms or total mass in the fuel, and the oxidation factor refers to the percent of carbon that is transformed into CO_2. The multiplication of the Gjs of NG, the carbon content, and the oxidation factor resulted in grams of CO_2 emitted, which was then converted into metric tons of CO_2e.

2. Vehicle fuel methods

Fuel usage data was converted from fiscal year to calendar year in order to make the data compatible with other data in the GHG inventory. Fiscal years run from July 1 of one year to June 30th of the next year. Fiscal year data was converted into calendar year data by dividing it by 12 for a monthly average for each fiscal year. The monthly averages were multiplied by 6 to develop a 6 month average. The 6 month averages from two sequential FYs were combined to create a calendar year (CY) total. Once the data was in CY, it was converted from dollars to gallons using an average cost per gallon of fuel for the corresponding year. The average cost per gallon paid by the university was estimated by using bills from the university's main fuel distributor, Busch Fuel Distributors. Once the yearly average cost per gallon was determined, it was divided by the yearly fuel expenditures to give the yearly fuel usage in gallons for UI.

During this process it was discovered that a significant portion of fuel used on campus was not captured by UI accounting systems. By comparing fuel expenditures data, which were broken down by department, with the bills provided by Busch Fuel Distributors, it was found that a significant amount of diesel used by Facilities Management and Operations at UI (FMO) was not present in the fuel expenditure data. This missing data were added to the fuel expenditure data in order to increase the accuracy and completeness of the data. After the fuel data were converted to gallons and calendar year and the missing data were added, they were entered into the World Resource Institutes GHG Protocol – Mobile Guide v1.3 to obtain metric tons of CO_2e emitted. It is unknown if other gaps in the data exist, although additional gaps are expected to be small because major accounts have already been cross-checked in both data sources.

3. Fugitive emissions methods

UI does not keep very thorough data on HFC and HCFC leakage from air-conditioning units and refrigeration systems. It is known that UI releases three types of HFCs: R-134A, R-408A, R-404A, and three types of HCFCs: R-22, R-416A and R-409A, but the exact quantity of each gas released is unknown.

All that is known is the total amount of HFCs and HCFCs released in a 31 month period. Since it is unknown exactly how much of each gas leaked, for each category the gas with the highest global warming potential was used. This way the amount of fugitive emissions will not be underestimated. The total amount of HFCs released—8.2 kg--was converted into metric tons and then multiplied by the global warming potential of the most potent gas, R-404A. The total amount of HCFCs released—134.3 kg—was converted into metric tons and then multiplied by the global warming potential of the most potent gas, R-22. Then the resulting emissions of HFCs and HCFCs in metric tons CO_2e was divided by 31 and then multiplied by 12 in order to determine the annual emissions.

4. Electricity methods

The calculation of emissions from purchased electricity was a fairly straightforward process. The electricity usage data was inserted into the GHG Protocol Indirect CO_2 Emissions from Purchased Electricity Workbook. Then the E-GRID map and data from 2004 embedded in the workbook were used to determine the proper regional emission factor. Then the electricity usage was multiplied by the regional emission factor, resulting in the number of metric tons of CO_2e emitted due to electricity usage.

5. Air Travel

UI only keeps fiscal data on air travel, and only data for the past four fiscal years (2005-2008) were available. The data were tracked in three categories of air travel: in-state, out-of-state, and international. Fiscal data were converted into miles traveled using a conversion factor of 1 air mile per $0.25 from the ACUPCC Implementation Guide.

