Greenhouse Gas Inventory

The University's Carbon Footprint: 2004-2008

OFFICE OF ENERGY RESEARCH, POLICY AND CAMPUS SUSTAINABILITY

September 15, 2008

John Gardner, Associate Vice President

ACKNOWLEDGEMENTS

Assembling a study of this magnitude is only possible with the help of a great many people. We can't hope to acknowledge all involved, since this truly is a campus-wide effort. However, we'd like to take a minute to give special thanks to James Maguire and his entire staff in Facilities and Planning, Peggy Davis in Travel, Barry Burbank (who so ably tracks our utility usage on campus), and Cynthia Rice in athletics.

As is often the case with important university initiatives, the greenhouse gas inventory has its roots in the classroom. Scott Lowe's Natural Resources Economics class in Fall of 2007 performed the first BSU inventory and developed the method used to estimate the impact on commuting. The following semester, students in the Environmental Studies program continued this work under the guidance of professors Bruce Ballenger (English), Dave Wilkins (Geosciences) and Christopher Hill (Anthropology).

Finally, it's important to acknowledge all the students, faculty and staff who help make this campus so efficient. Environmental impact is managed only if the entire community is playing its part. If this inventory is any measure, Boise State is clearly off to a good start.

Table of Contents

Boise State University Greenhouse Gas Inventory

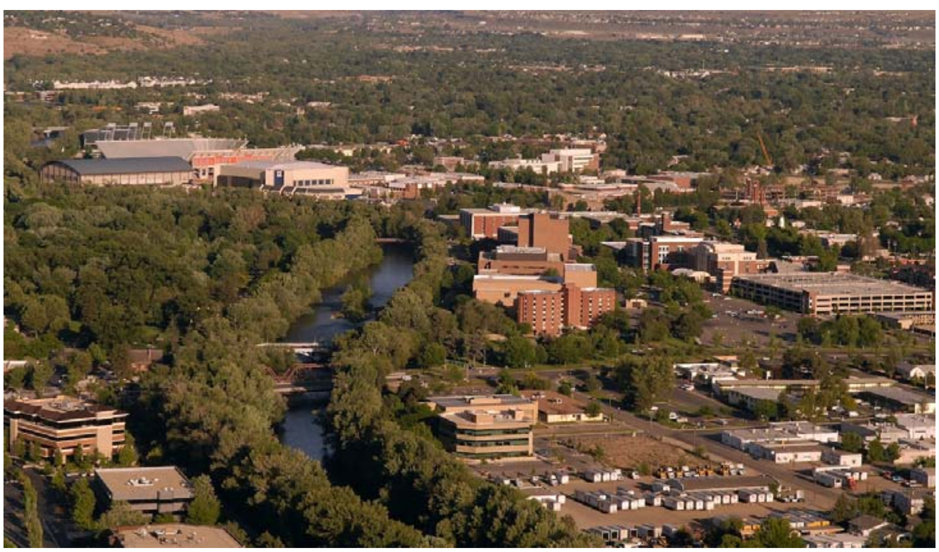
2004-2008

Executive Summary

Boise State University's per capita carbon footprint, as measured by this greenhouse gas inventory, is one of the smallest of all the universities in the country at 2.3 MT CO_2(e) per person/year[1]. This result is due to several factors. First, relative to the number of students we serve, our physical plant is small. Some analyses indicate that conditioned space is the single best correlate to carbon footprint. Second, we enjoy a relatively mild climate with the harshest conditions (summertime) coming when we have the least demand for buildings and services. Finally, the university continues to modernize and improve campus infrastructure and the efficiencies realized through those activities result in lower energy consumption and, therefore, lower carbon emissions.

The bad news is that, as an absolute number, the university's overall carbon footprint is growing at a rate of 3% per year over the past 5 years. While that growth is commensurate with the growth in our university, our first priority should be to eliminate the rate of increase.

As a campus community we should take pride in the fact that our "carbon intensity" is so low, but we can't rest on past success. In the coming months, we will be developing a long-term plan for the campus that puts us on the path toward total climate neutrality.



[1] One metric ton of CO2(e), also abbreviated as MTCDE, is the equivalent of 1000 kg of carbon dioxide released in the atmosphere

Introduction

In 2007, university president Bob Kustra signed the American College & University Presidents Climate Commitment[2] (ACUPCC), which is now supported by more than 560 university presidents. The first requirement of the commitment is the completion, and publication of, a university greenhouse gas inventory. The office of Energy Research, Policy and Campus Sustainability was tasked with this effort and from September of 2007 (when the office was established) through the summer of 2008, a methodology was established to inventory, track, and report the university's carbon footprint by taking an inventory of greenhouse gas (GHG) for which the university is responsible. This report documents the results of that effort. The next step is the development of a GHG reduction plan aimed at making the overall campus 'climate neutral'.

Scope and Methodology

GHG inventories have evolved significantly over the past decade. The ACUPCC provides guidance to the process[1]. In addition, the Greenhouse Gas Protocol Initiative[3] and the Chicago Climate Exchange[4] provides standards to which these efforts should be held. Within this framework, several concepts are discussed and should be defined at the outset:

Organizational Boundary

Whereas Boise State conducts many operations at various locations around the Treasure Valley, this report is limited to the operations on the main campus in Boise, ID. Most of the off-campus operations are quite small, consisting of a leased office and a few staff. The exceptions are two locations in Canyon County with property and buildings: The Boise State West Campus (150 acres with a 65, 354 sq. foot academic building and small tech center building housing a small business incubator) and the Canyon County Center (7.5 acres with an 81,554 sq foot classroom building). These facilities (with the exception of 50 acres and the Tech Center on the West Campus) will be transferred to the College of Western Idaho within the next 10 months and are therefore not part of the university's future. As a result, it was decided not to include these in the inventory.

Reporting Periods

We choose to report emissions on an academic year basis. Each academic year starts on July 1st and ends the following June 30th. For example, the 2008 Academic Year (AY 08) runs from 1 July 2007 to 30 June 2008.

Operational Boundaries

These refer to the specific gasses tracked as well as the various 'scopes' of activities considered (see below). The gasses considered are the same as those spelled out in the 1997 Kyoto Protocols, namely: Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), hydroflurocarbons (HFC's) , perflurocarbons(PFC's) and sulfur hexafluoride (SF_6). As called out in the ACUPCC implementation guide[1], the main focus of the inventory is CO_2 since SF_6 and PFC's are uncommon in a university environment and the other cases are minor compared to CO_2. When data is

[2] http://www.presidentsclimatecommitment.org/

[3] http://www.ghgprotocol.org/

[4] http://www.chicagoclimatex.com/

available for the other gases, they will be expressed in the units of metric tons of CO_2(e), or carbon dioxide equivalents (MTCDE).

Scopes

The GHG protocols define various scopes of activities from which GHG's emanate[2].

Scope 1: Direct emissions from sources owned or controlled by the university. For Boise State, Scope 1 emissions include the CO_2 resulting from all the natural-gas fired boilers and water heaters on campus. This also includes emissions from the university-owned fleet and maintenance vehicles. Finally, scope 1 includes "Fugitive" emissions. These are refrigerants accidently vented to the atmosphere or methane from university owned livestock. Our analysis showed that the contribution of fugitive emissions are minor (less than 1% of the total) and hence considered '*de minimis*' emissions and not tracked as part of this effort.

Scope 2: Indirect emission that result from the generation of electricity used by the campus.

Scope 3: All other indirect emissions that can be traced to university operations. The major scope 3 source is that due to student and staff commuting.

Consistent with the GHG Protocol standards, ACUPCC signatories agree to account for and report on emissions from Scopes 1 and 2. In addition, as specified in the Commitment, signatories agree to report some Scope 3 emissions, specifically those from commuting and from air travel paid for by or through the institution, to the extent that data are available. For purposes of the Commitment, commuting is defined as travel to and from campus on a day to day basis by students, faculty, and staff. It does not include student travel to and from campus at the beginning and end of term or during break periods.

