

Greenhouse Gas Emissions Inventory Update (1990-2008)

Ally Robertson, May 2009

Introduction

This report serves as an update of Bucknell's original Greenhouse Gas Emissions Inventory, compiled in 2006 by Environmental Geology student Christine Kassab '08, covering fiscal years 1990 through 2004. Christine used version 5.0 of the greenhouse gas inventory model developed by Clean Air Cool Planet (CACP), which allowed her to input raw data and calculate the University's emissions of greenhouse gasses during the 15 year period. Kassab's report also provided extensive background on the phenomenon of anthropogenic global climate change and the University's energy use practices. The full report may be accessed online at:

<http://www.bucknell.edu/Documents/EnvironmentalCenter/Christine%20Kassab%20GHG%20final%20report.pdf>.

This update uses a more recent version of the CACP model, version 6.0. Some of the information in this new version is processed differently than in the previous version used by Kassab, so the updating process began with a transfer of data from the version 5.0 spreadsheet to the new version 6.0 spreadsheet. In most cases Christine's raw input data remained intact unless an error in that data was discovered. Any changes to data values or spreadsheet formulae were recorded in the CACP spreadsheet as comments attached to the relevant data cells, as indicated by small red triangles in the corner of each cell.

This update covers only data calculation methods and results, but does not cover the energy use history and other relevant practices of the University. A full accounting of those practices is provided in A Comprehensive Environmental Assessment of Bucknell University, released in May 2009 and available online at:

<http://www.bucknell.edu/Documents/EnvironmentalCenter/Assessment%20Report%20final.pdf>.

Methods

The data in the Clean Air Cool Planet spreadsheet used for this Greenhouse Gas Emissions Inventory has been compiled through a variety of sources. The majority of the data was provided by Jim Knight, Associate Director of Facilities and Cogeneration, and others in the Facilities Department, with a few exceptions. Patty Johnston, Institutional Research Assistant, was able to provide the population data, and Bill George, Associate Controller in the Finance Office, provided the operating budget, research budget, and energy budget.

The information used to calculate the air miles and the commuting data was much more complicated and is explained in detail below. The air travel and commuting data had not been collected for the years prior to this update.

Air Travel:

Air travel data, covering FY 2006-2008, was calculated for the first time in this update by Ally Robertson and was added to the Clean Air Cool Planet Spreadsheet. To calculate the Greenhouse Gas emissions from air travel, it was necessary to first find the total number of air miles traveled. The air miles that we included in this inventory are flights sponsored by Bucknell University, such as flights for students who studied abroad, flights for athletic teams and coaches, and university sponsored faculty and staff travel.

To obtain the total number of air miles traveled by students studying abroad, the Office of International Education was contacted. Ben Morris, the Assistant Director of the Office of International Education, provided a list of every location to which students traveled abroad during the spring and fall semesters of each year. Because the exact points of departure and return were not identifiable, JFK Airport in New York was chosen as the starting and ending location for estimating the flight distances since this airport is frequently used for study abroad flights. A mileage calculator was used to calculate the distance in miles between JFK and each of the locations on the list (<http://www.usatoday.com/travel/flights/miles/calculator.htm>).

The total number of miles traveled abroad for 2005-2006 was 1,613,250. This number only accounts for travel to the location, so this number was doubled to include the flight back, which is 3,226,500 miles. The total number of miles traveled to the study abroad locations for the spring and fall semesters of the year 2006-2007 was 1,955,512 miles, doubled for a total of 3,911,024 miles. The number of air miles traveled in the 2007-2008 fiscal year was 1,508,385 miles, which was doubled to become 3,016,770 miles.

The Athletic Department was contacted in order to estimate the total miles traveled by Bucknell students. It was assumed that athletics constituted the largest source of university-sponsored student air travel outside of study abroad. Athletic department data included air travel for the sports teams, department travel, on campus recruiting (student athlete recruits to campus) and off campus recruiting (coaches flying to recruit). Thus the athletic air travel data included some faculty and staff miles as well as student miles, and these were unable to be separated out. Furthermore, the number of air miles traveled was not available for this department, so the number of dollars spent by each team was provided instead. The total dollars spent on air travel by the Athletics Department in the year 2005-2006 was \$178,953.77, in the year 2006-2007 was \$244,855.75, and in the year 2007-2008 was \$220,867.25. This information was provided by Mike McFarland, the Assistant Athletic Director of Facilities and Event Operations.

