2011

COLGATE UNIVERSITY'S

2011 GREENHOUSE GAS INVENTORY

A step-by-step guide to completing a greenhouse gas inventory at Colgate University

John Pumilio,
Sustainability Coordinator

Theresa (Evans) Mandery,
Sustainability Office & Environmental Studies
Program Assistant

Colgate University
13 Oak Drive
Hamilton, NY 13346

TABLE OF CONTENTS

2011 GREENHOUSE GAS INVENTORY

SECTION **PAGE**

LIST OF TABLES

2011 GREENHOUSE GAS INVENTORY

LIST OF FIGURES

2011 GREENHOUSE GAS INVENTORY

LIST OF ACRONYMS/ABBREVIATIONS

SUSTAINABILITY AND CLIMATE ACTION PLAN

ACRONYM	MEANING
AASHE	Association for the Advancement of Sustainability in Higher Education
ACUPCC	American College and University Presidents' Climate Commitment
B&G	Colgate's Buildings and Grounds
BoHP	Boiler Horsepower
CA-CP	Clean Air – Cool Planet
CAP	Climate Action Plan
CH4	Methane
CO2	Carbon Dioxide
COVE	Colgate's Center for Outreach, Volunteerism, and Education
MTeCO2	Metric Tons of Carbon Dioxide Equivalents
U.S. EIA	United States Department of Energy: Energy Information Administration
ENST	Colgate's Environmental Studies Program
U.S. EPA	United States Environmental Protection Agency
F-SEM	Colgate's First-year Seminar
FTE	Full-time Equivalent Student
FY	Fiscal Year (June 1 to May 31)
GHG	Greenhouse Gases
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
HCFC	Hydrochlorofluorocarbon
IRS	Internal Revenue Service
Kg	Kilogram
kWh	Kilowatt-hour
Lbs	Pounds
N2O	Nitrous Oxide
NSF	National Science Foundation
PFC	Perfluorocarbons
PPA	Power Purchase Agreement
SF6	Sulfur Hexafluoride
WBCSD	World Business Council on Sustainable Development
WRI	World Resources Institute

ACKNOWLEDGEMENTS
2011 GREENHOUSE GAS INVENTORY

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

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

Brian Belden, Physical Plant Foreperson

Birnie Bus Co., Hamilton

Jill Burdick, Human Resources Associate

John Collins, Director of Budget

Amy Davidson, Facilities Department Office Manager

Rachel DiDomizio, Associate Director of the COVE

Paul Fick, Associate Vice President for Facilities

Lori Godshalk, Athletics Department Administrative Assistant

Emmett House, Supervisor of Athletics Grounds

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

Bob Keats, Director of Document and Mail Services

Sue Marks, Campus Safety Administrative Assistant

Jon McConville, Golf Course Superintendant

Carrie McFall, Facilities Administrative Assistant

Penny Mintel, Administrative Coordinator, Dean of Faculty

Tom O'Neill, Associate VP/Controller of the Accounting Office

Tracy Ogren, Accounting Assistant

Beth Parks, Associate Professor and Chair of Physics and Astronomy

Dan Partigianoni, Associate Controller and Director of Financial Reporting

Art Punsoni, Director of Purchasing

Trish St. Leger, Associate Provost

Brendt Simpson, Director of Institutional Planning and Research

EXECUTIVE SUMMARY

SUSTAINABILITY AND CLIMATE ACTION PLAN

This report provides the methods and results of Colgate University's 2011 Greenhouse Gas Emissions Inventory. The Inventory was completed in compliance with one of the key requirements of the American College and University President's Climate Commitment (ACUPCC)—signed by former President Rebecca Chopp in January 2009 and fully supported by current President Jeffrey Herbst. The ACUPCC mandates Colgate to complete a greenhouse gas emissions inventory within one year of signing the commitment and update the inventory every other year thereafter. 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 v6.7 also recommended in the ACUPCC guidelines. This is our third consecutive year completing Colgate's greenhouse gas inventory. Colgate's greenhouse gas emissions were 17,353, 14,505 and 16,194 metric tons of carbon dioxide equivalent (MTeCO2) for the years 2009, 2010, and 2011, respectively. Colgate's inventory of emissions includes all Scope 1 emissions (on-campus stationary combustion of fossil fuels for space heating and domestic hot water, 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 (Colgate Cruiser), air travel (paid by or through the university), landfill waste, and paper use. Colgate's 835 acres of forestlands sequesters 1,239 tons of carbon annually. As a result, the university's 2011 net footprint, when adjusted for on-campus forest sequestration, is 14,955 MTeCO2. Colgate's 2011 gross emissions were 5.63 MTeCO2 per full-time student and 7.02 MTeCO2 per 1,000 square-feet of building space. This is a reduction in emissions of 0.60 MTeCO2 per student and 0.42 MTeCO2 per 1,000 square-feet when compared to our 2009 baseline inventory. Colgate's highest sources of emissions were found to be on-campus stationary combustion of fossil fuels (e.g., fuel oil #6, fuel oil #2, kerosene, and propane) at 35 percent of our total emissions, business-related air travel at 32 percent, electricity at 11 percent, and faculty and staff commuting at 8 percent.