Fiscal years run from July 1 of one year to June 30th of the next year. Fiscal year data was converted into calendar year data by dividing it by 12 for a monthly average for each fiscal year. The monthly averages were multiplied by 6 to develop a 6 month average. The 6 month averages from two sequential FYs were combined to create a CY total. From this CY data CO_2e emissions were determined using the mileage-based method presented in the WRI GHG Protocol – Mobile Guide v1.3. This calculation tool separates air travel into three categories; short haul (less than 281 miles), medium haul (between 281 and 994 miles), and long haul (more than 994 miles) each having a separate emission factor. The emission factor (kg CO_2/unit) is higher for shorter flights due to the fact that most aircraft fuel is used during take-off and landing. All of the in-state travel miles were placed in the short haul category since the majority of in-state travel occurs between Lewiston and Boise, which is a flying distance of about 200 miles. Half of the out-of-state were placed in the medium haul and half in the long haul. All of the international miles were placed in the long haul. These three categories with their different emission factors allow for a more accurate estimate of the CO_2e emitted as a result of air travel.

6. Commuter

The university conducted a survey of over 700 students during spring 2008 to determine commuting behaviors at UI. This survey was distributed to large classes whose instructors agreed to have their courses participate. The survey did not include faculty and staff at UI. Once the data was analyzed for completeness, the usable sample size was found to be 694 students. The survey focused on on four

specific data needs: how many students commute to campus, how many students commute via automobiles, how often these students commute, and how far they commute.

The percentage of students that commute to campus was found by a simple survey question asking whether or not students lived on campus. It was found that 83% of students sampled commute to campus. This percentage was then multiplied by the student enrollment for 2005, 2006 and 2007 (Appendix D) in order to determine the total number of students that commute to campus.

The next step was to determine the percentage of students who commuted by automobile, and how often they commuted by automobile. These two data needs were filled by the following question: "in an average week, how often do you commute to campus using these different methods: drive a car, carpool, bike, walk, bus, drive to Moscow and then walk to campus." This question was asked for two month periods (such as January and February), meaning that a person who commuted by car every day year round would receive a score of 30 (5 times a week for all six 2 month periods). This question was used to subdivide the surveyed commuting population into categories dependent upon how often they commuted to campus by car, with categories ranging from 0 (never) to 30 (always). The number of students in each category was then divided by the surveyed commuting population to determine the percentage of students who commute by car for each category. Next, the total commuting population for 2005, 2006 and 2007 was multiplied by the category percentages, resulting in the number of students who commute by car for each category. These frequency categories (0-30) were then converted into commuting days by dividing the category by 30 and multiplying by 240 (the number of commuting days in a year).

The final step was to determine the average commute. Instead of determining the average commute for each category, an average commute was found for the frequent drivers (20-30) and the infrequent drivers (1-19). This was done by adding up the commuting distance of all students that fell in the frequent driver's portion, eliminating the outliers, and finding the median. The same was done for the infrequent drivers. It was found that the frequent drivers round trip commute was 4 miles, which was double that of the infrequent drivers, 2 miles. To calculate the commuting miles traveled by students in a calendar year, the length of commute, frequency of commute, and number of people making the commute for each category was calculated. The category totals were then summed, resulting in the total annual student commuting miles.

The total annual commuting miles were added to the faculty and staff commuting miles which were determined by the following process. Since no faculty survey has been completed to date these numbers are very rough estimations. First, the faculty population was multiplied by the estimated percentage that regularly drives to campus (80%). This estimation is based solely on observational data. The resulting faculty population was then multiplied by the commuting days in a year (240) and the average commute (5 miles). The average commute is higher for faculty and staff because it is known that a significant amount of staff members live outside of Moscow.

The student commuting miles were then added to the faculty and staff commuting miles for each year, and the resulting mileage was entered into the WRI Mobile Combustion CO_2 Emissions Calculation Tool

Version 1.2. It was assumed that each commuter made the commute in an automobile that gets 23 mpg. With these parameters the calculation tool was able to determine the amount of CO_2e emitted from commuters at UI.