To convert these dollar figures to a rough estimate of the number of miles traveled, a conversion factor of \$0.25 per air mile traveled was used as recommended in the ACUPCC Implementation guide, p. 15 (see http://www.presidentsclimatecommitment.org/pdf/ACUPCC_IG_Final.pdf). Using this conversion factor, the approximate number of miles traveled was estimated. For the year 2005-2006, this number was found to be 715,815.08 miles, for 2006-2007, it was 899,423 miles, and for 2007-2008 it was found to be 883,469 miles.

The number of air miles traveled by faculty and staff was obtained through the Procurement Office. Don Krech, Director of Procurement Services, provided air miles on record from Expedia Corporate, the preferred travel provider for the University. Based on data for individual travel bookings through this provider, the air miles traveled by faculty and staff were estimated. (Since individual bookings were almost entirely faculty and staff, while group bookings were almost entirely students, the individually booked flight data was assumed to be a good estimate of faculty and staff air miles.) The total for 2006 was 959,237 miles, 2007 was 1,238,347 miles, and 2008 was 1,207,550. The data was available for calendar years only, so these were used as a substitute for fiscal year data. These values are a low estimate because they do not include reimbursed faculty and staff travel, which is tracked by the Finance Office. Several people from the Finance Office were contacted in order to acquire this information; however no one from this office was able to provide that data, due to the extremely decentralized nature of the records.

Commuting:

Commuting data, covering FY 2005-2008 was calculated by Civil and Environmental Engineering student Winnie Okello '09, who worked as an intern in Bucknell Facilities in the summer of 2008. Winnie reported using the methods outlined below:

INPUT spreadsheet

- The full time and part time students were from info received from Dennis Hopple
 - o Fulltime/ part time students - average of enrollments for fall and spring semesters
 - o Summer students = sum of fulltime and part time enrollment
 - Actual summer enrollment
- Faculty and staff data was from Human Resources: Marcia Hoffman
 - o Faculty = people count not FTE (full time equivalent)
 - o Staff = all others under categories not faculty
 - Thus staff values = total people count – faculty count
 - 2008 values for this variable are guesses estimated from previous trends.
- 2008 values for fall and summer values are approximated values for possible enrollment numbers following past trends.
- Sq. Feet = value from facilities ; Dennis Hawley, Associate Vice President for Facilities

- 07-08 year; 2104 student vehicles registered, 4834 faculty/staff registered vehicles

INPUT COMMUTER SPREADSHEET

- Student, faculty, and staff are values inputted using preprogrammed equation

Students

- Percent commuting by personal vehicle
- Assuming 50% of student registered vehicles are used daily
- - o Has been on a steady increase (even national studies have concluded that vehicle usage has been steadily increasing over the past 2 decades, however, over the past 2 years or so, this trend has been on a decline due to sky-rocketing fuel prices.
 - o Also students are bringing more items to school, thus making it necessary to bring personal vehicles (and keeping the vehicles on campus to use as necessary)
 - o Also keeping in mind that this is a matter of necessity as much a convenience. It is necessary to be mobile, and the convenience of a personal vehicle is greatly preferred in today's fast paced society
 - o Consider the fact that there is a significant population that is comprised of international student who stay from the previous semester through the summer.
- % TOT students driving alone;
 - o At least 90% of all upperclassmen (.9*75); assuming each class makes up 25% of total student body
- % TOT student carpooling
 - o Approximately 10-15% of campus (this does include freshmen and those who do have personal vehicles on campus)
- # Trips / day
 - o To Wal-Mart/ from-to the mods/ Weis.
 - o The values increases then decreases because, when gas wasn't so expensive people weren't too concerned w/ the amount of trips they made, however today, students think twice before making unnecessary trips to walk-mart or even driving to class.
- Days per year
 - o This accounts for the months that students are in school (weekdays)
 - o However since last year, due to significant increase in gas prices vehicle usage has been declining
- Miles per trip
 - o Most student trips are to/from campus to Wal-Mart, and local destinations
- Total distance – preprogrammed equation computes this value
- Fuel consumption - preprogrammed equation computes this value
- Total miles commuted - preprogrammed equation computes this value
- Gasoline consumption - preprogrammed equation computes this value

