Colgate University's 2008-09 Comprehensive Greenhouse Gas Inventory

By

Ben Taylor, Class of 2010, Sustainability Intern

August 2009

Revised and updated

January 2010

by John Pumilio, Sustainability Coordinator

ABSTRACT

Colgate University's
2008-09 Comprehensive Greenhouse Gas Inventory

Ben Taylor '10
John Pumilio, Sustainability Coordinator

This report provides the methods and results of Colgate University's first comprehensive greenhouse gas emissions inventory for the 2008-09 Fiscal Year. This inventory was completed in compliance with one of the key requirements of the American College and University President's Climate Commitment (ACUPCC) signed in January 2009 by President Rebecca Chopp. The commitment mandates that participating universities complete an inventory within one year of signing the commitment. The data gathered follows the protocol specified in the ACUPCC Implementation Guide and the calculations were made using the Clean Air-Cool Planet Campus Carbon Calculator v6.3 also recommended in the ACUPCC guidelines. Colgate's gross greenhouse gas emissions were 17,380 metric tons of carbon dioxide equivalent (MTeCO2). This includes all Scope 1 emissions (on-site combustion of fuel oil, vehicle fleet emissions, fugitive refrigerant chemicals, and emissions associated with grounds maintenance) and Scope 2 emissions (purchased electricity). Scope 3 emissions include faculty and staff commuting, bus commuting, air travel paid for by or through the university, paper use, solid waste, and animal husbandry. Colgate's net footprint, when adjusted for offsets (specifically forest sequestration), is 16,308 MTeCO2. Colgate's gross emissions per full time student were 6.24 MTeCO2 and 7.46 MTeCO2 per 1000 square feet. Colgate's highest sources of emissions were found to be on-site combustion of fuel oil at 36 percent of our total emissions, business-related air travel at 27 percent, electricity at 11 percent, and faculty and staff commuting at 10 percent. This report is the first comprehensive greenhouse gas inventory at Colgate and provides a solid foundation and source of information for future climate action planning reports and mitigation strategies.

~ TABLE OF CONTENTS ~

~ LIST OF FIGURES ~

~ LIST OF TABLES ~

ACKNOWLEDGEMENTS

The following individuals made significant contributions to this report. Without their assistance, the acquisition of inventory data and the final production of this report would not have been possible.

Michelle Atkinson, Accounting Assistant, Accounting and Control

Peter Babich, Associate Director of Facilities and Manager of Engineering Services

Brian Belden, Physical Plant, Foreperson, Millwright Shop

Birnie Bus Co., Hamilton

Jill Burdick, Human Resources Associate

Ed and Tori Carhart, White Eagle Farms

Lori Chlad, Director of Human Resources

John Collins, Director of Budget

Amy Davidson, Facilities Department Office Manager

Sharon Driscoll, Madison County Landfill

Julie Dudrick, Upstate Institute Project Director

Barbara Gorka, Office of Off-Campus Study

Ingrid Hale, COVE Director

Ian Helfant, Chair, Sustainability Council

Paul Fick, Associate Vice President for Facilities

Mike Jasper, Associate Director of Facilities and Manager of Lands and Grounds

Jon McConville, Golf Course Superintendant

Susan Murly, Office of Off-Campus Study

Tom O'Neill, Associate VP/Controller

Dan Partigianoni, Associate Controller

Art Punsoni, Director of Purchasing

Shaun Richard, Assistant Athletic Director

Lyle Roelofs, Interim President

Kevin Shen, Yale University

Trish St. Leger, Associate Provost

Brendt Simpson, Director of Institutional Research

Robert Turner, Professor of Economics & Environmental Studies, Director of Social Sciences

The Village of Hamilton

Terry Wilcox, Local Farmer

INTRODUCTION:

In January of 2009, former President of Colgate University Rebecca S. Chopp signed the American College and University President's Climate Commitment (ACUPCC). In doing so she pledged on behalf of the University that we shall strive towards carbon neutrality and undergo a list of necessary procedures and actions that will help promote a more sustainable future at Colgate. One vital aspect of the ACUPCC is a complete greenhouse gas inventory in which data for every major source of emissions at or funded by the University is accounted for. This procedure is listed within the commitment itself under step 1, part b:

> *b. Within one year of signing this document, complete a comprehensive inventory of all greenhouse gas emissions (including emissions from electricity, heating, commuting, and air travel) and update the inventory every other year thereafter.*

This report is the first comprehensive emissions inventory of what will now be a regular undertaking at Colgate. In previous years, students in Environmental Studies have quantified portions of our carbon footprint and this report builds off some of that work. The protocol specified by the ACUPCC Implementation Guide and the *Clean Air-Cool Planet Campus Carbon Calculator* (CA-CP) was used for Colgate's inventory. The CA-CP calculator is the most widely used carbon calculator in higher education. Moreover, it follows the protocol and the latest science established by the World Resources Institute and the World Council for Sustainable Development. It is also recommended by the ACUPCC.

This report contains the methods used to retrieve the data as well as brief analyses of the results. In some cases, retrieval of the data was simply a question of asking the right person. In such instances the names and positions of those individuals are listed. It is intended that this report will be used as a guideline for future inventories and that with each successive year the accuracy and completeness will improve as Colgate becomes, as a community, more experienced in calculating its greenhouse gas emissions.

The inventory is organized into three "scopes" as established by the World Resources Institute and followed by the *Clean Air-Cool Planet Campus Carbon Calculator*. The scopes are essentially levels of how directly Colgate is responsible for various sources of emissions. For example, travel carried out by Colgate's own fleet of vehicles is categorized as a "Scope 1" emission because Colgate's purchasing decisions and driving behaviors occur directly on campus and determine the level of emissions. On the other hand, faculty and staff commuting to and from campus is considered "Scope 3" because Colgate is not entirely responsible for the decisions employees make in their commuting behaviors.

For each scope, we have provided a brief synopsis of the methods used to attain data for the inventory, as well as the data itself. In some cases, lengthier, more detailed raw data are also referenced and can be found in the appendices at the end of the document. When appropriate, we have also provided brief analyses of the results and the implications they have on Colgate's total carbon footprint.

As anticipated, some of the data needed for the greenhouse gas inventory was either not available or incomplete. For example, we had to estimate the commuting behavior, frequency, and distance travelled for Colgate employees. We simply were unsure if faculty and staff members were driving alone to campus, how often they were driving, and the fuel efficiency of their vehicles. In cases such as this, assumptions were made given the data available.

Overall, this inventory establishes a solid baseline from which future inventories can model and from which our institutional climate action plan can be built.

Emission Coefficients

Emission coefficients for this report were taken directly from the Clean Air-Cool Planet Campus Carbon Calculator. The coefficients are used to provide an equivalent amount of carbon dioxide emissions for each of Colgate's activities. While some activities produce methane, nitrous oxide, or other greenhouse gasses, international protocol designates CO2 as the standard by which other gases are measured for two specific reasons: 1) in order to provide a standard unit of measurement across the board and 2) because carbon dioxide is the most abundant anthropogenic greenhouse gas. The equivalents listed below are used to convert emissions into the equivalent measure of metric tons of carbon dioxide (represented as eCO2). For example, cows emit a certain amount of methane and so the equivalent amount of carbon dioxide is calculated using the appropriate emission coefficients.