7. Waste Transport

First, the total waste, 1,500 metric tons, was divided by the average weight of waste transported in one trip: 20 metric tons. This resulted in the number of trips per year it takes to transport UI's waste to the landfill in Arlington, Oregon: 75. Then by multiplying the number of trips by the distance to Arlington, 225 miles, the annual mileage traveled for one leg of the trip was determined: 16,875 miles. This mileage was multiplied by the fuel efficiency of a full semi truck, 3 mpg, to obtain the amount of diesel used annually for one leg of the trip: 5,625 gallons. For the return trip back from the landfill the truck travels the same distance, 225 miles, but this time it is empty and therefore gets better gas mileage: 4 mpg. By multiplying the annual miles traveled for one leg determined above by the gas mileage of an empty semi truck the yearly fuel usage for the second leg of the trip is determined: 4,218.75 gallons. The total annual fuel usage of 9843.75 gallons was entered into the WRI Mobile Combustion CO_2 Emissions Calculation Tool Version 1.2 to determine that 102.3 metric tons of CO_2e were produced transporting UI's waste to the landfill annually.

Appendix B: Data Sources

Data	Years	Source	Contact	Data Quality
Enrollment	1999-2007	Institutional Research and Assessment	Archie George	High
Stationary Combustion	2003-2007	UI Facilities Management and Operations	Richard Nagy	High
Vehicle Fuel	2005-2006	Accounts Payable	Linda Keeney	Medium
Fugitive Emissions	2005-2007	UI Facilities Management and Operations	Mark Labolle	Low
Electricity for General Education accounts	2003-2007	UI Facilities Management and Operations	Richard Nagy	High
Electricity for Auxiliary accounts	2003-2007	Avista	Rick Davis	High
Air Travel	2005-2006	Accounts Payable	Linda Keeney	Medium
Commuter Travel	2002-2007	University of Idaho Sustainability Center	Eric Delmelle	Low
Waste (generation)	2005-2007	UI Facilities Management and Operations	Gerard Martin	Very Low
Waste (transport)	2005-2007	Latah Sanitation	Andy Boyd	Medium
Animals	2002-2007	Palouse Research, Education, and Extension Center	Don Thill	Medium

Appendix C: Building List

Building	Square Footage
Administration	121,545
Agricultural Engineering Office (Extension)	3,600
Agricultural Science	111,414
Agricultural Biotechnology	45,714
Agricultural Publications	2,400
Albertson, J.A. (College Of Business & Economics)	55,150
Alumni Center	28,677
Animal Pavilion	15,709
Aquaculture Institute	6,882
Aquaculture Wet Lab	5,945
Art & Arch East (327 W. 8th St)	8,652
Art & Arch. (= Psychology)	22,445
Art & Arch. North	29,021
Art & Arch. South	23,533
Art & Architecture Interior Design	3,018
Beef Working Facility	2,040
Bookstore	19,488
Brink Hall (Carol Ryrie)	41,664
Buchanan Engr. Lab	79,655
Business Technology Incubator	17,170
Campus Police Substation	2,745
Campus Storage #1	6,720
Central Mall Chiller Plant	2,424
College of Education	62,632
College of Mines	32,298
College of Natural Resources (Forestry)	90,881
Commons	100,042
Continuing Education	30,032
Early Childhood Learning Center	12,950
Engineering Annex Isotopes Lab	3,672
Engineering/Physics	63,000
Environmental Health / Safety	2,343
Events & Bookstore Storage	3,675
Facilities Services Center (FSC)	79,232
Farm Operation Shop	7,820
Farm Residence Beef	1,872
Farm Residence Sheep	13,968
FMO Campus Mail / Surplus	10,044
FMO garage / storage	25,576
Food Research Center	16,542
Garage / Motor Pool	2,480
Gauss-Johnson	83,110
Golf Clubhouse	3,642
Graduate Art (GAS House)	13,472
Graduate Student Residence	35,777