Faculty

- Total faculty – preprogrammed equation computes this value

- Percent commuting by personal vehicle
 - o This value has been increasing due to the convenience of this mode of transportation, especially for those who live farther away.
 - o Even those who live nearby prefer driving to campus because currently there aren't proper paths/ facilities for non-motorized vehicles.
- Percent driving alone;
 - o this value should be close to that of percent commuting by personal vehicle since those who commute by personal vehicle tend to drive alone
 - o % carpooling - 0%. Even if there are, it is a significantly small percentage such that one can assume 0% carpooling.
- Trips per day – 2; to and from campus
- Days/year – assuming they work 9 months, 5 days a week
- Miles/ trip - assuming that every faculty member driving to school at most commutes 10 miles.
- Total distance – preprogrammed equation computes this value
- Fuel consumption - preprogrammed equation computes this value
- Total miles commuted - preprogrammed equation computes this value
- Gasoline consumption - preprogrammed equation computes this value

Staff

- Total staff – preprogrammed equation computes this value
- % commuting by personal vehicle – all of them, since many of them live quite far from the campus
- % driving alone – this value should be close to that of % commuting by personal vehicle since the majority of those who commute by personal vehicle do drive alone.
- % carpooling – this percentage should be slightly higher than that of % carpooling done by faculty. Also, % carpooling has been steadily increasing with the incessant rise of gas prices
- Trips / day – 2; commuting to and from work.
- Days/yr – 10 months, 5 days a week.
- Miles/trip – assuming that staff has to travel farther distances coming to work, and that the average distance traveled is 15 miles
- Total distance – preprogrammed equation computes this value
- Fuel consumption - preprogrammed equation computes this value
- Total miles commuted - preprogrammed equation computes this value
- Gasoline consumption - preprogrammed equation computes this value

With the recent trends in fuel prices, it is reasonable to assume that even though persons driving alone have increased, similarly the percentage of carpooling has also increased; especially among students

Transportation modes that were not applicable to Bucknell University:

- Bus
- Commuter Rail
- Light rail

Results

This section of report summarizes the results of the greenhouse gas inventory based upon graphs provided in the CACP version 6.0 spreadsheet. A more extensive breakdown and analysis of this data will be provided in the University's Climate Action Plan, which is currently under development and expected to be submitted by May of 2010.

The total emissions of CO₂ equivalents decreased dramatically with the addition of the cogeneration plant in 1997, and have remained about constant since then (Figure 1). The apparent slight increase in the total emissions since 2005 is due to the addition of the air travel data and commuting data that had not been included previously. The slight decline in emissions 2008 is the result of a reduction in the emissions from purchased electricity due to an 4-fold increase in purchased wind power in January 2008.