Compared to Colgate's 2009 baseline inventory, the university decreased its emissions by 1,159 MTeCO2 (from 17,353 in 2009 to 16,194 MTeCO2 in 2011), or by 9 percent. Colgate was able to accomplish this despite adding an additional 92 students and a new 15,000 square-foot fitness center. Colgate University accomplished these reductions by implementing effective behavior change programs coupled with various energy conservation and efficiency projects.

THE ACUPCC AND COLGATE'S COMMITMENT TO CLIMATE NEUTRALITY

The American College and University Presidents' Climate Commitment (ACUPCC)[1] was officially announced in October 2006 during the AASHE[2] conference at Arizona State University. Signatories make a commitment to "*achieve climate neutrality as soon as possible*" by eliminating or offsetting 100 percent of the institution's greenhouse gas emissions. One mandatory component of the ACUPCC is to complete a greenhouse gas emissions inventory as specified in the pledge[3] under step 1, part 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."*

By March 31, 2007, 152 presidents and chancellors became charter signatories of the ACUPCC. Today, there are over 670 signatory institutions from all 50 states representing over 6 million students.

In 2009, Colgate University signed the ACUPCC and completed our first comprehensive greenhouse gas inventory[4]. Even though the ACUPCC requires an update to the inventory every other year, for tracking and consistency purposes, we felt it was important to complete the inventory on an annual basis. This is our third consecutive year completing Colgate's greenhouse gas inventory. Colgate's greenhouse gas emissions were 17,353, 14,505 and 16,194 metric tons of carbon dioxide equivalent (MTeCO2) for the years 2009, 2010, and 2011, respectively. Throughout this report, we provide the results of Colgate's 2009 and 2010 inventories; however, our focus here is on the 2011 inventory. More specifically, the goals of this report are to: 1) meet a key requirement of the ACUPCC by updating our 2009 baseline inventory, 2) highlight the methodology and results of Colgate's 2011 Greenhouse Gas Inventory, and 3) provide step-by-step instructions explaining how to collect the inventory data and make the calculations so this report can serve as a guide for future inventories.

Striving for and achieving climate neutrality is a significant commitment that further demonstrates Colgate's leadership in advancing the practice and teaching of sustainability. Colgate has already made significant progress towards climate neutrality as we have reduced our greenhouse gas footprint by 1,159 MTeCO2 (or 9 percent) since 2009. This reduction is mainly the result of conservation and efficiency projects through a:

- 14 percent decrease in fuel oil consumption (nearly 74,000 gallons less in 2011 compared to 2009)
- 2 percent decrease in electricity consumption (688,000 kWh less in 2011 compared to 2009)
- 33 percent decrease in paper use (43,000 lbs less in 2011 compared to 2009)
- 3 percent decrease in landfill waste (19 tons less in 2011 compared to 2009)

Conservation and efficiency is saving the university over $300,000 annually in operating costs while enhancing our liberal arts education as student participation is integral to these results through academic research,

[1] Website: http://www.presidentsclimatecommitment.org/
[2] Association for the Advancement of Sustainability in Higher Education website: http://www.aashe.org/
[3] ACUPCC Implementation Guide accessed online at: http://www2.presidentsclimatecommitment.org/pdf/ACUPCC_IG_Final.pdf
[4] Colgate University's 2009 Baseline Greenhouse Gas Inventory can be accessed online at: http://www.colgate.edu/portaldata//imagegallerywww/4352/ImageGallery/Greenhouse%20Gas%20Inventory%20-%20Final%20Report%20-%20Published%20Report.pdf.

governance, and co-curricular student group activities.