Table 1. *The emission coefficients used for the calculation of eCO2 in this report.*
**Wood Chips are not a part of Scope 1 emissions because, according to established protocols wood chip combustion does not add any additional carbon to the carbon cycle.*

COLGATE ACTIVITY	EMISSION COEFFICIENT
SCOPE 1	
Fuel Oil #6	0.011757907 MT eCO2 / Gallon
Fuel Oil #2	0.01004635 MT eCO2 / Gallon
Gasoline Vehicles	0.008924124 MT eCO2 / Gallon
Diesel Vehicles	0.0100761 MT eCO2 / Gallon
Refrigerent (HCFC-22)	0.771107029 MT eCO2 / lb.
Fertilizer (Organic)	0.004113436 MT eCO2 / lb. Nitrogen
SCOPE 2	
Electricity	0.0000596931 MT eCO2 / kWh
SCOPE 3	
Faculty/Staff Commuting	0.0004038 MT eCO2 / mile
Outsourced Bus Travel	0.000254 MT eCO2 / mile
Colgate Cruisers	0.0100761 MT eCO2 / Gallon
Air Travel	0.000776336 MT eCO2 / mile
Landfill Waste (no CH4 recovery)	1.0842857 MT eCO2 / Short Ton
Non-Recycled Paper	0.0012905 MT eCO2 / lb.
30% Recycled Paper	0.001147067 MT eCO2 / lb.
50% Recycled Paper	0.001051445 MT eCO2 / lb.
100% Recycled Paper	0.00081239 MT eCO2 / lb.
Dairy Cows on Leased Land	3.8285956 MT eCO2 / head

INSTITUTIONAL DATA:

The CA-CP Campus Carbon Calculator requires some basic institutional data in order to help normalize Colgate's footprint in relation to other colleges and universities. For example, budgets, population size, and square-footage of built environment were all considered.

Budget Information

Information regarding Colgate's annual budget (Table 2) was provided by **John Collins, Director of Budget.**

Table 2. *Breakdown of budget for Colgate University*

BUDGET	2006-07	2007-08	2008-09
Operating	$129,974,254	$138,395,036	$147,320,539
Research	$542,520	$564,811	$614,403
Utilities	$3,924,392	$4,393,533	$4,712,740

Population

Statistics on Colgate's population were provided by **Brendt Simpson, Director of Institutional Research.**

Table 3. *Number of full-time Colgate students.*

FISCAL YEAR	2006-07	2007-08	2008-09
Full-time Students	2,734	2,767	2,784
Faculty Members			280
Staff Members			688

Physical Size

Data on Colgate's physical size were provided by **Brendt Simpson, Director of Institutional Research.**

Total Sq. Feet: 2,331,239
On Campus Acreage: 515

SCOPE 1 EMISSIONS:

These are direct emissions from sources that are owned and/or controlled by our institution. This includes combustion of fossil fuels in college-owned facilities or vehicles, fugitive emissions from refrigeration, and emissions from on-campus agriculture or livestock husbandry. Our institution has direct control over these emissions, and they are no-one else's responsibility.[1]

Fuel Usage

Data on fuel use was accessed directly via the facilities database on the Colgate fileshare. John Pumilio (Sustainability Coordinator), Amy Davidson (Facilities Office Manager), or Peter Babich (University Engineer) can provide updated information for future inventories.

Both wood chips and residual fuel oil #6 are used in the central plant for heat. Distillate oil #2 is used for heat and hot water for most buildings off the main steam line. See Table 4 for the types and quantity of fuel used at Colgate over the past three years. A month-by-month breakdown for Fiscal Year 2008-09 can be found in "Appendix 1."

Table 4. *Fuel Usage*

FUEL TYPE	2006-07	2007-08	2008-09
Wood Chips (tons)	19,158	19,714	22,249
Residual Oil #6 (gallons)	263,570	368,304	371,457
Distillate Oil #2 (gallons)	157,614	207,597	185,503

It is important to note that the burning of wood chips does not add any additional CO2 to the carbon cycle (Table 5), rather it simply affects the speed at which already existent carbon is cycled. The Intergovernmental Panel on Climate Change (IPCC) recommends that wood chips and other biogenic sources of emissions do not be included under the "Scope 1" category for emissions. This is because they come from trees which sequester carbon and release oxygen. By burning something that has already removed carbon dioxide from the atmosphere during its lifetime, we are not actually adding any "new" carbon dioxide to the atmosphere when it is burned. Furthermore, if the trees are farmed sustainably, a new tree will replace each tree that is cut down for chips and so the carbon sink is not depleted. Emissions associated with the combustion of wood chips should only be considered if the current protocol changes. In sum, wood chips are not a part of Colgate's 2008-09 carbon footprint.

Table 5. *MTeCO2 by fuel type and year*

FUEL TYPE	2006-07	2007-08	2008-09
Wood Chips (MTeCO2)	0	0	0
Residual Oil #6 (MTeCO2)	3,009	4,331	4,368
Distillate Oil #2 (MTeCO2)	1,583	2,086	1,864

[1] Clean Air Cool Planet User's Guide

Using wood chips instead of other sources of heat such as fossil fuels has other advantages for Colgate. One advantage is that wood chips are locally abundant and when we purchase them the money spent helps our local economy. Another reason is that wood chips are cheaper than fuel oil on a per BTU basis. In 2008-09, using wood chips instead of fuel oil #6 saved Colgate $1.2 million in energy costs.

University Vehicle Fleet

Colgate's vehicle fleet includes all of the vehicles owned by the University and not rented or leased from other companies. Leased vehicles are accounted for under "Outsourced Travel." As the number of gallons of gasoline consumed was not available, the mileage was used in conjunction with average miles-per-gallon ratings for the vehicles in order to obtain an estimate of the gallons of gasoline used. This was then converted to eCO2 using the emissions coefficient for gasoline (Table 6). Initial mileage data for this section of the report were provided by **Amy Davidson, Facilities Office Manager.**

Table 6: *Gasoline Fleet Average MPG, Mileage, Fuel Consumption and MTeCO2*

Number of Vehicles and Type	Average MPG**	Total Annual Mileage	Estimated Annual Gallons of Gasoline	Total Annual Emissions (MT eCO2)
22 Student/Faculty use Vans ("T" Vehicles)	17.5	165,356	9,449	84
68 B&G Vehicles*	16.4	165,938	10,118	90
5 Campus Safety Vehicles*	22.6	48,344	2,139	19

*****exact mileage was unavailable, therefore, total mileage was divided by the year that they were purchased to get an annual average.*

***Average MPG ratings were found by averaging the EPA estimated MPG for the vehicles within each fleet. However, the ratio of city to highway driving is obviously not recorded and so the values used were mean of the city and highway mpg ratings.*

The B&G gasoline vehicles were responsible for 90 MTeCO2 and the student-leased vans were responsible for 84 MTeCO2. The Campus Safety fleet contributed another 19 MTeCO2. In total, vehicle fleet emissions are a fairly significant proportion of Scope 1 emissions (Figure 4) that could be reduced by researching and implementing mitigation strategies (i.e. replacing retired vehicles with electric or hybrid models).

