Hobart and William Smith Colleges
Greenhouse Gas Emissions Inventory

by
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Photo courtesy of Hobart and William Smith Colleges
http://www.hws.edu/experience/
LIST OF ABBREVIATIONS

HWS – Hobart and William Smith Colleges
ACUPCC – American College & University Presidents Climate Commitment
CA-CP – Clean Air - Cool Planet

CO₂ – Carbon Dioxide
CH₄ – Methane
N₂O – Nitrous Oxide
HFC – Hydro-Fluorocarbon
GHG – Greenhouse Gas
eCO₂ – Carbon Dioxide Equivalents
MTCDE – Metric Tons Carbon Dioxide Equivalents
GWP – Global Warming Potential
Btu – British Thermal Unit; the amount of heat required to raise the temperature of 1 pound of water by 1 degree Fahrenheit
MMBtu – One million Btu
One Metric Ton = 1,000 kg or 2,205 lbs
EXECUTIVE SUMMARY

The goal of our study was to compile a comprehensive inventory of the greenhouse gases (GHG) emitted by Hobart and William Smith Colleges (HWS) in 2007. We used the most recent data available for our 2007 figures, focusing on the fiscal year from June 2006 through May 2007 whenever possible. The inventory details all direct sources of the colleges’ emissions where data were available as well as some indirect sources. This will help the colleges to focus their emissions reducing policies by highlighting the primary contributing sources. The completion of future inventories will allow the colleges to evaluate the efficiency of any emissions reduction projects by analyzing previous years’ emissions levels.

The total amount of greenhouse gasses emitted in 2007 was 15,794 MTCDE\(^1\). This represents an increase in emissions of 60% from the fiscal year 2004/5 and an increase of 120% from 2005/6\(^2\). The 2005/6 data, however, only covered emissions from June 2005 through March 2006. The 2007 emissions show such a great increase because of the new format used for completing the inventory which was more comprehensive than the methods used to calculate previous years’ GHG emissions. New sources of emissions found in this inventory include athletic team vehicle and air travel, student air travel to study abroad programs, student commuting, agriculture, and solid waste disposal. The inventory also utilized campus wide surveys to obtain expanded data on faculty and staff commuting, campus sponsored vehicle travel, and campus sponsored air travel. These surveys can be seen in figures 6.b.1 and 6.c.1 of the methods section.

The primary sources of GHG emissions are, in order, natural gas used for heating, purchased electricity, faculty/staff/business commuting, student commuting, and

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1 see Figure 10 of the results section. For more information on carbon dioxide equivalents, see Table 1, p. 7
2 see Table 3, p. 18
faculty/staff/business campus sponsored air travel. The amount of GHGs emitted by each source can be found in Table 2 on page 17 of the inventory. These sources not only satisfy the reporting requirements of the Presidents Climate Commitment for direct GHG emissions, explained in more detail in the following introduction, but they also provide a good representation of the indirect emissions that HWS are responsible for. Although it is nearly impossible to discover all emissions that are indirectly linked to the colleges’ actions, i.e.: gasses emitted in the manufacturing process of the printer paper that the colleges’ buy, we hope that each future inventory will research new data and give as accurate a portrayal of Hobart and William Smith colleges’ emissions as possible. Some suggestions can be found in the discussion section on page 23 of the inventory.
INTRODUCTION

In September 2007, President Mark D. Gearan of Hobart and William Smith Colleges signed the American College & University Presidents Climate Commitment (ACUPCC). The commitment is a progressive step toward reducing GHG emissions and attaining climate neutrality. One of the document’s mandatory criteria is the completion of a comprehensive inventory of all the greenhouse gas emissions for the HWS campus. The inventory will help the colleges to identify the primary sources of emissions and to develop an action plan for achieving climate neutrality as soon as possible.

In order to complete the inventory, we utilized a calculating tool from Clean Air Cool Planet (CA-CP), a science-based non-profit organization that works to find solutions to global warming. The methods provided by the CA-CP Campus Carbon Calculator v5.0 are consistent with the standards of the Green House Gas Protocol of the World Business Council for Sustainable Development (WBSCSD) and the World Resources Institute (WRI). The calculator uses three “scopes” to organize direct and indirect emissions of the colleges.