Scope 3 emissions often include the impact of solid waste removal and disposal on the organization's carbon footprint. We choose not to track these because previous studies have shown that the overall impact of solid waste is quite small (a little more than 1% of the total). This is consistent with the facts that the campus is relatively close to the landfill (less than 10 miles) and that the Ada County landfill captures much of the methane produced at the landfill and uses it to produce electricity, thus greatly mitigating the carbon footprint of the operation.

Similarly, indirect emissions due to consumption are not tracked nor reported. While the carbon footprint of products purchased by the university can be a significant portion of the carbon footprint, we chose not track these for several reasons. First, as awareness of the importance of GHG emissions grows, all companies who provide products are motivated to track and reduce their own individual impact. To account for these from the university is to 'double count' the impact. Second, the university is well-motivated to reduce consumption on all levels, since budgetary resources are always scarce. Finally, this area is devilishly hard to track, and would present an undue burden on the staff who are engaged in this process.

Methodology

For most of the inventory, the methodology is rather straightforward. The university financial system keeps detailed records of bills paid for utilities, which includes the amount of energy used each month. The Greenhouse Gas Protocol Initiative and the Chicago Climate Exchange (CCX) [5] allow a straightforward computation of metric tons (1000 kg) of CO_2(e) for each unit of energy purchased. For example, each 'therm' of natural gas consumed in the university water heaters and boilers emits about 0.0053 MT of CO_2(e)[3]. Similarly, each Megawatt-hour of

[5] http://www.chicagoclimatex.com/

electricity consumed in the northwestern United States was responsible for 0.417 MT CO_2(e) through its generation and transmission (see appendix for discussion of this coefficient). Note that this conversion takes into account the relatively high percentage of our electricity that comes from hydroelectric projects.

GHG emissions from university fleet and maintenance vehicles are relatively easily tracked through the amount of motor fuel purchased each year. While the various engines extract varying amounts of useful work from a gallon of gas, the amount of GHG generated is approximately the same, regardless of the vehicle in which it was burned. On average, one gallon of gas, when burned in an internal combustion engine is responsible for 0.0092 MT of CO_2(e)[3].

Anyone who has developed a GHG inventory struggles with the "Scope 3" or indirect emissions. For the purposes of this inventory, we limit our indirect emissions tracking to travel. Travel is broken down into three categories, each handled separately:

University-Sponsored Air Travel

When a faculty member presents an academic paper in Boston, or a staff member attends a professional development seminar in California, they generally take an airplane to get there. Airline travel is often cited as particularly damaging to the atmosphere since it not only consumes large amounts of fossil fuels, but delivers the offending gases in the upper atmosphere where they do more damage. Some of this effect is mitigated as airlines struggle to make their operations more efficient, but it is nonetheless important to track this effort.

The university travel office tracks money spent on air travel in three categories, in-state, out-of-state and international. We have developed a method of tracking average ticket prices so that we can apply a conversion factor (adjusted annually) and estimate the number of passenger miles represented by the total amount spent. Then we can apply widely accepted coefficients to that number to estimate equivalent CO_2 emissions.

Athletics

Boise State University's varsity athletic teams participate in the Western Athletic Conference. This is one of the most geographically dispersed conferences in the country and includes the University of Hawai'i and Louisiana Tech University. As such, the varsity teams rack up a lot of miles playing their regular schedule. Currently, the athletics department does not track athlete-miles-traveled so a comprehensive accounting is not possible. The numbers reported here are an estimate based on the varsity teams we fielded in 2007/2008, number of students on each squad and the number and location of way games/meets. Various means of travel are used, but we assumed all of the travel was by air, thus establishing an upper bound on this number.

Commuting

Arguably the most difficult pieces of the GHG picture, it is also the 2^{nd} largest single contributor to our overall carbon footprint (purchased electricity is first). In July of 2008, the office of Energy Research, Policy and Campus Sustainability, with the help of the parking office, conducted a study which used data from a variety of sources to estimate the number of people who drove every day and how far they traveled. This approach is described in greater detail in a report that can be found on the BSU sustainability web site[6].

---

[6] http://www.boisestate.edu/sustain

Snapshot of the Carbon Footprint: AY 2008

Table 1 shows the results of our GHG inventory for the 2008 academic year. Figure 1 shows the results in graphical form.

TABLE 1: BOISE STATE GHG EMISSIONS: 1 JULY 2007 THROUGH 30 JUNE 2008

Category	*Qty*	*Emissions (MT CO_2e)*
Scope 1		
Natural Gas	1,370,987 therms	7,266
Fleet	58,734 gallons	540
Scope 2		
Electricity	44,407 MWhr	18,518
Scope 3		
Commuting	39.7 Million VMT*	16,522
University Sponsored Travel		4,686
Athletic Travel		2,352
TOTAL		**49,884**

* vehicle miles traveled

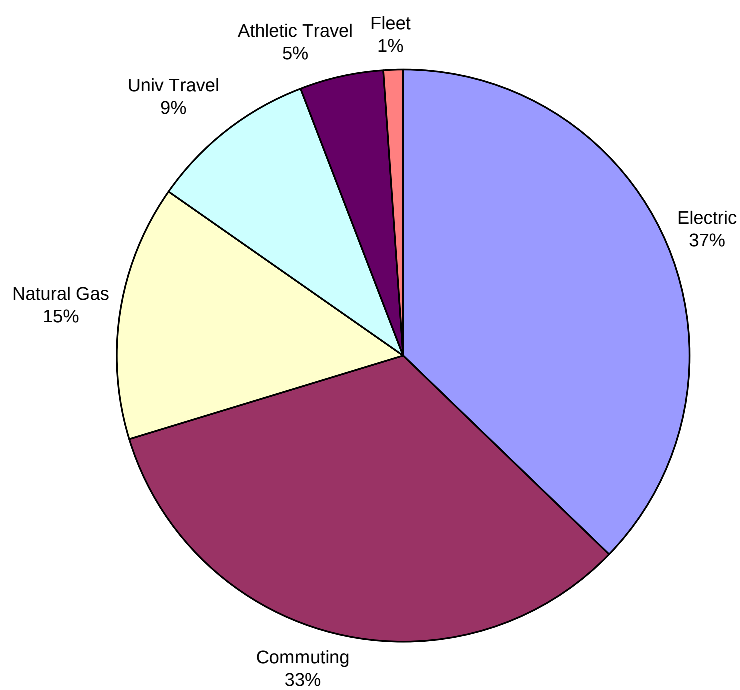


Figure 1: Breakdown of GHG emissions sources, AY 2008

Figure 1 is an excellent starting place when attempting to develop a plan to reduce GHG emissions. For example emissions due to utilities (natural gas and electric consumption) account for just over half of the campus's carbon footprint. These are also the categories that incur direct costs to the university. With the added realization that energy costs seem destined to rise significantly over the next decade, then one is led to conclude that efficiency and conservation efforts should remain a high priority for the campus.

Emissions associated with commuting are also a large portion of our footprint. Over the past decade, the university has been very proactive in encouraging alternative means of commuting. In recent years, signs have indicated that these efforts are starting to succeed. As the price of gasoline remains high, and the average fuel efficiency of automobiles also increases, this portion is likely to decrease in the coming years.

University sponsored travel, both athletic and professional, along with the campus fleet, make up the balance of the footprint.

Five-Year Trends

To better understand the university's carbon footprint, and to gain insight into the factors that influence it, a retrospective analysis can be enlightening. By gathering data over the past 5 years of operation, we are able to see which portions of the emissions picture represent increasing impact and which are shrinking. More importantly, it allows us to put the emissions in the context of the university's growth in student population, physical plant and research activities.