The total greenhouse gas emissions for Colgate's gasoline vehicle fleet is **194 MTeCO2**.

Diesel Fleet

Colgate consumed **19,770** gallons of diesel fuel in 2008-09 emitting **199 MTeCO2.** A complete list of diesel vehicles and generators can be obtained by contacting Amy Davidson, Facilities Office Manager.

The total greenhouse gas emissions for Colgate's gasoline and diesel vehicle fleet is 393 MTeCO2.

A complete list of vehicles and their respective mileages can be found in "APPENDIX 2."

Refrigerants and Chemicals

Data on Colgate's use of chemical refrigerants was provided by **Brian Belden, Physical Plant, Foreperson, Millwright Shop.** The largest source of refrigerant emissions came from Refrigerant-22 (HCFC-22) from the hockey rink (Table 7).

Table 7. *Total Refrigerant Type and Usage (Pounds).*

YEAR	R - 12	R - 502	R - 22	R - 404A	MP - 39
2009	0	0	116	0	0
2008	0	1	1616.9	5	8.2
2007	4.3	30	1829.1	n/a	3
2006	30	0	42	n/a	0

For 2008, the greenhouse gas emissions that resulted from the fugitive emissions of 1,616.9 lbs of HCFC-22 were: **1246.8 MTeCO2.** 2008 data was used for this report because 2009 data was incomplete at the time of this report. HCFC-22 was the only refrigerant calculated for two reasons. The first is that the CA-CP calculator did not supply emissions coefficients for the other refrigerants. The second is that in 2009 to date, the use of no other refrigerants was reported. Also, as the other refrigerants were used in such small amounts in 2008, their inclusion would not have a significant impact on the total eCO2.

Fertilizer Application

Data on Colgate's fertilizer usage was received from **Mike Jasper, Associate Director of Facilities and Manager of Lands and Grounds** and **Jon McConville, Golf Course Superintendant.**

Table 8: *Fertilizer application on campus grounds and the golf course.*

LOCATION	FERTILIZER TYPE	NITROGEN %	AMOUNT (lbs)
Grounds	Organic	21%	48,000
Golf Course	Organic	12%	8,828

The MTeCO2 for fertilizer can be found by multiplying the emissions coefficient of **0.004113436** by the number of pounds of nitrogen. The equations below illustrate this conversion for both the golf course and the grounds fertilizers.

Grounds: $(.21\times 48000)(.004113436) =$ **41.46 MTeCO2**

Golf Course: $(.12\times 8827.5)(.004113436) =$ **4.36 MTeCO2**

Agriculture Sources

Colgate's agricultural land is leased to private farmers. For this reason, "Agriculture Sources" is included as Scope 3 emissions rather than Scope 1.

SCOPE 2 EMISSIONS:

Scope 2 emissions include indirect emissions from sources that are neither owned nor operated by our institution but whose products are directly linked to on-campus energy consumption. This includes purchased energy: electricity, steam, and chilled water. Although our institution is not directly responsible for these emissions, it is strongly implicated. These emissions come from fossil fuel energy sources that release greenhouse gas emissions when used. Example: Although our institution did not burn coal to make on-campus electricity, someone had to, and although the electricity producer emitted the gasses, they sold the energy to Colgate for our consumption.[2]

Purchased Electricity

84 percent of Colgate's electricity comes directly from large-scale hydroelectric power mainly from Niagara Falls. The remaining 16 percent is purchased from the grid and comes from a mix of sources including nuclear, wind, coal, and other fossil fuels.

Using the Clean Air-Cool Planet Campus Carbon Calculator, we entered Colgate's mix of electricity to get an emissions coefficient of **5.96931E-5 MTeCO2 per kWh.** This is based on the known 84 percent hydroelectric power that we receive and an estimate produced by our regional grid for the remaining 16 percent.

Our emissions coefficient of **5.96931E-5 MTeCO2 per kWh** is relatively low in comparison to the Upstate New York average of **3.73082E-4 MTeCO2 per kWh.**

Electricity consumption data is recorded by **Dan Partigianoni,** Accounting and Control. The fuel mix was obtained from the **Village of Hamilton**.

In Fiscal Year 2008-09, Colgate used **31,571,030 kWh** of electricity. This resulted in the emission of **1,885 MTeCO2** for FY 2008-09.

SCOPE 3 EMISSIONS:

Other emissions attributed to our institution, are deemed "optional" emissions by corporate inventories. This includes emissions from sources that are neither owned nor operated by our institution but are either directly financed (i.e. commercial air travel paid for by the institution) or are otherwise linked to the campus via influence or encouragement (i.e. regular faculty, staff, and student commuting).[3]

Faculty/Staff Commuting

The inventory for faculty and staff commuting is an approximation based on commute distances derived from the home addresses of employees. Estimating faculty and staff commuting habits was a several step process.

Step 1: A list of all the addresses for Colgate's 968 faculty and staff was obtained from **Jill Burdick, Human Resources Assistant**

Step 2: Distances from all of the town centers within 100 miles of Colgate were calculated and multiplied by the number of faculty and staff living in each town. It was assumed that

[2] Clean Air Cool Planet User's Guide
[3] Clean Air Cool Planet User's Guide

those living more than 100 miles from campus were not commuting daily. (The vast majority of cases were within 50 miles of Colgate, and there were very few addresses between 50 and 100 miles.)

Step 3: The total daily miles were summed excluding the 37 individuals whose addresses were more than 100 miles from campus. The average roundtrip commuting distance was found to be **19.3 miles** and so this was multiplied by 37 and then added to the total mileage to account for those addresses that were more than 100 miles from campus.

Step 4: The total miles figure was multiplied by **5 days per week** and then **48 weeks per year**.

Step 5: To account for the faculty who are not present during the summer months the **280 faculty** were multiplied by the **19.3** mile average roundtrip commute for 14 weeks of summer during which the vast majority are probably not commuting every day. The resulting figure was subtracted from the total annual mileage. Finally, to account for the 52 couples who assumingly share rides to Colgate, 52 times the average weekly mileage times the average number of weeks worked for both faculty and staff was subtracted from the total commute mileage.

Based on this methodology, the total annual commuting miles by all faculty and staff was estimated to be: 4,025,510 miles which emitted 1,626 MTeCO2

Student Commuting

Colgate is a residential campus and all but approximately 250 students live in campus housing. The students who do not live in Colgate housing, tend to rent apartments/homes located within a 3-mile radius of campus. Most students live within walking distance of class. More specifically, all first-year and sophomore students live in dorms on campus. Junior and senior students live either in the University Apartments, the Townhouses, Broad Street houses, or off-campus. We believe that most townhouse and apartment residents frequently take the cruiser or walk/ride a bike to campus. The majority of Broad St. and off-campus residents walk or ride a bike. Students do share rides in automobiles, however this seems to be in the minority. Additionally, students are not permitted to park their vehicles "up the hill" on campus between the hours of 8:00am and 3:30pm on weekdays. For all of these reasons, we assumed that greenhouse gas emissions associated with student commuting are de minimus (less than 5 percent of gross emissions), and therefore, not required under the ACUPCC guidelines. As a result, student commuting is not included in the 2008-09 campus carbon footprint.