**Scope 1** refers to all direct GHG emissions occurring from sources that are owned or controlled by the institution including the production of heat and energy, fuel use by campus owned vehicles, agriculture, and fugitive emissions (i.e.: HFC leakage).

**Scope 2** refers to all GHG emissions from imports of energy and purchased electricity.

**Scope 3** refers to all other indirect emissions that result from the activities of the institution, but occur from sources owned or controlled by another company including commuting, air travel, athletic team travel, and solid waste management.

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3 ACUPCC Implementation Guide, p. 10
The Presidents Climate Commitment mandates that signatories report on all Scope 1 and Scope 2 emissions and on Scope 3 emissions where data are available.

Our goal was to complete a comprehensive inventory for the fiscal year starting in June 2006 and continuing through May 2007. Emissions data from the previous three years were taken from a study by Clancy Brown, William Smith class of 2009. Hopefully, this project will also serve as a template for the completion of future GHG emissions inventories at HWS. More information on the ACUPCC can be found at http://www.presidentsclimatecommitment.org/
METHODS

DATA COLLECTION

The CA-CP Campus Carbon Calculator was very helpful in discovering the sources of GHG emissions on the HWS campus. It breaks down scopes 1, 2, and 3 into the following source categories: purchased electricity, purchased steam and chilled water, on campus stationary production of heat and electricity, transportation, agriculture, solid waste disposal, and the release of refrigerants and other chemicals. For all sources except transportation, the data were retrieved by contacting the directors of the HWS Facilities and Buildings and Grounds departments and by accessing Utility Manager Online, which holds records of all utility use.

Transportation data were accumulated for the air and ground travel that the colleges are responsible for. In addition to the university fleet emissions that are required by the ACUPCC, we compiled additional scope 3 emissions data for athletic team travel (air and ground), student and faculty/staff commuting, campus sponsored vehicle travel, campus sponsored faculty/staff air travel, and student air travel to study abroad programs. These sources were placed into three categories by the CA-CP calculator: university fleet, air travel and commuting.

The flight schedules for travel to all 2007 study abroad programs were obtained from the Center for Global Education. The athletic team competition schedules were provided by the Hobart and William Smith College athletic directors. Additional athletic team travel information, including flight plans and vehicle use, were obtained by contacting the teams’ head coaches. Two surveys were made up to obtain the information for student and faculty/staff transportation and were edited after being given to a class as a trial run. The two anonymous online surveys, provided in figures 6.b.1 and 6.c.1 of the methods section, were sent out to all faculty, staff and students on November 7, 2007 and left open to responses for 10 days. The surveys were created with the help of HWS IT (information technology) services and are stored in the Surveyor program under the “environmental studies” subject heading.

Table 1.
Global warming potentials (100 years).4

<table>
<thead>
<tr>
<th>GHG</th>
<th>CO₂ Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>1</td>
</tr>
<tr>
<td>CH₄</td>
<td>23</td>
</tr>
<tr>
<td>N₂O</td>
<td>296</td>
</tr>
<tr>
<td>HFCs</td>
<td>up to 12,000</td>
</tr>
</tbody>
</table>

4 Source: CA-CP Campus Carbon Calculator v5.0
Figure 1 - Purchased Electricity (Scope 2)
- Data obtained from HWS Facilities, using the Sodex-Ho website – Utility Manager Online
- Data Range – June 2006 thru May 2007
- Some problems were encountered in the use of the CA-CP Campus Carbon Calculator. When entering electricity use, the calculator asks to select your region of the United States because it has emissions factors of CO₂, CH₄ and N₂O per kWh stored in the database. It lists upstate New York’s emissions factors as .381kg CO₂ / kWh; .00000367kg CH₄ / kWh; .00000403kg N₂O / kWh. When we initially ran the calculator, it returned emissions resulting from electricity use as 7,180 MTCDE, and a total emissions level of 18,960 MTCDE. However, when we analyzed the data more closely, we found that the calculator was using different emissions factors. It used .686kg CO₂ / kWh instead of .381. We were unable to find anything in the calculator listing the steps of conversion between these two numbers. Instead of using this data, we chose the option in the CA-CP calculator to enter a custom fuel mix. We entered the 2007 emissions factors that the calculator listed for upstate New York as our custom mix and ran the operation again. This method reduced GHG emissions resulting from electricity usage to 3,994 MTCDE and reduced the total campus emissions to 15,794 MTCDE.
- Not knowing whether there was a bug in the calculator, we opted to use the second method for our data analysis. This returned emissions levels due to electricity use that were much more consistent with the previous years’ research done by Clancy Brown⁵ (William Smith class of 2009).