Figure 2 shows the total emissions picture by academic year for the past 5 years of Boise State University's operations. The physical, operation and temporal boundaries are the same as described in the outset of this report. In some cases,

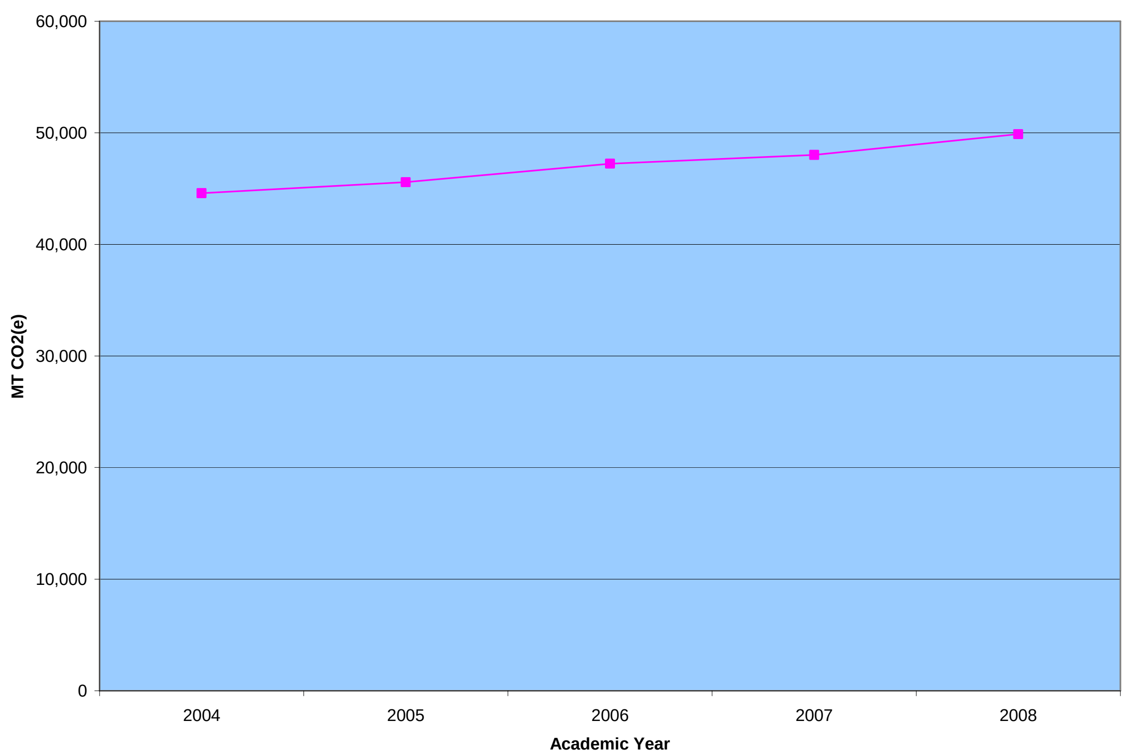


Figure 2: Total GHG emissions for the 5-year period from 2004 to 2008

comprehensive data were not available in which case, the numbers were either assumed to be same as those computed for the 2008 academic year (fleet emissions, athletic travel) or were pro-rated on a per capita bases (as was the case for commuting).

The most important feature of this graph is that it shows *consistent growth of Boise State's carbon footprint over the past 5 years*. The rate of increase was 3% per year, for a total increase of just under 12% over 5 years. Most of that increase is attributable to increased consumption of utilities which were significantly higher in 2008, a year in which our winter was harsher than any of the previous 4 years (see section on weather in this report).

However, it is also important to put these increases in the correct institutional context. In same time period, Boise State added significantly to its physical plant, increasing our conditioned GSF (gross square feet) by 5.5%. (This includes the indoor sports complex, offices in the parking structure, the Integrated Learning Center and various properties in the campus expansion zone.) Additionally, the number of students served by the campus increased by 6% and the number of on-campus resident students increased 83%. This growth is accompanied by the growth in full time faculty and staff and a shift in student demographics favoring full-time students. These factors are combined in a weighted Full Time Equivalent measure described in the following section.

Institutional Data

While the total carbon footprint of any organization should be considered as its responsibility relative to climate change, it is equally important to examine the GHG emissions in light of the university's operation and growth over the same time period. In this way, we can see if the university is getting more efficient in its operations, thus lowering its "carbon intensity" over time. The table below shows a compilation of university statistics over the past five years.

TABLE 2: SUMMARY OF INSTITUTIONAL DATA, 2004-2008

AY	*2004*	*2005*	*2006*	*2007*	*2008*
Gross Square Feet (GSF)	2,937,123	2,937,123	3,034,431	3,088,431	3,099,511
Total Students	18,431	18,418	18,650	18,876	19,414
Resident Students	839	913	1,192	1,409	1,536
Faculty & Staff	2186	2196	2265	2298	2443
FTE*	15,051	15,142	15,663	16,062	16,691
Total Head Count	20,617	20,614	20,915	21,747	21,857

** For the purposes of this report, FTE refers to Full Time Equivalent computed in a manner consistent with AASHE guidelines: (# resident students) + 0.75*(# FT students + Faculty & Staff)+.5*(#PT students)*[7]

Figure 3 shows the 'per capita' carbon foot print for the campus. Note that three different sets of data are shown. The lower number (per headcount) simply divides the total emissions by the sum of students enrolled and full-time employees. The larger set of numbers (per FTE) divides the total emissions by a 'full time equivalent' number as described by the Association for the Advancement of Sustainability in Higher Education (AASHE). In between we report the GHG emission on a 'per student' basis, which is how many other institutions choose to report their data.

This plot is particularly illustrative. As opposed to our total footprint, which has increased over the five year period, on a per capita basis, the picture is slightly more complicated. Our emissions on a per student basis are growing, albeit at rate which is less than half the rate of the overall footprint. On the other hand, using the AASHE's definition of FTE, our footprint is essentially flat, perhaps indicating that the addition of buildings and students do not bring about incremental increases that are out of line with our baseline emissions.