Directly Financed Outsourced Bus Travel

Directly financed outsourced travel includes 2008-09 total mileage from the Colgate Cruisers as well as the mileage of all outsourced varsity athletics travel. As most class trips and club outings use the "T" vans that are owned by Colgate, they are included within the "University Fleet" section of this report (Scope 1.) Data for this section was provided by **Birnie Bus Co., Hamilton** and also by **Shaun Richard, Assistant Athletic Director.**

Varsity Athletics Travel:

FY 2006-07
Number of trips = 184
Total miles traveled = 92,753

FY 2007-08
Number of trips = 185
Total miles traveled = 94,446

FY 2008-09
Number of trips = 183
Total miles traveled = 91,674
Approximate Gallons of Gas (mileage divided by estimate of 5 MPG) = 18,335
Emissions = 23 MTeCO2*

**The emissions coefficient used by the CA-CP calculator and in this report is .000254 MTeCO2 / mile. As miles were the data provided by the athletics department and the conversion to gallons is based on an estimated MPG value, it was decided that the more accurate method of calculation would use miles rather than gallons. The calculator's emissions coefficient for miles also takes in to account the methane and nitrogen emissions associated with bus travel.*

Table 9. *Cruiser mileage, fuel usage, and MPG for FY 2008-09*

BUS #	MILES	FUEL (gal)	MPG
2800	8,731	1,838	4.8
485	9,870	1,541	6.4
461	9,518	2,093	4.6
486	4,695	994	4.7
453	4,335	764	5.8
TOTAL	37,149	7,230	

Gallons were used as opposed to miles to calculate cruiser mileage. This was done because data on the gallons of fuel used for each bus was provided by **Birnie Bus, Hamilton**. Using the emissions coefficient for gallons of diesel, the total MTeCO2 for Cruiser travel in FY 2008-09 was **73 MTeCO2.**

Business-related Air Travel
Faculty and staff air travel was calculated based on a list of flight purchases provided by **Michelle Atkinson, Accounting Assistant, Accounting and Control.** Contact John Pumilio (Sustainability Coordinator) for the raw data showing the airline and cost for each flight for FY 2008-09. The data includes all flights paid for using Colgate issued JP Morgan Cards (this includes all flights booked through our two travel agents: AAA and BTI). According to this data set, total money spent on faculty and staff air travel was $983,423.23.

While this method of accounting captures the vast majority of Colgate business travel, we realize that there are instances of missed flights. Examples of missed accounting include but are not limited to:

- faculty and staff who use personal credit cards to purchase a flight then were reimbursed;
- faculty and staff who purchased a flight using Expedia, Travelocity, Hotwire, etc. using PayPal or a personal debit card then were reimbursed;

- any purchase made (not using the JP Morgan card) and were then reimbursed out of their program budget.

From the total cost, we calculated mileage using the method recommended by the Association for the Advancement of Sustainability in Higher Education (AASHE.) This method requires taking the average cost per mile for air travel as provided by the Air Transport Association of America (http://www.airlines.org/economics/finance/PaPricesYield.htm), increasing that average by 20 percent to account for taxes, and then dividing the total cost of air travel by the resulting amount. This equation is shown below.

Average cost per mile (taxes included): 16.5 cents per mile = **5,960,140 miles = 4,627 metric tons of greenhouse gas emissions (MTeCO2)**.

Student Air Travel

As a general rule, we included student air travel paid by or through the university as specified in the ACUPCC Implementation Guide. Table 10 summarizes the total miles and emissions for athletic air travel and for student air travel sponsored by COVE for FY 2008-09. Also, see Appendix 3 for athletics air travel.

***Table 10**: Student Air Travel by Group*

GROUP	MILES	EMISSIONS (MT eCO2)
Athletics '08-09	19,461	15
COVE '08-09	5,966	5
TOTAL	**25,427**	**20**

After careful consideration we concluded that student emissions associated with our study abroad programs should not be included in our reported inventory.

The overarching reasons why we did *not* to include study abroad air travel in our emissions inventory include:

- The ACUPCC Implementation Guide specifies that only air travel paid by or through the university is required.
- Data was difficult to obtain. We had to determine which students were studying abroad then get each of their home addresses in order to calculate the distance between their home airport to their final destination.
- Data was only partially available and gross assumptions were necessary to estimate student emissions. We did not know actual flight itineraries.
- We do not "require" students to study abroad to complete their Colgate degree. Therefore, it can be effectively argued that these emissions should not be included in Colgate's carbon inventory.
- Many peer institutions are not including student air travel in their emissions inventory or climate action planning efforts.

Solid Waste

Data on Colgate's landfill waste was provided by **Sharon Driscoll** at the **Madison County Landfill.** Currently, Colgate's landfill waste goes to a landfill that does not capture methane but flares and vents it instead. However, Madison County Landfill has recently built a methane capture and recovery system that will allow for excess methane to be generated in to electricity. Once this generator is connected to the main grid, Colgate's own carbon footprint will be reduced. The data on our landfill waste for the past 4 years is below. Though methane is in fact the greenhouse gas being emitted, most calculators use the standard unit of measurement of MTeCO2 and so in the case of landfill waste, methane emissions are converted into their carbon equivalents.

***Table 11**: Landfill waste by year with MTeCO2 equivalents. 2009 data is not currently complete and so the 2008 data was used for this report.*

YEAR	TONS	EMISSIONS (MT eCO2)
2006	**903**	**979**
2007	**938**	**1,017**
2008	**934**	**1,012**
2009	**812***	**880***

2010 Prediction

Using the emissions coefficient for a landfill that generates electricity with waste methane, it is possible to make a prediction for the eCO2 value for 2010. If we send 934 tons of solid waste to the Madison County Landfill in 2010 with the methane generator connected to the grid, our emissions would be 150 MTeCO2 – reducing our emissions by roughly 85 percent.