Figure 2 - Purchased Steam and Chilled Water (Scope 2)
- HWS does not purchase steam or chilled water from outside sources, but produces its own

Figure 3 - On Campus Stationary (Scope 1)
- HWS only uses Natural Gas
- Data obtained from HWS Facilities, using the Sodex-Ho website – Utility Manager Online
- Data Range – June 2006 thru May 2007

⁵ Using a custom-derived emissions factor for purchased electricity of .344 kg CO₂ / kWh
Transportation (Scope 1, 3)

**Figure 4** - University Fleet (Scope 1)
- The colleges’ university fleet is made up of HWS Facilities vehicles, Security and Campus Safety vehicles, and Campus Vans and Recruiting vehicles.

**Figure 4.a** Fuel use by HWS Facilities was provided by Scott Woodworth. The 2007 data were the average fuel use of the previous 3 years (2003/4, 2004/5, 2005/6).

**Figure 4.b** Fuel use by Security and Campus Safety was provided by Cal Brown. The 2007 data were the sum of the monthly fuel usages from June 2006 thru May 2007. The vehicles run only on gasoline.

**Figure 4.c** Fuel use by Campus Vans and Recruiting Vehicles was provided by Erica Connor. The 2007 data were the sum of the yearly average miles driven by campus vans (16mpg) and recruiting cars (22mpg). Both types of vehicles run only on gasoline.

**Figure 5** - Air Travel (Scope 3)
- Air travel consists of Athletic Team air travel, Student Programs air travel, and Faculty/Staff campus sponsored air travel.

**Figure 5.a** Athletic Team Air Travel data were derived from the 2007/2008 Hobart and William Smith competition schedules, provided by Mike Hannah and Sally Scatton. The 2007 data were the sum of the distances of all flights by HWS athletic teams. This includes flights for all winter/spring break team trips – the locations may change each year and individual head coaches should be referred to.

**Figure 5.b** Student Programs Air Travel data were derived from every study abroad program of the Spring 2007 and Fall 2007 terms, provided by Amy Teel. The 2007 data were the sum of the distances of all flights to and from HWS study abroad programs.

**Figure 5.c** Faculty and Staff Air Travel data were derived from the responses to the faculty and staff transportation survey. Respondents were asked to list all campus sponsored air travel that they had participated in over the past 12 months, including the cities they flew in and out of during their trip. The 2007 data used the average miles traveled of the 212 respondents to the survey multiplied by a total of 617 faculty/staff members.

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6 the distance between cities for all air travel was calculated using the website [http://www.indo.com/distance](http://www.indo.com/distance)

7 See figure 6.b.1 of the methods section
Figure 6 - Commuting (Scope 3)

- Commuting consists of Athletic Team vehicle travel, Faculty/Staff commuting and Student commuting.

Figure 6.a) Athletic Team Vehicle Travel data were derived from the 2007/2008 Hobart and William Smith competition schedules. The miles traveled to each competition (including winter/spring break team trips) were calculated using Mapquest\(^8\). The total number of miles traveled by each team was divided by the fuel efficiency of the type of vehicle traveled in (listed below). The 2007 data was the sum of the total gallons of gasoline and diesel consumed:

a. **Coach Bus** (5mpg diesel)\(^9\) – Soccer(m/w)\(^10\), Cross Country(m/w), Field Hockey, Football, Lacrosse(m/w), Hockey, Basketball(m/w)

b. **K-Ventures Bus** (10mpg diesel)\(^11\) – Tennis(m/w), Squash(m/w)

c. **Campus Van** (16mpg gasoline) – Golf(m/w), Swimming and Diving

d. HWS Crew teams traveled using 1 Coach Bus, 1 Campus van and 1 1-ton Pickup Truck (17mpg gasoline)\(^12\)

Figure 6.b) Faculty/Staff Commuting data were obtained using the faculty and staff transportation survey. The following questions were asked in an anonymous online survey\(^13\):