[7] http://www.aashe.org/stars/documents/STARS_0.5.pdf

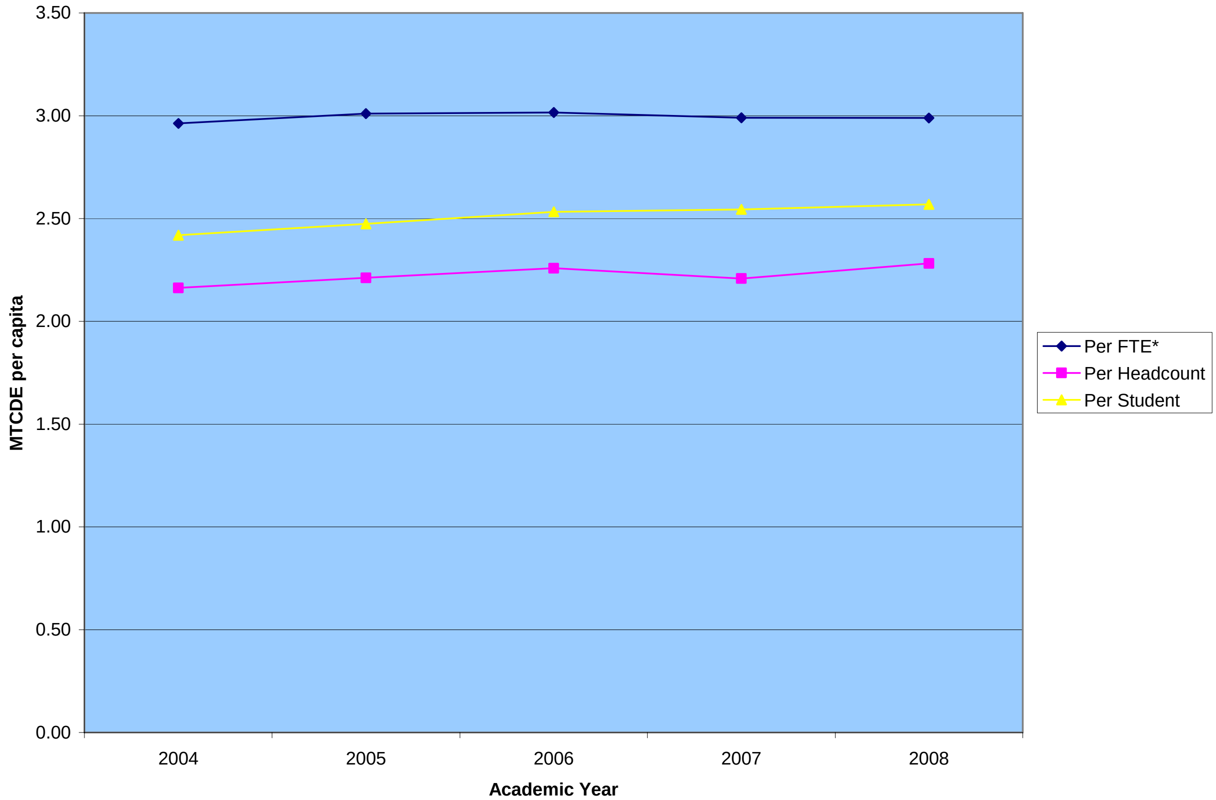


Figure 3: Boise State's carbon footprint on "per capita" basis, 2004-2008

As a point of comparison, Figure 4 shows per capita carbon GHG emissions for a sampling of other universities, most of which are reported for the 2007 or 2006 academic years. These data are reported as a function of student headcount, not including faculty or staff (corresponding to the yellow data points in Figure 3). The sources of the data represented on the graph are described in greater detail in the Appendix of this report. Schools were chosen on the basis of available data (from university web sites or the AASHE web site) and comparable methodologies. Every effort is made to ensure that a fair comparison is being made.

Note that two of the universities with the smallest per capita footprint are Idaho institutions. While the underlying reasons for this are difficult to assess with any certainty, the following circumstances no doubt contribute. Both universities are engaged in an aggressive and long-term campaign to improve the efficiency of campus operations and decrease their footprint. For example, the University of Idaho uses a wood-fired boiler and steam system to heat (and cool!) 63 of the campus buildings. At Boise State, we benefit from an ongoing energy efficiency program that spans over 10 years. The Boise campus benefits from a performance contract with Siemens, Inc. which targeted some of our oldest and most inefficient buildings for significant infrastructure upgrades. Another reason for the low carbon intensity is that all the institutions of higher education in Idaho have learned to be very efficient in their usage of space, as growth over the past decades has, in general, outstripped support required for additional infrastructure. In fact, normalizing carbon footprint data to the size of the university's physical plant is also illustrative.

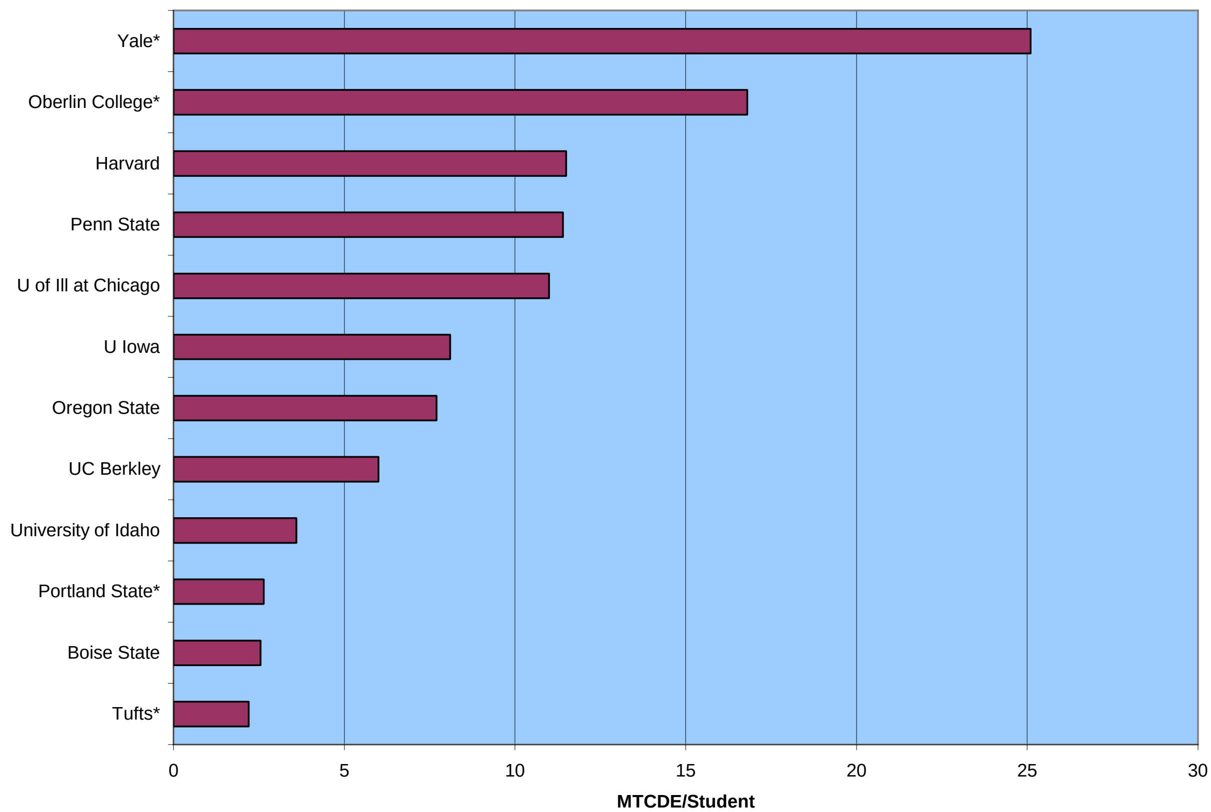


Figure 4: GHG emissions per student for a sampling of other universities. All data for FY06 or FY 07, with the exception of the starred universities, see appendix for details.