Paper Use

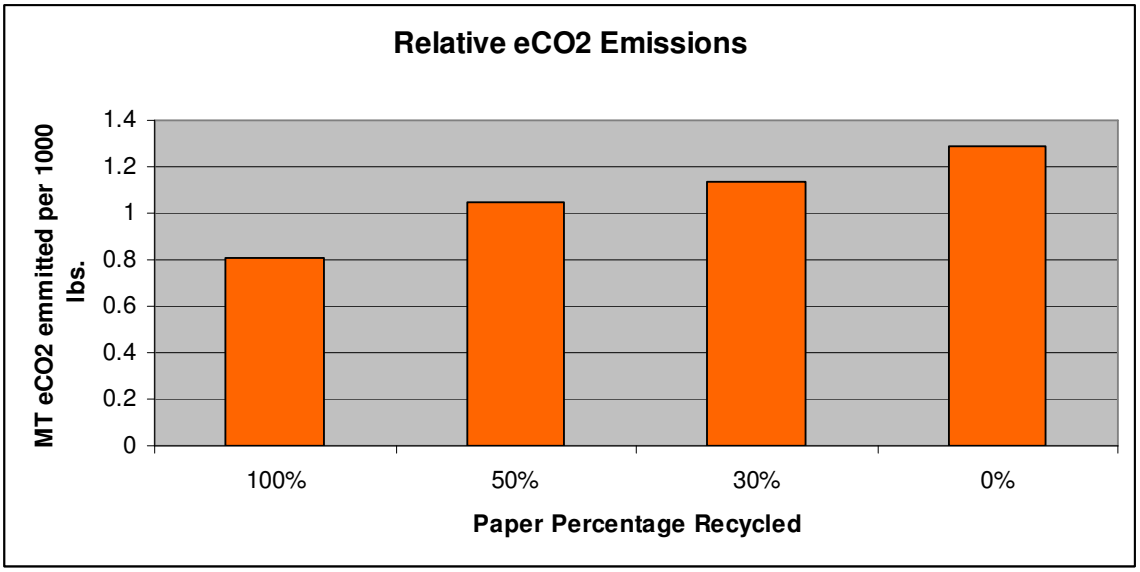
Inventory for Colgate's paper use was provided by **Art Punsoni, Director of Purchasing.** Colgate currently uses a mix of 100 percent, 50 percent, 30 percent and 0 percent recycled paper. Table 12 shows the pounds of each used in 2008 and the corresponding emissions. Complete data for 2009 is not yet available.

***Table 12**: Shows the amount and MTeCO2 for each type of paper purchased in 2008.*

% Recycled	Pounds Purchased	EMISSIONS (MT eCO2)
0%	46,218	60
30%	32,094	37
50%	53	0.06
100%	51,699	42
TOTAL	**130,064**	**139**

Total greenhouse gas emissions for paper = 139 MT eCO2

Figure 1. *Relative emissions for the production of 1000 lbs. of paper for four different recycled material percentages. These are the four types purchased by Colgate in the 2008-09 fiscal year. This graph demonstrates how Colgate's emissions would decrease if we used higher content recycled paper in lieu of non-recycled paper.*



Agriculture Sources

Colgate leases farm land to Ed Carhart at White Eagle Farms (201 acres for growing crops (corn & hay) & Terry Wilcox (188 acres for cattle grazing). Terry Wilcox currently has a herd of 15 cows on property leased from Colgate.

(15 cows) x MTeCO2 factor for cows (3.8285956) = 57.43 MTeCO2

Information on Colgate's leased farmland was obtained from the farmers directly and not through Colgate.

OFFSETS

Forest Preserve

Colgate owns 875.8 acres (354.4 hectares) of protected forest land.[4] The rate of sequestration for temperate forest in the northeastern United States is between 1.5 and 4.5 MT of carbon/hectare per year.[5] If we take the median of that range (3.0 MT of carbon/hectare per year) and multiply it by the number of hectares we get **1,063.2 MT eCO2** sequestered each year. This figure is subtracted from our gross carbon emissions to get our net carbon emissions.

Retail Offsets

Bob Turner, Professor, Environmental Studies and Economics, bought **6 MTeCO2** worth of offsets in 2007-2008 and **9 MTeCO2** in 2008-2009 to offset the travel of the CEWS lecture series guest speakers.

[4] Colgate University Forest Stewardship Plan 2007
[5] IPCC Land Use and Forestry Guidelines: http://www.grida.no/climate/ipcc/land_use/007.htm

OVERVIEW OF CUMULATIVE EMISSIONS: ALL SCOPES

Colgate's gross carbon footprint for all three scopes was calculated to be **17,380 MTeCO2.** This is broken down below into emissions by source and by scope (Table 13).

Table 13. *Colgate's total greenhouse gas emissions by source and scope.*

FISCAL YEAR 2008-09	
SOURCE OF EMISSIONS	**EMISSIONS (MTeCO2)**
SCOPE 1	
Fuel Oil #6	4,368
Fuel Oil #2	1,864
Vehicle Fleet	393
Refrigerant (HCFC-22)	1,247
Fertilizer	46
SCOPE 1 TOTAL	**7,918**
SCOPE 2	
Purchased Electricity	1,885
SCOPE 2 TOTAL	**1,885**
SCOPE 3	
Faculty/Staff Commuting	1,626
Cruisers/Bus Travel	96
Air Travel	4,647
Solid Waste	1,012
Paper Consumption	139
Animal Agriculture (Cows)	57
SCOPE 3 TOTAL	**7,577**
FISCAL YEAR 2008-09 EMISSIONS	**17,380**

Total Gross Carbon Footprint 2008-2009: 17,380 MTeCO2

Total Net Carbon Footprint 2008-2009: 16,308 MTeCO2

As can be seen in Figures 2 and 3, the two greatest contributors to our emissions across all scopes were "Fuel Oil" and "Air Travel." Colgate burns fuel oil as the existing wood boiler does not have enough capacity to provide heat to all buildings connected on the steam line during the winter months. Colgate also burns distillate oil (#2) in certain buildings not connected to the steam line. "APPENDIX 1" lists fuel consumption for Fiscal Year 2008-09.