Figure 6.b.1

1) Do you walk to campus? 2) Do you drive to campus? 3) What type of car do you drive? 4) How many days a week do you drive to campus? 5) When you drive to campus, how many trips on average do you make per day? (1 trip = to and from campus) 6) How far is your trip to campus? 7) While on campus, how many trips do you make in your car? (for meetings, the field house/athletic facilities, lunch, etc….) 8) What is the average distance of these trips? *Please estimate in miles.* 9) How many days a week do you commute to campus or make trips for school programs using public or campus sponsored transportation? 10) When using this transportation, how many trips on average do you make per day? (1 trip = to and from campus) 11) How far is your trip? *Please estimate in miles* (distance from starting point to destination) 12) What type of vehicle do you travel in? 13) In the past 12 months, have you used any air travel sponsored by HWS? (ie: to conferences) 14) For any air travel (past 12 months) that was paid for by HWS, please list the starting point and destination of the airports you used. If the flight plan was not the same on your return trip, please list those cities as well. 15) How many miles of automobile travel do you do per year that is paid for by HWS? (Conferences, field trips, labs, etc…) 16) In which type of

\(^8\) http://www.mapquest.com

\(^9\) source – Onondaga Coach http://www.onondagacoach.com/

\(^10\)(m/w) means that both men’s and women’s teams use that form of transportation. Some teams travel to competitions together in the same vehicle – this info can be obtained by asking the athletic directors and/or head coaches

\(^11\) source – K-Ventures Bus Charters http://www.kventures.org/

\(^12\) source – estimate of vehicle class from http://fueleconomy.gov/

\(^13\) using the Surveyor program, provided by IT services
vehicle was the travel? (select all that apply) *if different types of vehicles are used, please specify the miles traveled in each in the text box below 17) How many vehicles were used per trip?
   - 212 Faculty and Staff members responded to the survey. The survey data were exported to an Excel workbook for analysis.

Figure 6.b.2) Fuel efficiency of each vehicle type was assigned by filtering the data14:

1. SUV – 16mpg
2. Small SUV – 22mpg
3. Minivan – 17mpg
4. Hybrid – 45mpg
5. Large Car – 20mpg
6. Midsize Car – 24mpg
7. Compact Car – 26mpg
8. Sub-compact Car – 28mpg
9. Truck – 15mpg
10. Wagon – 20mpg
11. Small bus (k-ventures) – 10mpg diesel
12. Large bus (coach/school bus) – 5mpg diesel
13. Campus van – 16mpg diesel

Figure 6.b.3) Total Fuel Consumption was calculated using the following steps:

1) Miles driven per week was calculated using the following15:
   (Driving days per week) * (Trips per day) * (Distance * 2)

2) Commuter gallons consumed were calculated using the following16:
   average of [(miles per week) / (vehicle fuel efficiency) * (40 weeks)] * 617
   - The same formula was used for trips made while on campus
   - Public transportation used the same formula with one exception:
     Gallons consumed were divided by the passenger capacity of each vehicle
     Campus van – 7; Small bus – 25; Large bus – 50

3) Campus sponsored vehicle travel was calculated using the following:
   average of [(miles per year) * (number of vehicles) / (fuel efficiency)] * 617

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14 estimates based on vehicle class from http://fueleconomy.gov/
15 The survey asked for one-way distance and for the number of round-trips per day, therefore the distance from starting point to destination was doubled.
16 the average of yearly gallons consumed by the 212 Faculty and Staff members who responded to the survey. - 40 weeks was an assumption of the time spent on campus by Faculty and Staff members since many are only on campus when school is in session (32 weeks). - 617 is the number of full and part time Faculty and Staff employees of the colleges. (Sodex-Ho employees are technically not employees of HWS)
Figure 6.c) Student Commuting data were obtained from the Student Transportation Survey. The following questions were asked in an anonymous online survey:\(^{17}\):

1) Do you own a car? 2) What type of car do you drive? 3) How many days a week do you drive to campus? 4) When you drive to campus, how many trips on average do you make per day? (1 trip = to and from campus) 5) How far is your trip to campus *Please estimate in miles (distance from starting point to campus) 6) How many days a week do you commute to campus or make trips for school programs (service programs, internships, etc.) using public or campus sponsored transportation? 7) When using this transportation, how many trips on average do you make per day? (1 trip = to and from campus/destination) 8) How far is your trip *Please estimate in miles (distance from starting point to destination) 9) What type of vehicle do you travel in?