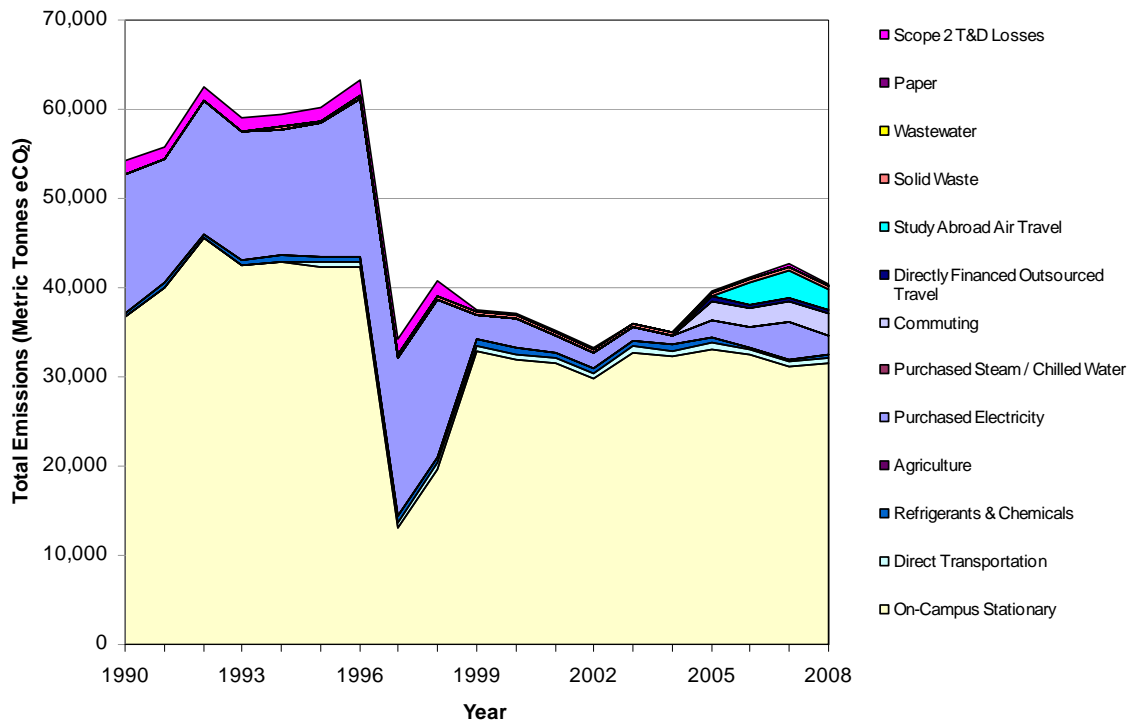


Figure 1. Graph of total emissions produced from on-campus stationary sources, direct transportation, refrigerants and chemicals, purchased electricity, commuting, directly financed outsourced travel, study abroad air travel, and solid waste. Although they appear in the legend, wastewater, and paper were not calculated for this inventory, and agriculture and purchased steam/chilled water were not relevant to the University's operations.

The total emissions of carbon dioxide equivalents per student dropped significantly in 1997 due to the installation of the cogeneration plant, and has remained about constant since then (Figure 2). Because of the addition of air travel data since 2006 and

commuting data since 2005, the total emissions per student to appears increase in recent years.

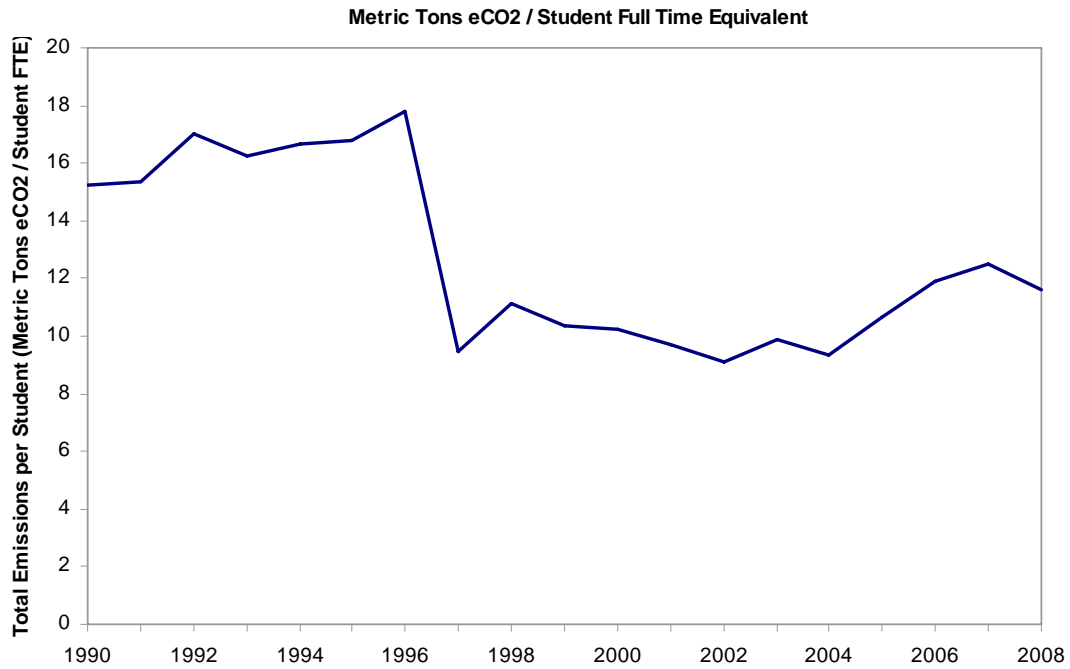


Figure 2. Total emissions of CO2 equivalents per student.

The total emissions of carbon dioxide equivalents per square foot of building space decreased by in 1997 and, similar to the total emissions of the campus, has remained about constant since then, despite the inclusion of the commuting and air travel data beginning in 2005 and 2006 respectively (Figure 3). This is likely due to improvements in energy efficiency in new buildings and building renovations during recent years.