Figure 2. *Colgate's emissions by source, Fiscal Year 2008-09.*

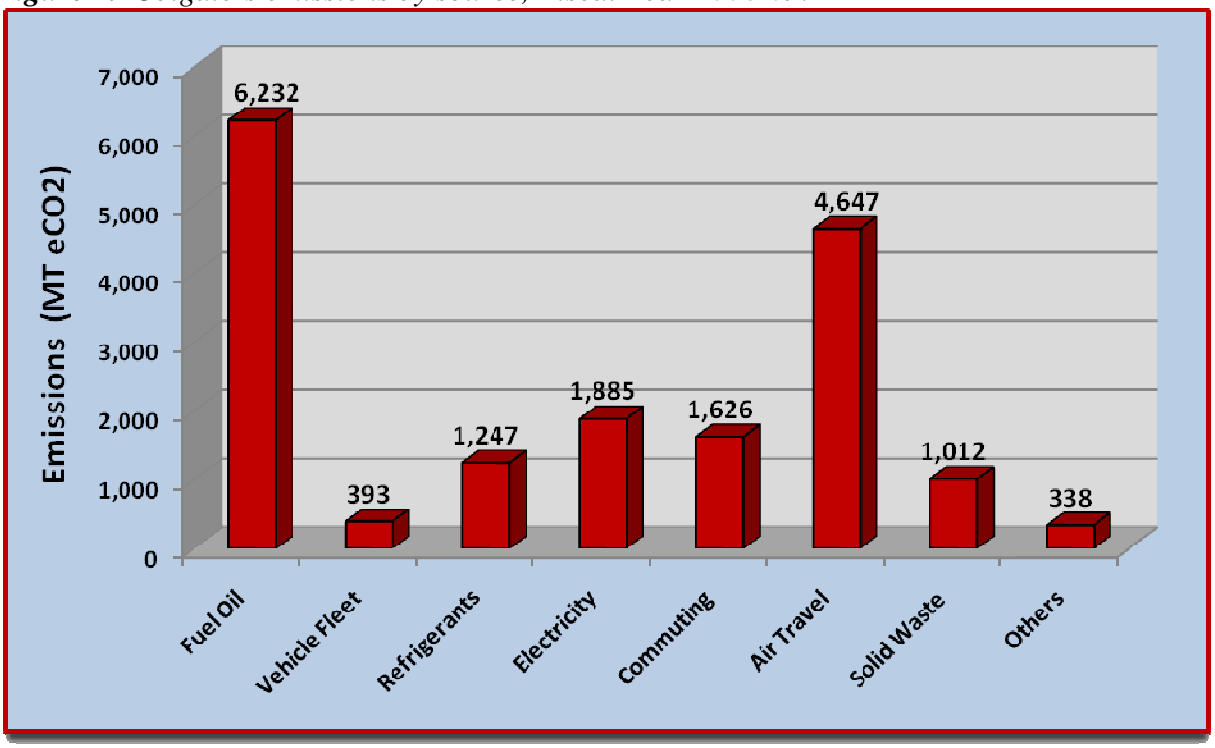
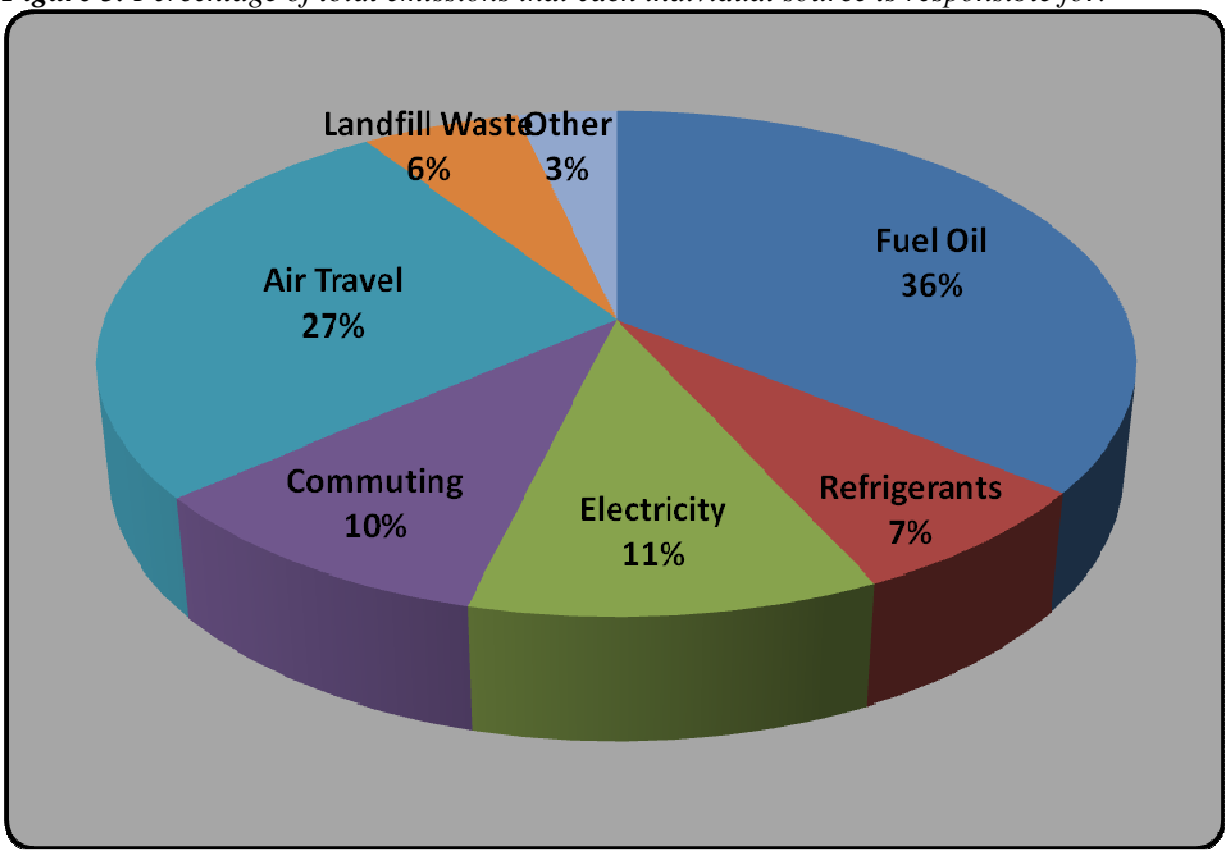
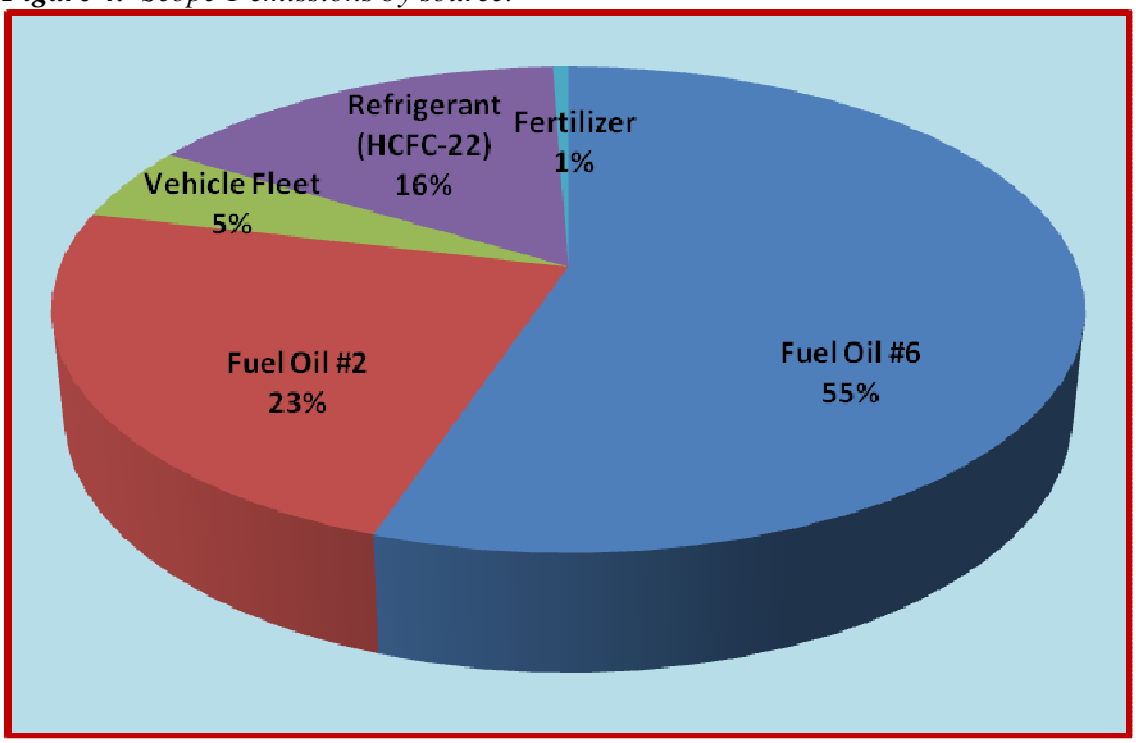