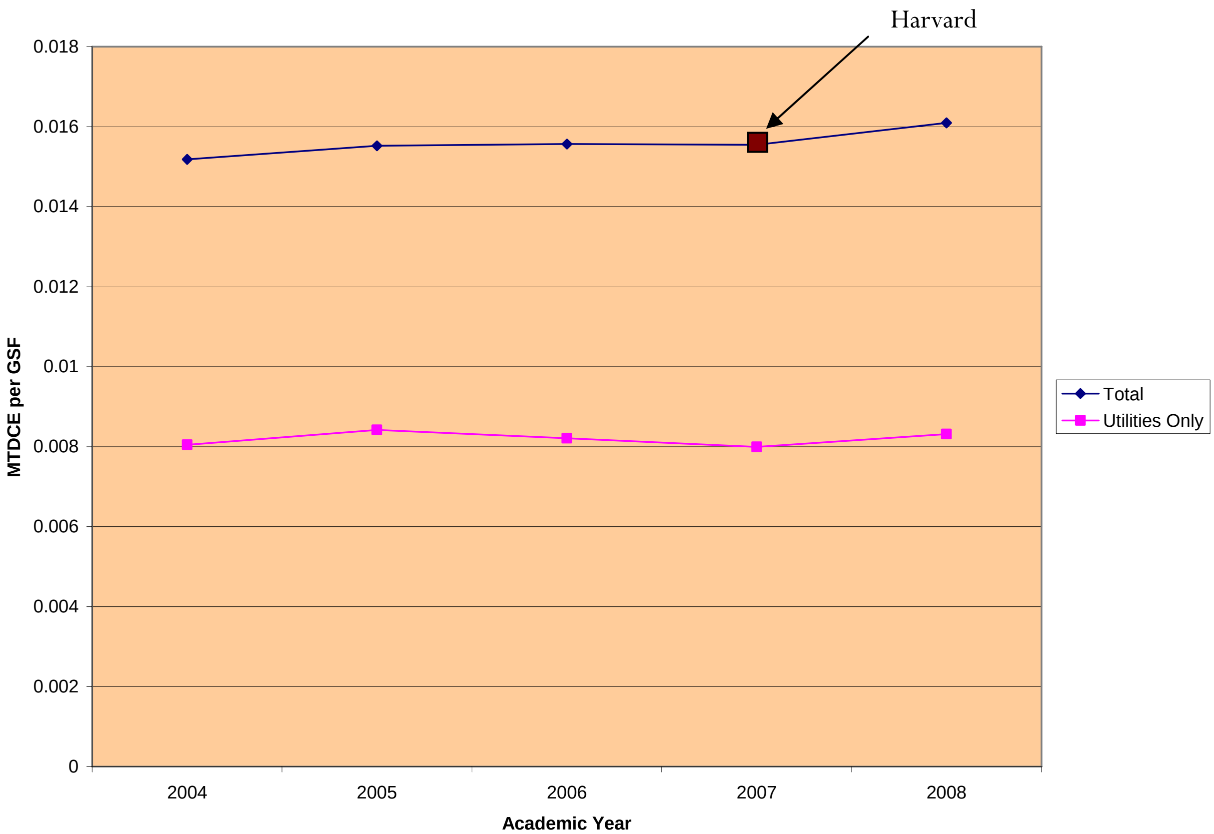


Figure 5: Boise State's GHG emissions per gross square foot of conditioned space, 2004-2008

When one normalizes the data by dividing by Gross Square Feet (GSF) of conditioned space on campus, other trends emerge. Figure 5 shows the results of that analysis. Two sets of data are presented, the higher number divides the entire carbon footprint by the number GSF, the lower set of numbers looks only at the GHG emissions due to natural gas and electricity divided by the GSF. Note that this plot shows no significant trend over this time period as well, with the exception of a slight increase in AY 2008, largely attributable to a relatively colder winter (see Figure 9). As we add more efficient buildings to our physical plant, we could expect the lower data to trend downward because our newer buildings are more efficient and we continue to improve our existing buildings. Taking the winter of 2008 into account, the graph may be consistent with this expectation.

While few other schools report their footprint in this manner, Harvard University recently reported their GHG emission as 0.0156 MTDCE per square foot of conditioned space while their total emissions for 2007 were 230,616 MTDCE. For a student population of about 20,000, their *per student* emissions are 11.5. These facts suggest that while a university's carbon footprint per student may vary widely, when taken on a per GSF basis, there is less variation. More study on this issue is appropriate, but it does suggest that, as the campus grows, we should continue to put a high priority on energy efficient building designs.

What Does it Mean?

Since the overarching goal should be the reduction, indeed the elimination, of our carbon footprint, it's important to look beyond the data and begin to chart a course for the future. While the data indicate that we run a very efficient and effective campus, the overall upward trend is disturbing and clearly, there's more to be done. This report is the starting point for the strategic plan of climate neutrality which will be prepared during the 2009 academic year.

Figure 1 indicates that the vast majority of our carbon footprint is due to utilities (electricity and natural gas) and commuting. Commuting is an issue with which everyone is familiar and the steps required to reduce our footprint are well known. On the other hand, utilities are often taken for granted. Natural Gas (methane) is used extensively on our campus for two purposes: heating the buildings and heating water for the hot water taps throughout campus. As such, one would expect there to be significant monthly variation in natural gas consumption. Figure 6 shows that monthly consumption data (in Million BTU's) over the past 5 years.

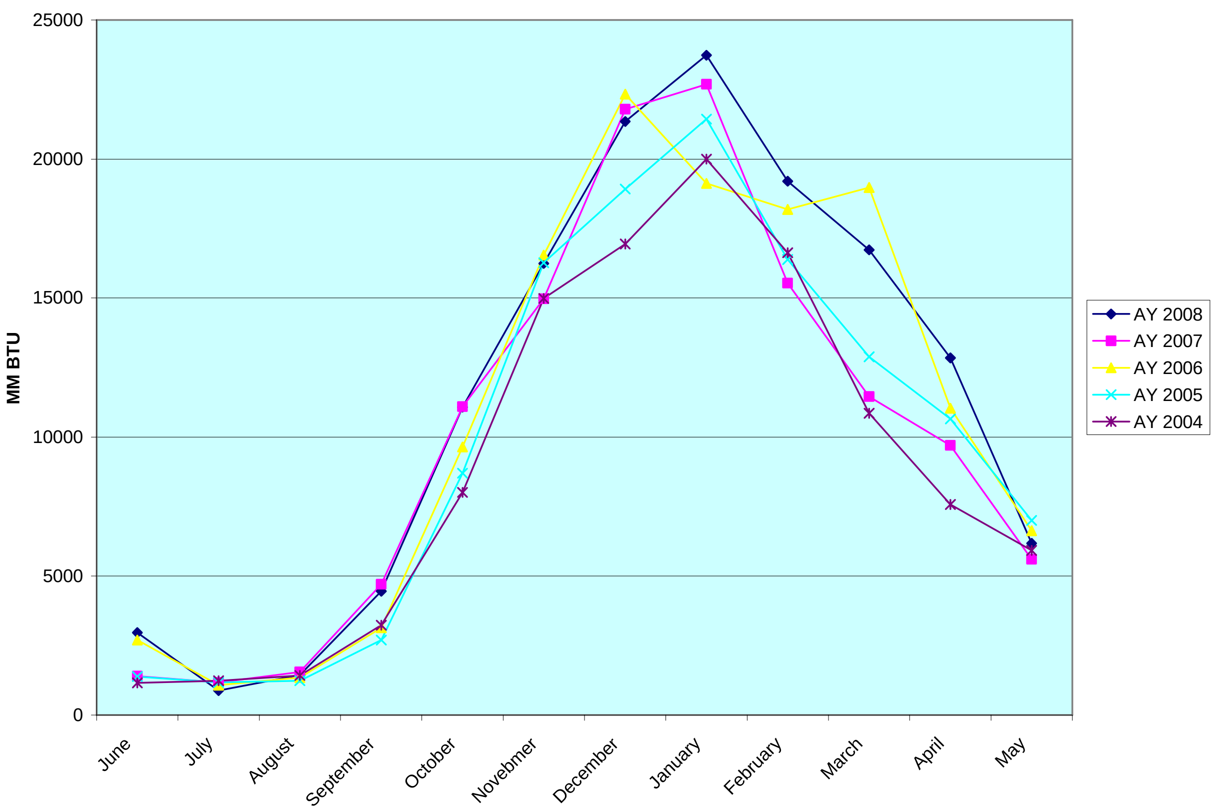


Figure 6: Monthly variation in natural gas consumption

Note first that year-to-year variation is generally quite small, but that the peak value in February is trending upward (commensurate with our increase in conditioned building space) and the overall usage for 2008 being higher in the winter months. More importantly, we can see that we use about 10 times as much natural gas in February as we do in August and September. This variation makes sense as there is no need to heat the buildings in the summer and the on-campus population is lowest in July and therefore hot water use is also at its lowest. The conclusions we can draw from this figure is that we can decrease the carbon footprint of the campus by improving building energy performance which includes such measures as improved insulation, reduce infiltration, upgrade to high performance windows, use of interior window shading devices, and modifying building set points. Another avenue to explore is to seek non-fossil fuels (such as wood chips or geothermal) to heat our buildings.

Electrical use is more complicated. Electricity permeates campus operations. Aside from the obvious uses such as computers, printers and vending machines (so-called "plug loads") it lights our offices and parking lots and is an integral part of our building environmental control. In the summer, we use electric motors to run compressors and pumps required to cool the buildings and year round, electrically-driven fans and air handling units are used to ensure that our classrooms and offices are kept comfortable. Figure 7 shows the monthly variations in our electrical usage on campus, expressed as average Megawatts of load each month.