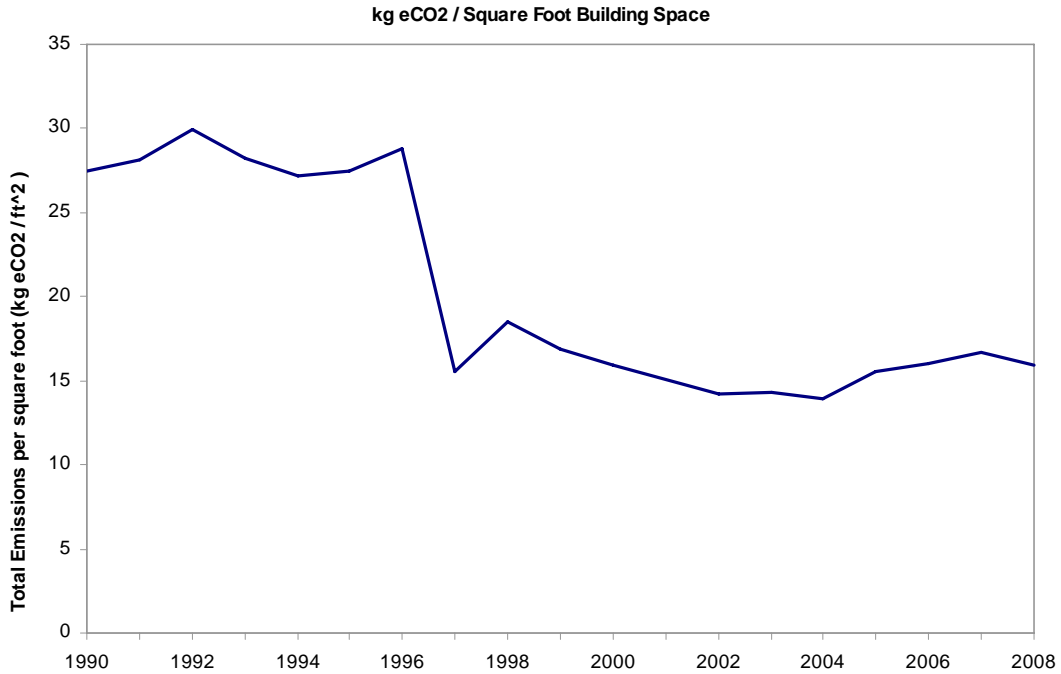


Figure 3. Total emissions of CO2 equivalents per square foot of building space.

The total energy use per student dropped in 1997 and has remained about constant since then, with the slight increase in recent years because of the addition of the commuting data since 2005 and air travel data since 2006 (Figure 4).

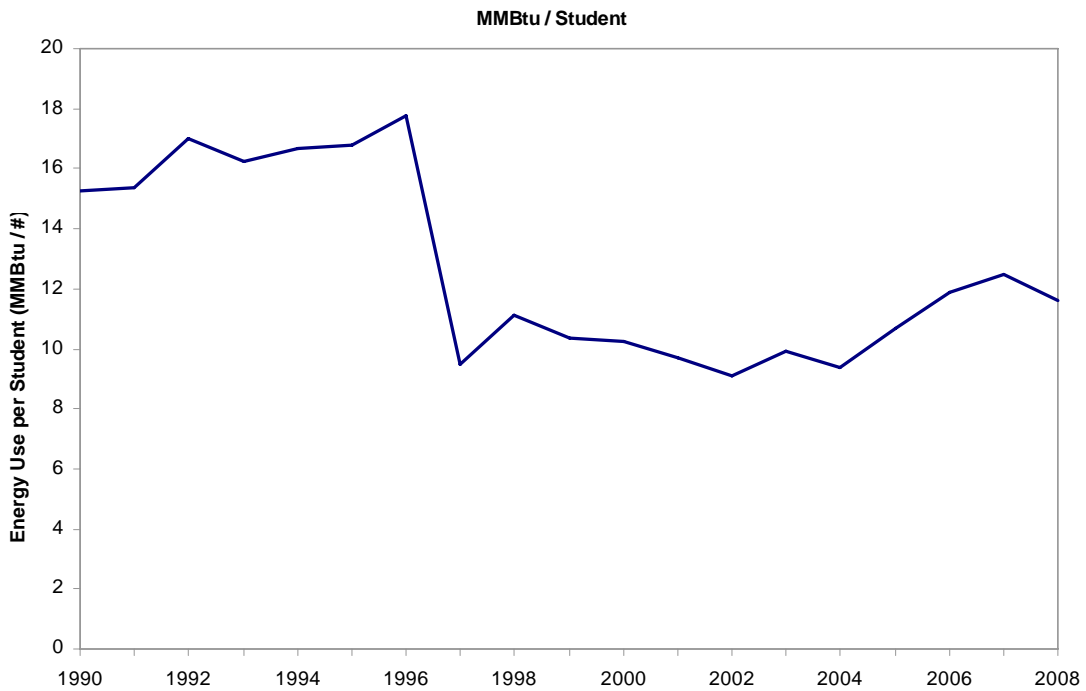


Figure 4. Total energy use per student.