Figure 3. *Percentage of total emissions that each individual source is responsible for.*



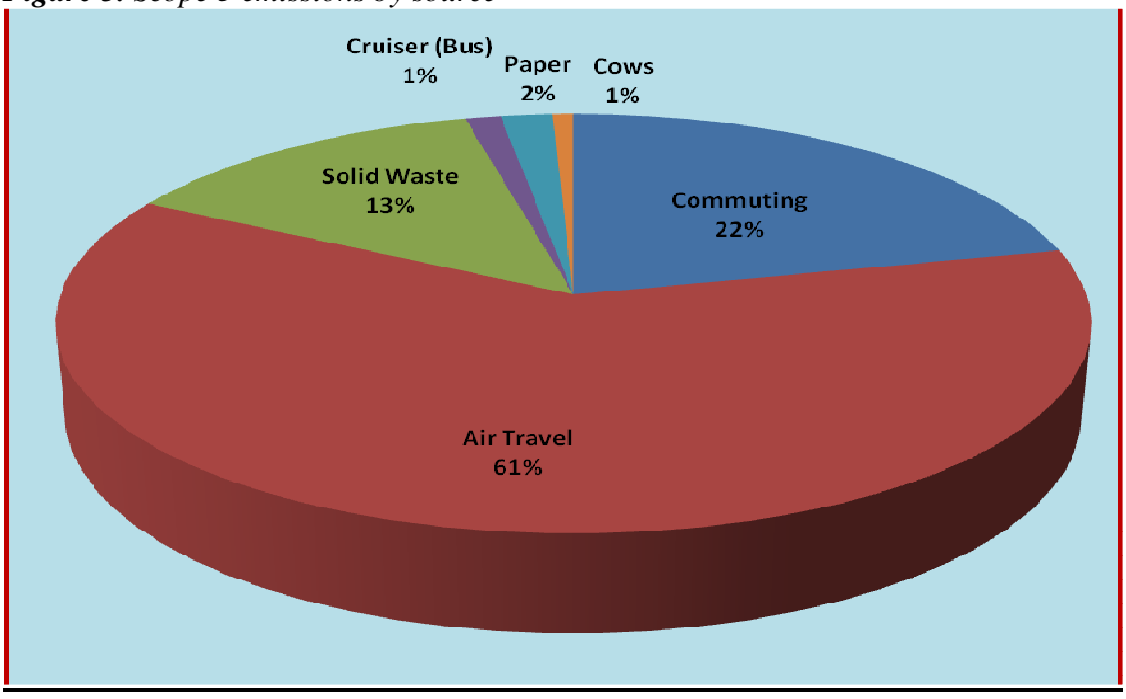
When we separate Colgate's emissions by source, we can better assess which Scope 1 (direct emissions) are the most significant and also which Scope 3 (indirect emissions) are significant. See Figures 4 and 5.

Figure 4. *Scope 1 emissions by source.*



Air travel is responsible for 61 percent of Colgate's total Scope 3 emissions. Faculty and Staff commuting also contribute a significant proportion at 22 percent and solid waste contributes 13 percent (Figure 5).

Figure 5. *Scope 3 emissions by source*



The ACUPCC recommends a publication of emissions in to two categories: "per full-time enrollment" and "per 1000 square feet." As college campuses vary significantly in terms of the size of their student body and overall physical size, this adjustment allows for more accurate comparison between colleges (Table 14).

Table 14. *Breakdown of emissions by scope, full-time enrollment, and 1000 square feet.*

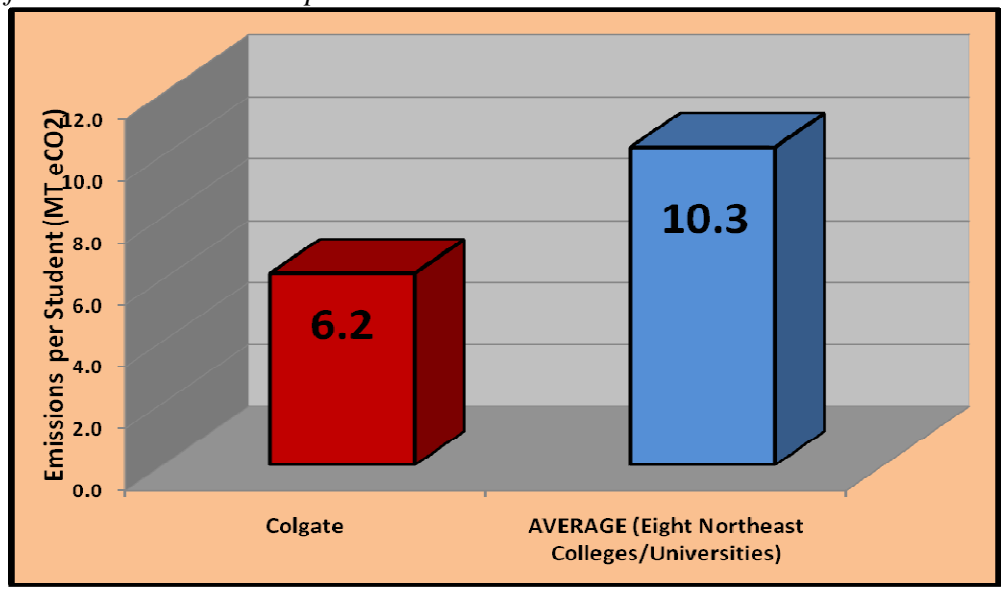
EMISSIONS	TOTAL	PER FULL-TIME ENROLLMENT	PER 1000 SQUARE FT
Scope 1	7,918	2.84	3.40
Scope 2	1,885	0.68	0.81
Scope 3	7,577	2.72	3.25
Gross	17,380	6.24	7.46
Net	16,308	5.86	7.00

Colgate's "Net Emissions" include the offsets of forest preservation and the purchased retail offsets. Our per-enrollment footprint is **5.79 MTeCO2** for our gross emissions and **5.40 MTeCO2** when our offsets are included in the equation. These figures are quite low in comparison to other similar sized and located schools (Figure 6).

Comparisons to Peer Institutions

Colgate's gross MTeCO2 per enrollment is lower than many other similar-sized colleges and universities in the northeast (Figure 6). This is due, in part, to our wood-fired boiler that supplies the majority of heat to campus and our electricity consumption that comes mainly from hydroelectric sources.

Figure 6. *Colgate's gross MTeCO2 per student in comparison to the average of eight other similar-sized northeast colleges and universities. Note: the data for peer institutions was taken from the most recent reports available. These were all either 2007 or 2008 reports.*



Limitations of this Report

While this report aims to provide the most comprehensive assessment of Colgate's greenhouse gas inventory possible, it does have some limitations. It is important when viewing this report that the reader takes note of the prose that accompanies the numbers. In particular, descriptions of graphs and tables as well as any text marked with an asterisk (*) should be given careful attention. In some cases, complete data was not available and so estimations were made or data from previous years was used.