-418 students responded to the survey. The survey data were exported to an Excel workbook.

Figure 6.c.2
Analysis methods were the same for the Student Commuter and Public Transportation as they were for Faculty/Staff Commuter and Public Transportation found in figures 6.b.2 and 6.b.3 of the methods section, with two exceptions:

1) The number of weeks used was only when the colleges are in session, 32 weeks
2) Average fuel consumption was multiplied by 1978 students\(^ {18}\)

Figure 7 - Agriculture (Scope 1)
- Agricultural emissions sources consist of fertilizer application and animal agriculture. Animal agriculture was not included because the colleges do not have projects raising cows, swine, horses, goats, sheep or poultry.
- Fertilizer Application data were provided by Scott Woodworth and David Iannicello. The 2007 data were the total weight of Nitrogen applied between May and December of 2007.

Figure 8 - Solid Waste (Scope 3)
- Solid Waste data were provided by Scott Woodworth. The 2007 figure was the total weight of garbage sent to the Ontario County Landfill in 2006. The data were entered into the CA-CP calculator under the category “landfilled waste with CH\(_4\) recovery and electric generation” because the Ontario County Landfill is equipped with these technologies.

\(^{17}\) Surveyor program
Figure 9 - Refrigerants and Other Chemicals (Scope 1)

- This source was not included in the 2007 inventory because we were unable to obtain information on HFC leakage.
- Several other colleges and universities that have posted inventories on the Clean Air Cool Planet website chose not to include this source because it contributes such a small amount of GHG.
- The Presidents Climate Commitment states that “participants may designate small emissions sources that are difficult to track as de minimis and exclude them from the inventory, provided that the emissions sources collectively comprise less than 5% of the institution’s total GHG emissions.”
- Since total CH₄ and N₂O emissions from all sources only comprise 2% of the colleges’ GHG emissions, we are assuming that HFC leakage from refrigeration and air-conditioning units would be insignificant.

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19 American College & University Presidents Climate Commitment Implementation Guide, p. 12
20 see Graph 4, p. 20
RESULTS

Figure 1 - Purchased Electricity
- Data are entered into the calculator in units of kWh
- The total purchased electricity for the period June 2006 – May 2007 was 10,338,433 kWh. The emissions resulting directly from purchased electricity were calculated to be 3,994 MTCDE using the emissions factors for Upstate New York listed in figure 1 of the methods section. This represents a 68.9% increase in emissions from the period June 2005 – March 2006, and a 20.8% increase from the period June 2004 – May 2005.21

Figure 2 - Purchased Steam and Chilled Water
- none

Figure 3 - On Campus Stationary
- Natural Gas Usage is entered into the calculator in units of MMbtu
- The total natural gas used in all HWS facilities for the period June 2006 – May 2007 was 105,886 MMbtu. The emissions resulting directly from natural gas usage, computed by the CA-CP calculator, were 5,606 MTCDE. This represents an increase in emissions of 27.9% from the period June 2005 – March 2006, and a decrease of 8.8% from the period June 2004 – May 2005.22

Transportation

Figure 4 - University Fleet
- University fleet data are entered into the calculator in units of gallons
- Total University Fleet is the sum of gallons of fuel consumed by HWS Facilities, Security and Campus Safety, and Campus Vans and Recruiting Vehicles. Fuel consumption for 2007 was 42,923 gallons gasoline and 1,928 gallons diesel. The emissions directly resulting from fuel use by the colleges’ university fleet, computed by the CA-CP calculator, were 403 MTCDE. This represents an increase in emissions of 80.7% from the period June 2005 – March 2006, and an increase of 91% from the period June 2004 – May 2005.23

Figure 4.a) Fuel Use by HWS Facilities
- Diesel – 1,928 gallons
- Gasoline – 22,256 gallons
- Fuel consumption by HWS Facilities was derived from the average gallons consumed during the three previous years: 2003/4, 2004/5, and 2005/6.

21 Previous years’ emissions taken from: Brown, Clancy. 2006. “Hobart and William Smith Colleges Carbon Dioxide Emissions Inventory”
22 Ibid.
23 Ibid.
**Figure 4.b)** Fuel Use by Security and Campus Safety
- Gasoline only – 6,746.75 gallons
- The 6,746.75 gallons consumed are the sum of the monthly fuel use from June 2006 – May 2007.