Greenhouse 6th Street	25,999
Hampton Music Building	35,705
Hartung, (Performing Arts)	23,700
Health Center	28,556
Health Education & Welfare Building	6,890
Holm Research Ct (Vet Science)	24,555
Housing Storage (& Shop)	7,533
Human Resources & Purchasing	5,100
Industrial Education	11,992
Irrigation Pumphouse	150
Janssen Engineering Building	48,298
Kibbie Activity Center	270,379
Letters & Science Annex	6,366
Library	186,850
Life Science North (Gibb Hall)	57,456
Life Science South	65,034
Little Blue House	931
Little Brown House	1,213
Living & Learning Center #1	21,558
Living & Learning Center #2	35,436
Living & Learning Center #3	29,125
Living & Learning Center #4	22,624
Living & Learning Center #5	22,624
Living & Learning Center #6	22,624
Living & Learning Center #7	24,445
Living & Learning Center #8	22,624
Manis Ent. Research Laboratory	3,080
Manis Lab Storage Bldg. (Host Resistance Lab)	200
Martin, J.W. Lab (Agricultural Engineering)	28,390
McClure Hall (ERB)	73,475
McConnell	21,595
Memorial Gym	93,561
Menard Law Building	68,781
Morrill Hall	31,175
Native American/Migrant Education Center	3,236
Navy Bldg	9,387
Niccolls Hall (Home Economics)	29,999
North Campus Center	41,150
Observatory	154
old University Recylcing	10,356
PE Building	53,694
Perimeter Drive Greenhouse	2,700
Phinney Hall (Archie)	31,197
Poultry Hill Warehouse	3,000
Power Plant	22,656
Presidents House	6,136

Pritchard Gallery	8,176
Pumphouse #2	305
Pumphouse #3	507
Pumphouse #4	667
Pumphouse #5	229
Pumphouse #9	1,055
Radio/TV	5,801
Renfrew Hall	92,598
Ridenbaugh	16,265
Shoup Hall	22,035
South Hill Community Center	2,343
Steel House	13,396
Student Rec Center	85,563
Student Union	109,349
Swimming Center	47,779
Targhee Hall	14,899
Teaching & Learning Center	49,743
Theophilus Tower	89,943
UI Foundation Office Of Development	4,125
University Vehicle Storage A	2,800
University Vehicle Storage B	1,248
Wallace Center	45,375
Wallace Dorms (Ballard Hall)	38,855
Wallace Dorms (Gooding)	58,284
Wallace Dorms (Stevenson Hall)	38,855
Wallace Dorms (Wiley Hall)	58,284
TOTAL	**3,700,839**

Appendix D: Student Enrollment (from Institutional Research)

Campus	Term	Year	Total Full Time	Total Part Time	TOTAL
Moscow	Fall	1997	7,697	2,017	9,714
Moscow	Fall	1998	7,991	2,532	10,523
Moscow	Fall	1999	8,001	2,394	10,395
Moscow	Fall	2000	8,229	2,511	10,740
Moscow	Fall	2001	8,580	2,324	10,904
Moscow	Fall	2002	8,955	2,620	11,575
Moscow	Fall	2003	9,262	2,525	11,787
Moscow	Fall	2004	9,184	2,629	11,813
Moscow	Fall	2005	9,052	2,575	11,627
Moscow	Fall	2006	8,773	2,259	11,032

Appendix E: Acknowledgments

The completion of this inventory was very much a collaborative effort and as such we would like to thank all those individuals who had a hand in its completion.

University of Idaho

Accounts Payable: Linda Keeney

Division of Finances and Admin Services: Doug Hall

Facilities Management and Operations: Richard Nagy, Charles Zillinger, Gerard Martin, Mark Labolle, Carolyn Reader, Greg Dahmen

Parking Services: Carl Root, Becky Couch

Palouse Research, Education, and Extension Center: Don Thill, Jason Campbell, Joshua Peak

Department of Animal and Veterinary Sciences: Dirk Vanderwall

Department of Geography: Eric Delmelle

Institutional Research and Assessment: Archie George, Joan Jones

University of Idaho Sustainability Center: Jeannie Matheison

Steam Plant: Mike Lyngholm

Area Businesses

Avista Utilities: John Lyons, Rick Davis

Latah Sanitation: Andy Boyd

Moscow Valley Transit: Tom Lapointe

Busch Distributors: Crete Davis

Appendix F: References for Emissions Comparison (Table 6)

University of Oregon

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Portland State University

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Evergreen State College

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University of Minnesota Morris

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