The total energy use per square foot of building space follows a similar pattern as the total emissions per building space, with a significant decrease in 1997 due to the cogeneration plant, and has remained constant since then despite the addition of commuter data since 2005 and air travel data since 2006 (Figure 5). As mentioned previously, this is likely due to improved energy efficiency in new buildings and building renovations in recent years.

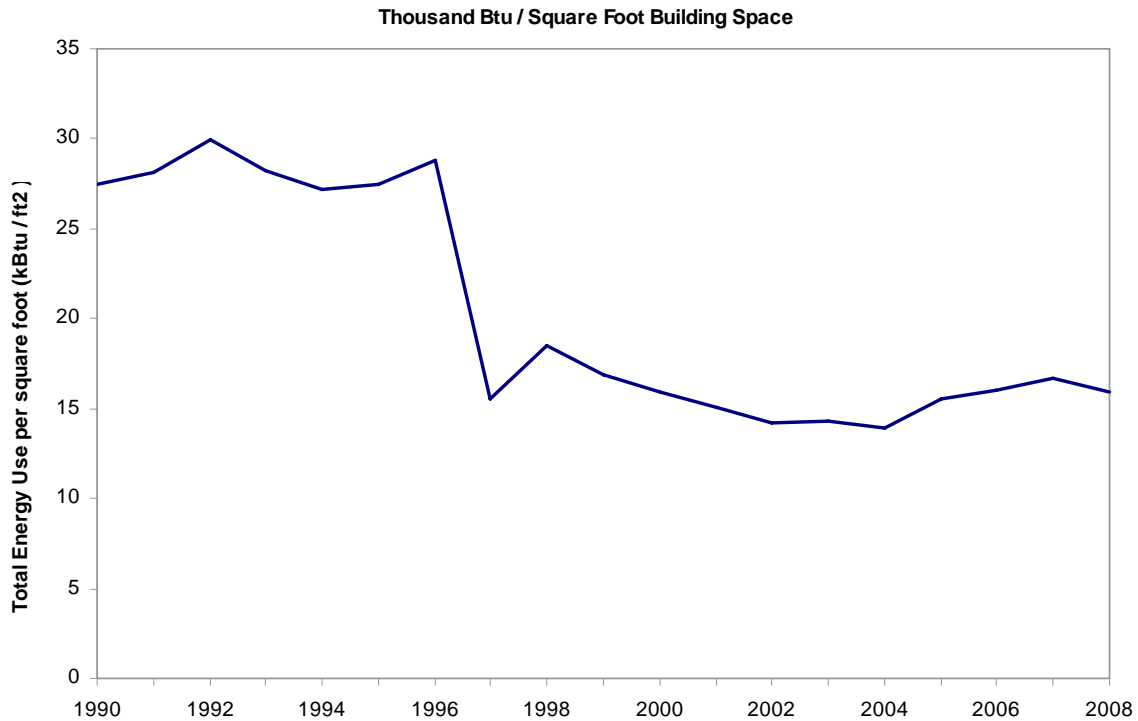


Figure 5. Total energy use per square foot of building space.

Conclusions

The total greenhouse gas emissions at Bucknell University have seemed to remain fairly constant since the last report done by Christine Kassab. The reason that there appears to be an increase in emissions since 2005 fiscal year is because of the addition of air travel data and commuting data to the spreadsheet, which had not been included in the previous report. As Christine stated in her report, the majority of the emissions produced by the university is the result of the on-campus stationary sources like the co-generation plant. Since this is the source of the campus's electricity and steam, it cannot be eliminated, but can be reduced by implementing environmentally conscious practices by the students and faculty. Overall, Bucknell University seems to be on par with other colleges and universities in their greenhouse gas emissions, and is making a conscious effort to reduce these emissions and keep them low. Further discussion and analysis will be provided in the University's upcoming Climate Action Plan.