**Figure 4.c)** Fuel Use by Campus Vans and Recruiting Vehicles
- Gasoline only – 13,920.1 gallons
  a. Vans – 149,994 miles driven / 16mpg = 9,374.65 gallons
  b. Recruiting Vehicles – 100,000 miles driven / 22mpg = 4,545.45 gallons
- The 13,920.1 gallons consumed resulted from the average miles driven per year by campus vans and recruiting cars.

**Figure 5** - Air Travel
- Air travel data are entered into the calculator in units of miles traveled
- Total Air Travel is the sum of the miles flown by athletic team air travel, student programs, and faculty and staff air travel sponsored by HWS. Total air travel for 2007 was 1,650,331 miles. The emissions directly resulting from campus sponsored air travel, computed by the CA-CP calculator, were 1,282 MTCDE. This represents an increase in emissions of 2,464% over the years 2003/4, 2004/5 and 2005/6.  

**Figure 5.a)** Athletic Team Air Travel
- 13,375.28 miles
- 13,375.28 miles was the total distance of all flights by HWS athletic teams according to the 2007/2008 competition schedules.

**Figure 5.b)** Student Programs
- 362,234 miles
- 362,234 miles was the sum of the distances of all flights to and from HWS study abroad programs in the spring and fall semesters of 2007.

**Figure 5.c)** Faculty and Staff
- 1,274,722 miles
- 1,274,722 miles was the sum of the distances of all campus sponsored flights for faculty and staff. Data were obtained from the 2007 faculty and staff transportation survey. The 212 respondents to the survey averaged 2,066 miles traveled per year.
  a. 2066 miles per faculty/staff member * 617 members = 1,274,722 miles

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24 Ibid. note: previous years’ emissions data did not include athletic team travel or student programs, and campus sponsored air travel was based on only 22 responses to a faculty survey.
Figure 6 – Commuting

- Commuting data are entered into the calculator in units of gallons.
- Total Commuting is the sum of gallons of fuel consumed by athletic team vehicle travel, faculty/staff commuting, and student commuting. Total commuting data for 2007 were 470,067 gallons of gasoline and 19,689 gallons of diesel. The emissions directly resulting from commuting, computed by the CA-CP calculator, were 4,398 MTCDE. This represents an increase in emissions of 2,872% over the years 2003/4, 2004/5 and 2005/6.\textsuperscript{25}

Figure 6.a) Athletic Team Vehicle Travel

- 1,804.95 gallons gasoline
- 8,997.52 gallons diesel
- The 2007 data were the gallons consumed from vehicle travel by HWS athletic teams to all competitions according to the 2007/2008 competition schedules.

Figure 6.b) Faculty/Staff Commuting

- 362,714.51 gallons gasoline
- 558.35 gallons diesel
  - a. Commuter – 283,420.9 gallons gasoline
  - b. On campus trips – 29,867.34 gallons gasoline
  - c. Public Transportation – 2,808.5 gallons gasoline
  - d. Campus Sponsored Travel – 46,617.75 gallons gasoline
- The 2007 data were derived from answers to the faculty and staff transportation survey, found in figure 6.b.1 of the methods section.

Figure 6.c) Student Commuting

- 105,547.1 gallons gasoline
- 10,133.29 gallons diesel
  - a. Commuter – 56,287.95 gallons gasoline
  - b. Public Transportation – 49,259.12 gallons gasoline
- The 2007 data were derived from answers to the student transportation survey, found in figure 6.c.1 of the methods section.

Figure 7 – Agriculture

- Data are entered into the calculator in units of lbs.
- The total fertilizer application for the time period of May – December 2007 was 1,600 lbs Nitrogen. The emissions resulting directly from agriculture, as computed by the CA-CP calculator, were 6 MTCDE. There are no previous year’s data on agricultural sources of GHG emissions.

\textsuperscript{25} Ibid. note: previous years’ emissions data did not include athletic team travel or student commuting, and faculty commuting data were based on only 22 responses to a faculty survey.
Figure 8 – Solid Waste

- Data are entered into the calculator in units of tons
- The total solid waste sent to the Ontario County landfill in 2006 was 712 tons. The emissions resulting directly from this solid waste, as computed by the CA-CP calculator, were 104 MTCDE. There are no previous year’s data on GHG emissions resulting from solid waste disposal.