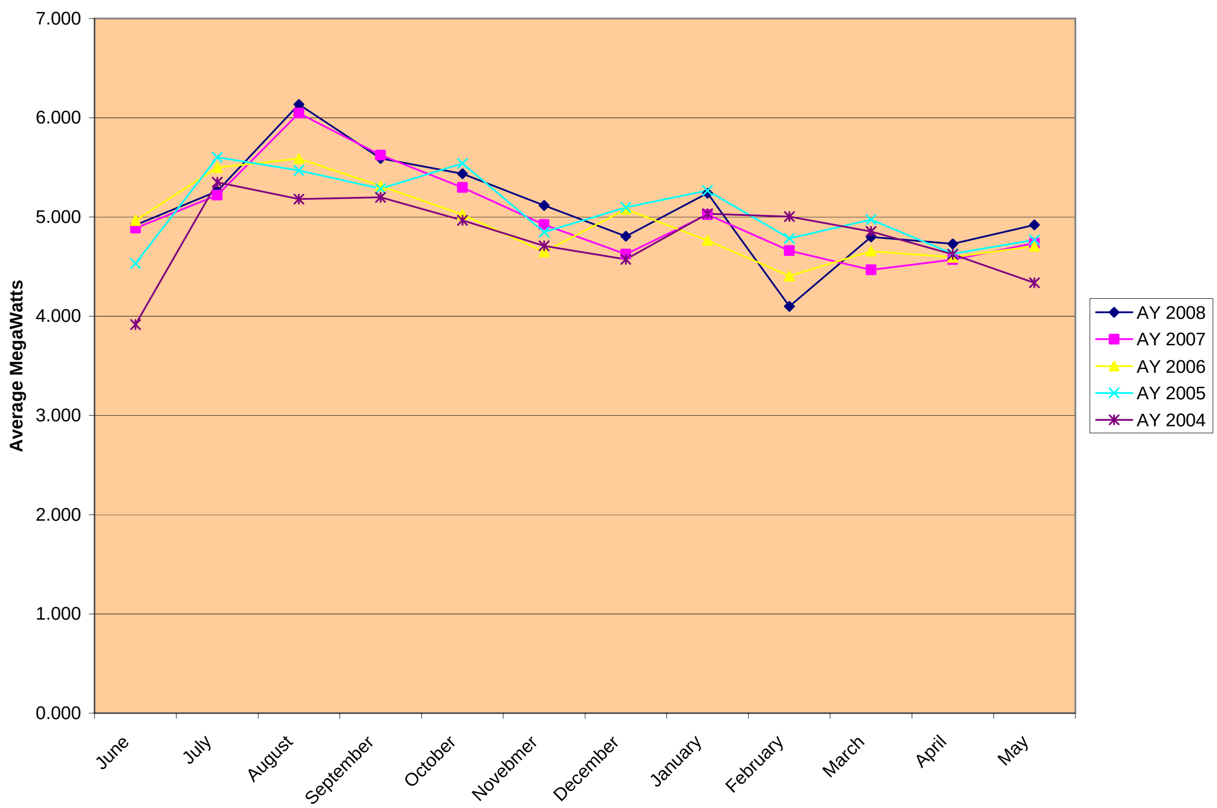


Figure 7: Monthly variation in campus electrical load

Again, there are two important points to derive from this figure. First, there are two variations in the usage over the course of the year; one in August, the other in January/February. This is consistent with the local utility's experience in electrical loads throughout the region. The August peak is due to a combination of air conditioning requirements and the onset of Fall semester classes. The graph seems to indicate that we are very effective in managing our building air conditioning systems during the summer months, when fewer people are on campus. The second variation is in the middle of winter. Even though we don't use electricity to heat our buildings directly (see previous section), increased heating needs correspond to increased requirements on our air handling units (fans and pumps) and hence our electrical usage is high. In addition, this peak corresponds to a month of very short days, thus placing higher demands on both our internal and external lighting systems.

But even more striking is the fact that the variations are quite small compared to the base-line usage. In other words, the average campus load never gets much below 4 MW regardless of the time of year. To put that in perspective, 4 MW is approximately the load we could expect of about 3,100 average homes in Idaho[8]. The Boise State campus consumes approximately the same amount of electricity as Boise's North End.

The take-home message here is that to decrease our carbon footprint due to electricity usage, we must take a broad-based approach. There's no one area of operations to target. The campus Facilities, Operation & Maintenance group has been very pro-active in identifying energy savings in air handling and lighting systems, and more work is to be done. But beyond this, the entire campus community must be engaged in aggressively handling lighting and plug loads. Computers and computer peripherals are a significant part of this load and fairly simple steps can be implemented to greatly reduce this part of our footprint.

Other Factors: Weather Trends

The previous section gave context to our GHG inventory by describing what has been happening on campus during the reporting period. While enrollment growth and new buildings affect the carbon footprint of our operation, it's also important to note that what happens to the campus also has an impact. A particularly cold winter or warm summer will increase the GHG emissions by demanding more of our building heating and cooling systems. These effects are estimated by tracing "Cooling Degree Days" and "Heating Degree Days" for Boise over the past 5 years. Degree days are measured taking the difference between the average temperature on a given day from 65° F and adding that up for every day. If the average daily temperature is above 65°F, then the number goes into the CDD column since it represents an increase in air conditioning load. If the temperature is less, then it adds to the HDD total, representing additional heating needs.

The plots below show the HDD and CDD for Boise as reported by the National Oceanic and Atmospheric Administration. From these plots we can see that the 2005 academic year required somewhat less air conditioning of our buildings since the summer was not as hot as the others in this time frame. Similarly, the winter in AY08 was cooler than the previous ones requiring more of our building heating systems, as noted previously. Finally, it's interesting to note that, in all five of the report years, we far exceeded the 30 year average of CDD's and fell far short of the 30 year average of HDD's, indicating that the overall climate of the past five years was significantly warmer than that of the 30-year average.

[8] While estimates vary, Idaho Power reports that an average household in their service area consumes electricity and an average rate of 1.3 kW.