Comparisons with other colleges and universities should also, to at least some extent, be taken with a grain of salt. Unfortunately, a perfect apples to apples comparison does not exist as colleges and universities themselves vary significantly from one another in their size, wealth, and needs. For this reason, some aspects of the carbon calculator were either not applicable to Colgate or were not formulated in a way that was compatible with Colgate's own processes. In these cases separate calculations were made. Different schools take unique approaches to tackling these problems of compatibility, and therefore, comparisons to other institutions are only approximate and should not be taken as absolutely accurate.

CONCLUSION

This Comprehensive Carbon Inventory for Colgate University provides insight into how and to what extent we as an institution are producing greenhouse gasses. It is our hope that this report will be used to identify sources of high emissions and then find solutions to reduce them accordingly. While Colgate seems to measure up quite favorably with peer institutions in terms of our overall footprint, this is largely due to our fortunate location where much of our electricity comes from hydroelectric, low emission sources. If we look more specifically at our Scope 1 and Scope 3 emissions there is still much room for improvement.

While this report can and should be used to identify chief emissions sources, it is important to remember its limitations. Obviously there are sources of emissions that are connected with the University that were not accounted for specifically. We followed the protocol in accordance with the guidelines of the ACUPCC, only the emissions sources that are universally agreed to be the biggest and most important were calculated. The figure of 17,380 MTeCO2 is accurate in the sense that it accounts for a standard set of emissions calculated by a standard protocol. In this sense it forms a good basis for comparison. Overall, this inventory establishes a solid baseline from which future inventories can model and from which our institutional climate action plan can be built.

APPENDIX 1. Fuel consumption, Fiscal Year 2008-09

Fiscal Year 2008-09
Fuel Consumption

	Wood (tons)	No. 6 Fuel Oil (gal)	No. 2 Fuel Oil (gal)
Jun-2008	956	14,126	0
Jul-2008	1,238	705	0
Aug-2008	1,477	2,000	0
Sep-2008	1,480	4,242	0
Oct-2008	2,031	19,582	16,066
Nov-2008	2,086	17,600	20,578
Dec-2008	2,676	57,254	29,769
Jan-2009	2,820	93,876	37,616
Feb-2009	2,316	57,421	32,397
Mar-2009	2,304	38,484	24,266
Apr-2009	1,795	23,421	24,811
May-2009	1,069	42,746	0
Total	**22,249**	**371,457**	**185,503**

APPENDIX 2: University Vehicle Fleet

YEAR	VEHICLE	MILEAGE	ANNUAL MILEAGE	MPG
2004	Chevy Van	7371	1228.5	17.5
2004	Chevy 4X4 w/Rubber Plow	13140	2190	17.5
2007	Volvo S60 AWD			
2007	Chevy Van	5496	1832	17.5
2007	Chevy Van	4355	1451.67	17.5
2009	Ford Van	1270	1270	17.5
2007	Chevy Van	4936	1645.33	17.5
2007	Chevy Van	8595	2865	17.5
2001	Dodge Pick Up	25760	2862.22	16.5
2009	Ford Van	1346	1346	17.5
2007	Chevy Van	7667	2555.67	17.5
2007	Chevy Van	10176	3392	17.5
2005	Ford Freestar	30912	6182.4	17
2006	Ford Freestar	11668	2917	17
2003	Chevy Astro	38139	5448.43	18.5
2000	Dodge Van	16830	1683	17.5
2009	Ford F150 Pick Up	243	243	17.5
2001	Dodge Van	19717	2190.78	17.5
2009	Ford Van	1309	1309	17.5
2009	Ford Van	1337	1337	17.5
2004	Chevy Van	10944	1824	17.5
2004	Chevy Van	22598	3766.33	17.5
1997	Chevy Arial	5586	465.5	17.5
2008	Ford Van	1461	730.5	17.5
2004	Chevy Pick Up w/Plow	42782	7130.33	16
2006	Ford F350 4x4 w/Plow	11024	2756	13
2006	Ford F550 Dump w/Plow	11407	2851.75	13
2007	Ford F350	5078	1692.67	13
2006	Chevy Pickup w/Plow	21711	5427.75	13
2003	Freightliner	95799	13685.6	7
2004	Freightliner	45075	7512.5	7
2004	Ford Stake/Dump Truck w/Plow	14575	2429.17	7
2005	Chevy Pick Up w/Plow	29724	5944.8	14
1995	GMC Sierra w/Tailgate Lift	22086	1472.4	15
2004	Ford Stake w/Plow	23212	3868.67	15
2009	Chevy Pickup Truck	2588	2588	17
2007	Toyota Highlander	65738	21912.7	20
2001	Dodge Van			17.5
2000	Dodge Van	19990	1999	17.5
2004	Chev Astro	9902	1650.33	17.5
2009	Ford Van	574	574	17.5
2003	Chevy Astro	8622	1231.71	17.5
2006	Chevy Van	15067	3766.75	17.5
2008	Chevy Uplander	2873	1436.5	17.5
2005	Dodge Caravan	14080	2816	19
2005	Dodge Caravan			19
2009	Ford F150 Pick Up	252	252	17.5
2007	Chevy Van	4933	1644.33	17.5
2009	Ford Van	1537	1537	17.5
2004	Chevy Van	18650	3108.33	17.5
2006	Chevy Van	9219	2304.75	17.5
2007	Chevy Van	7260	2420	17.5
2006	Dodge Caravan	10131	2532.75	20
2009	Chevy Van	142	142	17.5
2009	Chevy Van	213	213	17.5
2009	Ford F150 Pick Up	249	249	20
2004	Dodge Van	10052	1675.33	17.5
2004	Chevy Van	8896	1482.67	17.5
2004	Chevy Van	5938	989.667	17.5
2009	Chevy Van	462	462	17.5
2006	Dodge Caravan	9345	2336.25	19
2008	Chevy Uplander	2214	1107	17.5
2009	Chevy Silverado		0	17.5
2002	Chevy Impala	95996	11999.5	20
2009	Ford Escape	8473	8473	24
2003	Dodge Caravan	88480	12640	19
2009	Ford Fusion	8042	8042	25
2009	Ford Fusion	7189	7189	25

APPENDIX 3: 2008-09 Varsity Athletics Air Travel

GROUP AND DESTINATION	DISTANCE FROM SYRACUSE (MILES)
Women's Soccer to Portland OR, Sept. 08	2,282
Volleyball to Durham NC, Sept. 08	508
Men's Soccer to Durham NC, Oct. 08	508
Women's Basketball to Clinton SC, Nov. 08	667
Men's Hockey to Denver CO, Nov. 08	1,508
Men's Basketball to Portland ME, Dec 08	300
Men's Basketball to Oakland CA, Dec. 08	2,428
Men's Hockey to Ft. Myers FL, Dec. 08	1,176
Men's Basketball to Dallas TX, Jan. 09	1,327
Swim team to San Juan, PR, Jan. 09	1,792
Men's Lacrosse to Durham NC, March 09	508
Tennis to Ft. Myers FL, March 09	1,176
Women's Lacrosse to CA and Oregon, March 09	2,282
Softball to F. Meyers FL, March 09	1,176
Women's Track to Orlando FL, March 09	1,042
Golf team to Atlanta GA, March 09	781
TOTAL MILES	**19,461**