Figure 9 – Refrigerants and Other Chemicals

- none

Table 2.
Greenhouse Gas Emissions by source

<table>
<thead>
<tr>
<th>Source</th>
<th>Units of energy consumption</th>
<th>Resulting GHG emissions (MTCDE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased Electricity</td>
<td>10,448,433 kWh</td>
<td>3,994</td>
</tr>
<tr>
<td>Natural Gas Use</td>
<td>105,886 MMbtu</td>
<td>5,606</td>
</tr>
<tr>
<td>University Fleet</td>
<td>44,851 gallons (gas and diesel)</td>
<td>403</td>
</tr>
<tr>
<td>Student Air Travel</td>
<td>362,234 miles</td>
<td>281</td>
</tr>
<tr>
<td>FSB Air Travel&lt;sup&gt;26&lt;/sup&gt;</td>
<td>1,288,097 miles</td>
<td>1,001</td>
</tr>
<tr>
<td>FSB Commuting</td>
<td>374,076 gallons (gas and diesel)</td>
<td>3,353</td>
</tr>
<tr>
<td>Student Commuting</td>
<td>115,680 gallons (gas and diesel)</td>
<td>1,045</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1,600 lbs N</td>
<td>6</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>712 tons</td>
<td>104</td>
</tr>
</tbody>
</table>

<sup>26</sup> FSB stands for Faculty, Staff and Business: the FSB air travel and FSB commuting data include athletic team travel (air and vehicle) because there was no separate category to enter it into the CA-CP calculator
Figure 10 – Total Campus Greenhouse Gas Emissions
• 15,794 MTCDE

Figure 11 – Per Capita Emissions
• 7.99 tons per student
• Colleges of similar size
  a. Smith College – 11.59 tons per student\textsuperscript{27}
  b. Middlebury College – 14.5 tons per student\textsuperscript{28}

Table 3.
HWS Greenhouse Gas Emissions since 2003\textsuperscript{29}

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GHG emissions</td>
<td>10,147 metric tons CO\textsubscript{2}</td>
<td>9,861 metric tons CO\textsubscript{2}</td>
<td>7,169 metric tons CO\textsubscript{2}</td>
<td>15,794 MTCDE</td>
</tr>
</tbody>
</table>

Graph 1.

eCO\textsubscript{2} Emissions by Scope (metric tonnes)
  total - 15,794 MTCDE

\textsuperscript{29} Previous year emissions taken from: Brown, Clancy. 2006. “Hobart and William Smith Colleges Carbon Dioxide Emissions Inventory”
Graph 2.

![Graph 2. Emissions by Source (metric tonnes)](image)

**Graph 2.**

**eCO₂ Emissions by Source (metric tonnes)**
- total - 15,794 MTCDE
  - 3994, 25%
  - 5606, 35%
  - 6083, 39%
  - 104, 1%
  - 6, 0%

- purchased electricity
- on-campus stationary
- transportation
- agricultural
- solid waste

Graph 3.

![Graph 3. Transportation Breakdown (kg CO₂)](image)

**Graph 3.**

**Transportation Breakdown (kg CO₂)**
- total emissions - 5,905,282 kg
  - 1021322, 17%
  - 393428, 7%
  - 3273023, 54%
  - 997106, 17%
  - 280403, 5%

- campus fleet
- student commuters
- FSB commuters
- student air-travel
- FSB air-travel

**FSB stands for Faculty, Staff and Business**

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30 these figures include athletic team travel because there was no separate category for entering the data into the CA-CP calculator
Graph 4.

Emissions Breakdown by Gas (kg * GWP)

- CO2: 98%
- CH4: 1%
- N2O: 1%

Graph 5.

CH₄ Emissions by Source (kg CH₄)
total - 6,055 kg

- purchased electricity: 4540, 75%
- on-campus stationary: 559, 9%
- transportation: 38, 1%
- solid waste: 918, 15%
Graph 6.

N\textsubscript{2}O Emissions by Source (kg N\textsubscript{2}O)
total - 402 kg

- 328, 82%
- 22, 5%
- 42, 10%
- 11, 3%

Graph Source: Utility Manager Online, Sodex-Ho database

Graph 7.