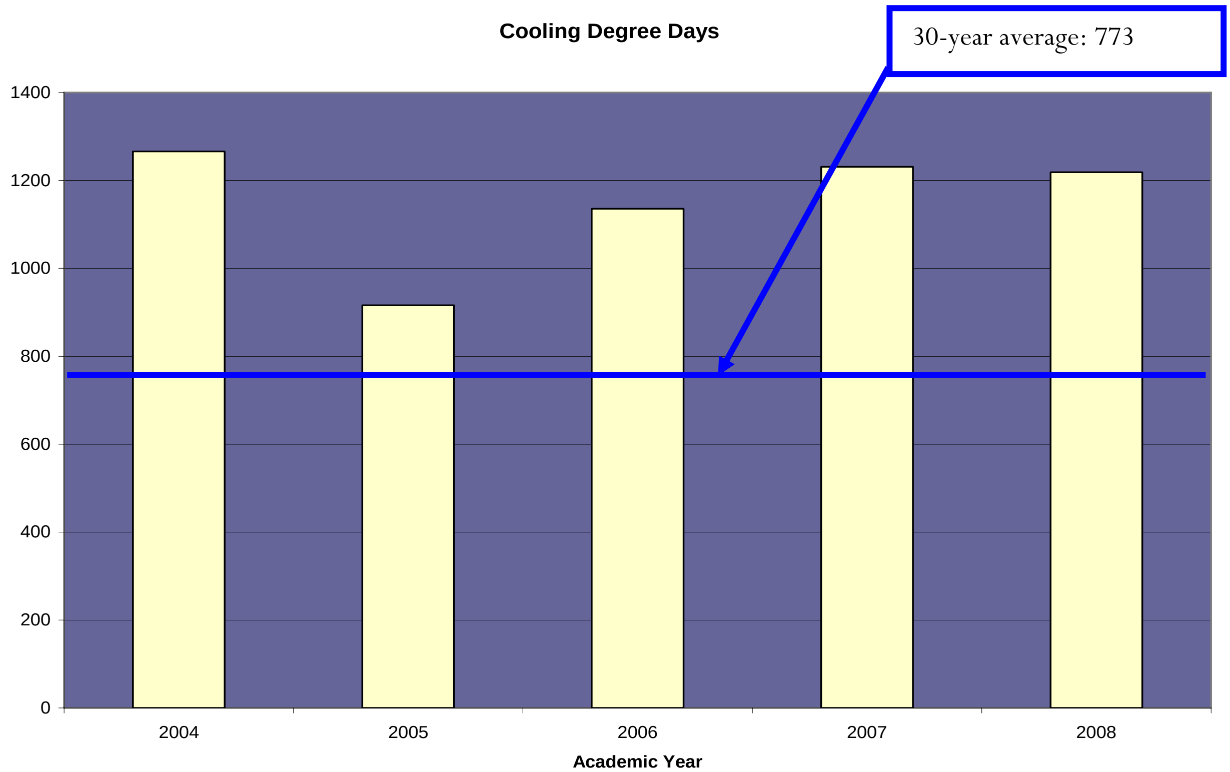


Figure 8: Boise Cooling Degree Days for the past 5 years

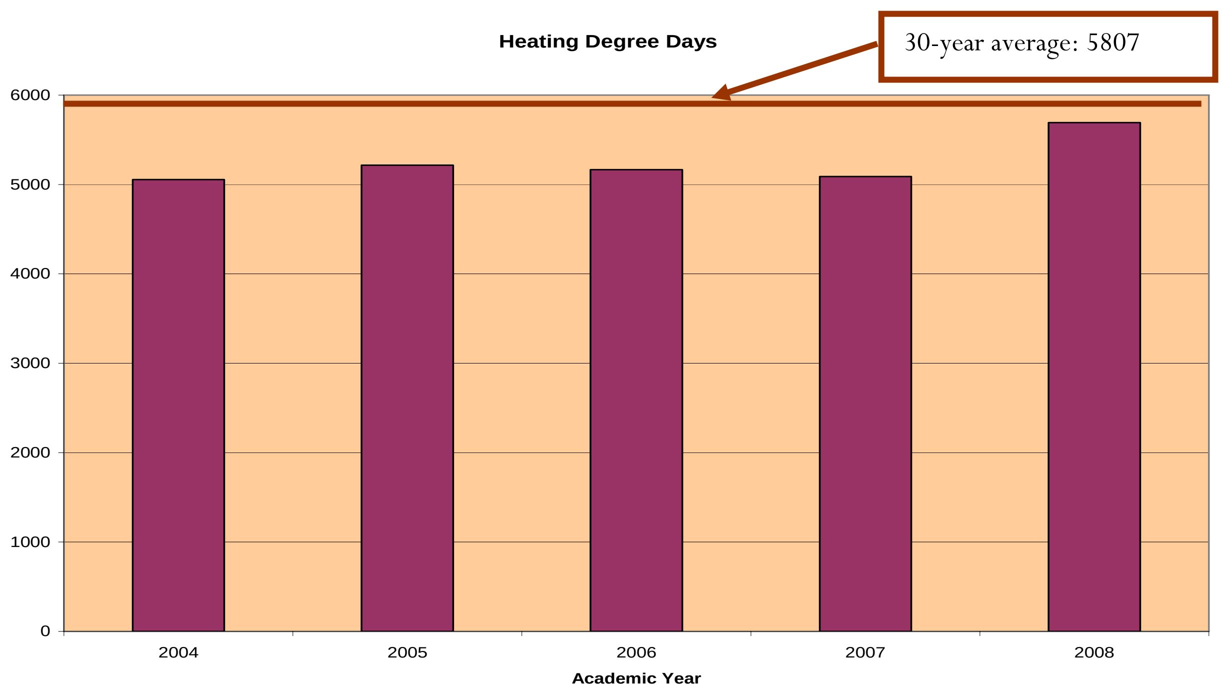


Figure 9: Boise Heating Degree Days for the past 5 years

What's Next?

This report, and the underlying analysis, is only the first step of a long-term commitment to make Boise State a national leader in sustainability. This study indicates that we are very effective in using our resources. We provide essential educational access to far more students per unit of energy than most institutions of higher learning. We are poised to show the way in achieving climate neutrality and do so in a manner that does not compromise our core mission or values.

As we pointed out in the acknowledgements, this greenhouse gas inventory began in the classroom. Our academic programs continue to be intricately tied to the overarching notion of sustainability. From engineering to business and many places in between, our faculty incorporate the lessons of sustainability, conservation and stewardship in all of our academic programs. In the appendix, we have included a list of courses in which the faculty who teach them indicated a substantial component dealing with sustainability. We plan on sharpening that focus to allow interested students to engage this issue in great depth, regardless of their chosen academic plan.

From an operational standpoint, we will soon begin a process that will result in a comprehensive, long term plan that charts the course toward climate neutrality. We will do so with broad participation from experts and volunteers from within the campus community and beyond. This plan will contain milestones along the way to ensure that we don't stray off the path. A key part of the process is an annual update of this report that will be released at the same time we release or sustainability master plan.

Clearly, a multifaceted problem like this will require an equally multifaceted solution. The process of developing the plan will consider best practices across the country and beyond to find the solutions that fit our region, our mission and our expected growth. While the exact details will be decided in the months to come, it appears clear that some of all of the following elements will be involved:

- A focused effort to conserve electricity throughout the campus. Computers, lighting and other loads governed by individual behavior make up the bulk of our electrical usage. Campus-wide participation in energy conservation will be key.
- A university-lead partnership to develop renewable energy resources like a wind farm to offset our electricity consumption with an equivalent (or larger) amount of renewable energy will be considered.
- We could consider improvements to the central heat plant. Some schools have replaced their plant with a "cogeneration" facility which generates electricity as well as heating the campus. At University of Idaho, they use wood chips instead of natural gas for most of their heating.
- Partnering with ValleyRide to improve bus service for those coming to campus.

As always, our office welcomes suggestions, complements and complaints.

Appendices

Detailed Data

The following tables show the details of the emissions numbers over the 5 year tracking period.

Scope 1: Direct Emissions

AY	*2004*	*2005*	*2006*	*2007*	*2008*
Natural Gas	5,722	6,293	6,929	6,447	7,266
University Fleet*	540	540	540	540	540
Total	6,262	6,833	7,469	6,988	7,807

* Fleet data was not available for previous years. The data in this table reflects our best estimate for the 2008 academic year. It was then assumed that the same value would represent an adequate upper bound estimate for the previous 4 years.

Scope 2: Indirect, Electric Utilities

AY	*2004*	*2005*	*2006*	*2007*	*2008*
Emissions	17,916	18,439	17,983	18,232	18,518

Scope 3: Indirect, Travel

AY	*2004*	*2005*	*2006*	*2007*	*2008*
Daily Commute	14,899	14,989	15,505	15900	16,521
University sponsored travel	3,159	2,968	3,926	4,553	4,686
Athletic Team Travel	2,352	2,352	2,352	2,352	2,352
Total	20,410	20,309	21,783	22,805	23,560

Total Tracked Emissions:

AY	*2004*	*2005*	*2006*	*2007*	*2008*
Total	44,589	45,582	47235	48,024	49,884

Background Data

Scope 1 Emissions:

Natural Gas: While possible to trace the amount of CO2 that results from every BTU of heat generated by burning natural gas, there is surprising little variation in this process. The coefficient used in this report, 0.053 MTCDE per million BTU, can be found in the publication generated by the Chicago Climate Exchange (CCX)[3], which, in turn followed the procedures set out by the Greenhouse Gas Protocol Initiative[2].

Fleet: Emissions from mobile combustion sources (the university fleet of vehicles and other mobile gasoline engines) are quite small relative to the other sources. That said, these sources contribute disproportionately to local air quality problems in the region and we should be tracking them carefully. The methodology used here was based on our financial record system. All gasoline purchases made by the university are coded and can be tracked that way. For example, in AY 2008, the university spent $190,886 on gasoline purchases. The average price of gasoline in the Boise region for this time frame was $3.25 (from boisegasprices.com) so we can estimate that 58,734 gallons of gasoline were purchased (and subsequently used in some kind of combustion process). Like natural gas, we chose to use a standard conversion coefficient as defined by the Chicago Climate Exchange, 0.0092 MTDCE per gallon of gasoline[3]. At the time of this report, we did not yet have historic data for gasoline purchases so we assumed it was constant over the 5 year period.

Scope 2 Emissions:

The Environmental Protection Agency has developed a process by which the environmental impacts of electrical consumption have been analyzed and reported for each region of the country. The Greenhouse Gas Protocol Initiative references this process as the appropriate way of finding the coefficient to convert total electrical consumption to MTCDE. According to the EPA EGRID[9] report, last updated in 2004, the coefficient that is appropriate for Idaho (in the Northwest Power Pool) is 0.417 MTDCE per MWhr of electricity consumed. According to the same report, the aggregate fuel mix for the NWPP was 49% hydroelectric, 34.4% coal, 10.6% natural gas. The balance is made up of nuclear (3.6%), biomass (1.2%), wind (0.5%) and other (0.7%). Note that this does not necessarily reflect the actual average fuel mix for Idaho Power, which is not regularly reported.

[9] http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

Data from Other Schools

A good faith effort was made to find a cross section of universities and represent their data in a manner which invites a fair and equivalent comparison. In most cases, data were taken from greenhouse gas inventories submitted by institutions to the Associate for the Advancement of Sustainability in Higher Education (AASHE). Enrollment numbers we found on the institution's web site. Most of the data refers to the 2006 or 2007 academic year but exceptions are noted.

Yale University:

Yale was has conducted a very comprehensive GHG inventory and their 2005 report is available on their web site[10]. Table 1.1 in this report lists their total emissions and emissions listed on a per capita basis for the calendar year of 2002.

Total Emissions: 284,663 MTCDE
Per capita (students): 25.1 MTCDE/Student

In addition, the table includes number from other schools. While not taken from primary sources, these have been quoted widely in other reports and include the only data point we found that indicates a smaller footprint than Boise State

School	Year	Emissions per capita (MTCDE/Student)
Oberlin College	2000	16.8
Tufts	1998	2.2

Penn State:

Penn State's greenhouse gas inventory report can be found on their site[11]. For AY 2006, they report:
Total Emissions: 479,881 MTCDE
Also, they total enrollment on the University Park campus for AY 06 is reported as 42,039, yielding a per capita number of 11.4 MTCDE/Student.

Oregon State University

OSU's 2007 GHG inventory report is available from the AASHE web site.
Total Emissions: 151,287 MTCDE
Enrollment: 19,753
7.7 MTCDE/Student

University of Illinois at Chicago:

This report is also available on the AASHE web site.
Total Emissions: 240,416 MTCDE
11.0 MTCDE/Student

---

[10] http://environment.yale.edu/documents/downloads/v-z/wp_7_yale_ghg.pdf

[11] http://www.ghg.psu.edu/campus_inv/UP.asp

University of Iowa

According to the 2006 report of the Chicago Climate Exchange (of which Iowa is a member), their total emission in 2006 were: 234,300 MTCDE. The university web site indicates that "some 29,000" student enroll.
8.1 MTCDE/Student

University of California, Berkeley

According to the report available on the UCB web site[12],
Total Emissions: 209,000 MTCDE
The web site also shows enrollment in Fall of 2007 as 34,953.
6.0 MTCDE/Student

Harvard University

Harvard's FY 2007 report is available on their web site[13]:
Total Emissions: 230,598 MTCDE
Total students: about 20,000 from web site
11.5 MTCDE/Student

University of Idaho

Personal correspondence with the coordinator of sustainability at University of Idaho indicates that in 2006, their emissions were 3.6 MTCDE/Student

Portland State University

Portland State's AY 2001 inventory is available on their web site[14].
Total Emissions: 45,500 MTCDE
2001 enrollment: 17,230
2.64 MTCDE/Student

---

12 http://sustainability.berkeley.edu/calcap/inventory-2006data.html

13 http://www.greencampus.harvard.edu/ggi/cambridge_emissions.php

14 http://web.pdx.edu/~arice/carboncapstone/PSU%202003%20Inventory.pdf

Sustainability-Related Courses at Boise State University

ANTH 103 Introduction to Archaeology

ANTH 203 Old World prehistory

ANTH 294 Cultures & Sustainable Futures Workshop

ANTH 303 Human Paleoecology

ANTH 314: Environmental Anthropology

ANTH 402 Geoarchaeology

ANTH 414 Quaternary vertebrate Paleontology

ANTH 494 Cultures & Sustainable Futures Workshop

ANTH 520 Quaternary Stratigraphy and Paleoenvironments

ANTH 521 North American Paleoenvironmets

Biol 422 Conservation Biology

Econ 333: Natural Resource Economics

Econ 498: The Economics of Global Climate Change

ECON435: Environmental Markets

English 397 Special Topics: Green Writing

English 516 Topics in Print Doc Production: Eco-Friendly Printing Processes

ENGR 100: Energy for society

ENVHLTH 100: Introduction to Environmental Health

ENVHLTH 480: Air Quality Management

GEOG 213: Introduction to Meteorology

GEOG 321: Conservation of Natural Resources

GEOG 331: Climatology

GEOG/GEOS 212: Water in the west

HIST 376: Global Environmental History

IPT 597 Special Topics: Redesigning Organizations for Sustainability

ME 433 Dynamic Meteorology

ME 497 Renewable Energy Systems

MGMT-HR 305 Human Resource Management

MGMT-HR 340 Employee and Labor Relations

MGMT-HR 406 Compensation and Benefits

POLS 321: Introduction to Comparative Politics

POLS 325 Introduction to Latin American Politics

POLS 333 Introduction to the Politics of Developing Nations

POLS 335 United States Foreign Policy

POLS340 -- Environmental Politics

SCM345:Principles of operations management

SCM416: Procurement, logistics, and supply chain integration

SOC 102 Social Problems

SOC497: Sociology of Science, Technology & Engineering

Spanish 303 Advanced Conversation & Composition

Glossary

CDD: Cooling Degree Day; A measure of the cooling requirement for conditioned buildings. One CDD is measured for each day during which the average temperature is one degree above 65° F.

CO_2(e): Carbon Dioxide Equivalent. Some greenhouse gases are potentially more damaging than others. While carbon dioxide is by far the most common, others, such as methane are significant, in part because their potential to disrupt heat transfer from the earth is many times great. To simplify measures of carbon footprint, greenhouse gas emissions are reported in terms of the equivalent amount of carbon dioxide that would result in the same effect on the atmosphere.

GHG: Greenhouse Gas; refers to the group of gases implicated in global climate change through absorption of thermal energy in the atmosphere

GSF: Gross Square Feet; measure of floor space in a building (includes hallways, closets and restrooms).

HDD: Heating Degree Day; A measure of the heating requirements for conditioned buildings. One HDD is measured for each day during which the average temperature was one degree under 65° F.

MT: Metric ton, tonne or metric tonne; A unit of mass equal to 1000 kg (1 MT is 10% larger than a common ton)

MTCDE: Metric Ton CarbonDioxide Equivalent; MT CO_2(e)

Per capita: per person

References

1. Dautremont-Smith, J., *Implementation Guide*. 2007, American Colleges & Universities Presidents Climate Commitment.
2. Ranganathan, J., *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised Edition*, World Resources Institute.
3. CCX, *Greenhouse Gas Emission Factors for Direct Emission Sources*. 2007, Chicago Climate Exchange.