Energy Use Monthly and Annual Trend Graph For Campus
Name: HOBART & WILLIAM SMITH COL

Graph Source: Utility Manager Online, Sodex-Ho database
DISCUSSION

The increase in GHG emissions seen between the 2005/6 and 2006/7 data is mostly due to a more comprehensive inventory, not an actual increase in the Colleges’ emissions. Graph 7 on page 21, “Energy Use Monthly and Annual Trend”, shows that electricity and natural gas consumption have remained mostly constant over the past 3 years, and therefore is not the cause of increased emissions. The transportation sector was the main source of the increase. By using an online survey, we were able to come up with more accurate estimates of faculty and staff air travel and commuting than the previous inventory. We were also able to obtain new data on student commuting, air travel to study abroad programs, athletic team travel and solid waste disposal: none of which had been included in previous inventories.

When compared to colleges of similar size such as Middlebury and Smith, HWS has lower emissions totals for two reasons. First, the emissions factor for electricity is very low in upstate New York (0.381 kg CO₂ / kWh) because a high percentage of energy comes from hydro-electric plants. The average in the New England area is 0.408 kg CO₂ / kWh. However, even if we were located in Massachusetts, the increase in emissions due to electricity use would only increase our overall emissions to 16,087 MTCDE – not a significant change. Second, HWS only uses natural gas to produce energy and heat its buildings. In addition to natural gas, Smith and Middlebury use #2 and #6 oil which release greater amounts of GHG when burned. This may cause a more significant change than electricity use, but we do not know their exact fuel mixes in order to do an emission comparison. In the future, it may be more useful to compare our emissions with other small colleges in the region if they complete GHG emissions inventories.
Suggestions for Future Inventories

- Use the CA-CP Campus Carbon Calculator and User Guide. It is very helpful in researching GHG emissions because it breaks them down into source categories, and it provides an easy place to store and access data. The methods and conversion factors that the calculator provides are approved by the ACUPCC; they save a lot of time and help to reduce errors in the calculation of emissions. The calculator allows for the storing and comparison of data from multiple years and it will help to provide data consistent with the 2007 inventory. They can be found at http://www.cleanair-coolplanet.org/toolkit/content/view/146/132/

- Obtain more accurate solid waste figures on a monthly or weekly basis; contact the students involved in the colleges’ Recyclemania program to coordinate the collection of this data.

- The colleges’ solid waste goes to Ontario County Landfill. If the fuel efficiency of the garbage and recycling trucks can be found, the emissions resulting from the transport of solid waste to the landfill can be added to the inventory under Scope 3.

- Some athletic teams practice off-campus. By contacting individual head coaches, the location and method of transportation can be used to determine the resulting emissions; this would fall under the athletic team vehicle travel source.

- Ask HWS Facilities about refrigeration and HFC leakage right away, so that they might be able to obtain this information

- Carbon sinks can also be incorporated as offsets to GHG emissions. The colleges own the Hanley preserve, which may be able to be analyzed for offsets. It will be helpful to contact professors in the Environmental Studies, Biology, and/or Geology departments

- Use IT (HWS information technology) services to conduct an online survey for faculty, staff and student transportation.
- Make sure to get the surveys approved by the campus internal review board (IRB) before sending them out.
- When asking students for their commuting distance, be sure to specify that this is asking for the distance between their residence during the school year and their destination on campus. Some students replied with the distances from their home residences, which are not included in commuting. We omitted all outliers that listed a distance of over 15 miles. Although not required by the ACUPCC, future inventories could also include the distances traveled by students to get to campus each semester under Scope 3 emissions.

Our thanks go out to the following people:

Professors Eugenio Arima and Thomas Drennen of the HWS environmental studies department; Clancy Brown – William Smith class of 2009; Scott Woodworth – Assistant Director of Facilities at HWS; Cal Brown – Director of Campus Safety; Erica Connor – Director of Summer programs and Conferences and Events; Amy Teel – Global Education Program Operations Manager; Mike Hannah – Director of Athletics, Hobart College; Sally Scatton – Asst. Director of Athletics / Head Field Hockey Coach, William Smith College; all athletic team coaches for providing travel information; Faculty, Staff and Students who participated in the online surveys; HWS IT services; and President Mark Gearan for signing the Presidents Climate Commitment. We would not have been able to complete this inventory without your help.