Additionally, in April of 2010, Colgate's faculty officially approved the goals of a Colgate education. Among them, they specified that a Colgate education should enable students to "*recognize their individual and collective responsibilities for the stewardship of the earth's resources and the natural environment*" and graduate as "*engaged citizens who strive for a just society*." To meet these ends, Colgate offers over 40 courses per semester related to or focused on sustainability and climate change.

On September 15, 2011, the Sustainability Office published Colgate's Sustainability and Climate Action Plan[5]. The Plan details a set of specific, measurable, and tangible goals to achieve climate neutrality by Colgate's bicentennial celebration in 2019—an ambitious target date. Colgate's updated greenhouse gas inventories (including this one) will track our progress towards that goal.

As a result of our recent climate action planning efforts, Colgate was honored with ACUPCC's 2011 Climate Leadership Award[6]. With our wood-fired boiler, low-carbon electricity grid, sustainability-focused academic programming, and a campus culture that promotes sustainability, Colgate is well-positioned to continue as a leader in sustainability in the 21st century.

[5] Accessed online at: https://sites.google.com/a/colgate.edu/2011-2015-sustainability-and-climate-action-plan/
[6] http://secondnaturebos.wordpress.com/2011/06/23/colgate-university-recognized-for-climate-leadership/

According to the United States Environmental Protection Agency (U.S. EPA), a greenhouse gas inventory is an accounting of greenhouse gases (GHGs) emitted to or removed from the atmosphere over a period of time. Colgate's comprehensive greenhouse gas inventory is an essential step of continuing to track our emissions over time. Understanding the basic concepts and calculations of the inventory is not only important for the individuals carrying out the methodology but is also important for anyone interested in what the inventory is telling us and how the results were derived.

Colgate's Greenhouse Gas Inventory quantifies our institution's contribution to global climate change by revealing our net greenhouse gas emissions (total emissions minus the sum of our offsets). Offsets can be any process or activity that removes greenhouse gases from the atmosphere (e.g., methane capture and recovery, forestry-based carbon sequestration, composting, and others) or any strategy that increases the amount of energy produced from clean, renewable sources (e.g., investing in wind energy or solar photovoltaic arrays or other renewable energy technologies). Because Colgate is committed to climate neutrality, the goal is to balance our greenhouse gas budget at zero where total emissions equal total offsets. Once armed with a greenhouse gas budget, the Colgate community can make informed decisions on how to reduce our emissions and increase our offsets. This was the purpose of our Sustainability and Climate Action Plan published in September 2011.

INVENTORY BOUNDARIES

Colgate, like other ACUPCC signatory institutions, follows the international protocol established by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI)[7] and The Climate Registry's General Reporting Protocol[8]. The *ACUPCC Implementation Guide* outlines these protocols as they relate to higher education institutions. Complying with these protocols, we have established the following boundaries when conducting Colgate University's Greenhouse Gas Inventory.

Fiscal Year

Colgate's Greenhouse Gas Inventory tracks emissions over the fiscal year (as opposed to calendar year or academic year). Traditionally, Colgate's fiscal year started on June 1 and ended on May 31 of each year. Therefore, the data in the 2011 inventory represents Colgate's activities from June 1, 2010 through May 31, 2011. However, it is important to note that in 2012 Colgate's fiscal year will officially change from July 1 through June 30 of each year.

Throughout this report, whenever a year is mentioned (e.g., 2011) we are referring to the fiscal year (June 1, 2010 through May 31, 2011) unless otherwise noted. Also, "fiscal year" is sometimes abbreviated to "FY" throughout this report.

[7] See the *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* for additional details. Website: www.**ghgprotocol**.org/files/**ghg-protocol**-revised.pdf

[8] Website: http://www.theclimateregistry.org/resources/protocols/general-reporting-protocol/

Scope of Emissions

Sources of greenhouse gas emissions are organized into three categories called "scopes" as established by the World Resources Institute and followed by the Clean Air-Cool Planet (CA-CP) Campus Carbon Calculator[9]. The three-scope format ensures that there is consistency in measurement between institutions. 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 has complete control over what vehicles we decide to purchase and our driving behavior. On the other hand, faculty and staff commuting to and from campus are considered "Scope 3" because Colgate is not responsible for the decisions employees make in purchasing neither their private vehicles nor in their commuting behaviors. The three scopes of greenhouse gas emissions recorded in Colgate's Inventory are as follows:

- Scope 1 Emissions. Scope 1 refers to direct GHG emissions occurring from sources that are owned or controlled by the institution. At Colgate, this includes on-campus stationary combustion of fossil fuels (such as fuel oil #6, fuel oil #2, kerosene and propane), vehicle fleet emissions, fugitive refrigerant chemicals, and emissions associated with grounds maintenance.
- Scope 2 Emissions. Scope 2 refers to indirect emissions generated in the production of electricity consumed by the institution. To calculate these emissions, we have to determine how our electricity is produced (e.g., hydroelectric, coal, wind, etc.) and calculate the rate of greenhouse gas emissions associated with each source.
- Scope 3 Emissions. Scope 3 refers to all other indirect emissions – those that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution. Colgate's Scope 3 emissions include faculty and staff commuting, bus commuting (Colgate Cruisers), air travel (paid by or through the university), paper use, and solid waste.

De Minimus Emissions

Colgate is a residential campus with only 250 students (9 percent of population) renting apartments or houses that are not affiliated with the university. The students who do not live in Colgate housing tend to rent apartments or homes located within a three-mile radius of campus. The vast majority of students live within walking distance of class. More specifically, all first-year and sophomore students live in residence halls on campus. Junior and senior students live either in the University Apartments, the Townhouses, Broad Street houses, or off campus and share rides in automobiles. Emissions associated with this activity are minimal since the distances to campus are so short and students frequently take the Cruiser (free shuttle bus), walk, or ride a bike as an alternative. Additionally, students are not permitted to park their vehicles "up the hill" on campus between the hours of 8:00 a.m. and 3:30 p.m. 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 for reporting under the ACUPCC guidelines. As a result, student commuting is not included in Colgate's Greenhouse Gas Inventory.

Operational Boundaries

In compliance with international and ACUPCC guidelines, Colgate University tracks each of the six greenhouse gases covered under the Kyoto Protocol: carbon dioxide (CO2), methane (CH4), nitrous oxide (N20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6). Colgate is also required to account for and report all Scope 1 and Scope 2 emissions. In addition, Colgate is required to report Scope 3 emissions from air travel (paid by or through the university) and employee commuting to and from campus.

[9] Accessed online at: http://www.cleanair-coolplanet.org/toolkit/inv-calculator.php.

Organizational Boundaries

In order to calculate Colgate's greenhouse gas emissions, it is necessary to determine the organizational boundaries. Following the Greenhouse Gas Protocol, Colgate defined its organizational boundary by using the operational control approach. As a result, emissions associated with auxiliary services such as the leased buildings incorporated under the for-profit Hamilton Initiative, LLC (e.g., The Barge, the Colgate Bookstore, the Colgate Inn) are not accounted for in Colgate's greenhouse gas inventory because the utilities are not directly managed or serviced by Colgate employees.

INVENTORY CALCULATIONS

Global Warming Potentials

Global warming potentials (GWPs) are measures of each greenhouse gas's influence to warm the Earth's atmosphere (called radiative forcing). The greater the GWP, the more potent the greenhouse gas (Table 1). Carbon dioxide is used as the standard for which the other greenhouse gases are compared (hence the term carbon dioxide equivalent), and therefore, has a global warming potential of one. Methane has a global warming potential of 25 and nitrous oxide is more powerful yet with a global warming potential of 298. Because methane has a global warming potential of 25, it means that one kilogram of methane has a radiative forcing that is 25 times greater than one kilogram of carbon dioxide over a 100 year period.

Table 1. *Global Warming Potentials for Colgate's 2011 Greenhouse Gas Inventory.*

GREENHOUSE GAS	100-YEAR GWP
CO_2	1
CH_4	25
N_2O	298
HFC-134a	1,430
HCFC-22	1,700

Metric Tons of Carbon Dioxide Equivalents (MTeCO2)

Colgate's greenhouse gas emissions are measured in the internationally recognized units of metric tons of carbon dioxide equivalents (represented as MTeCO2). International protocol designates carbon dioxide as the standard by which other gasses are measured for two specific reasons: 1) in order to provide a standard unit of measurement across the board and 2) carbon dioxide is the most abundant anthropogenic greenhouse gas.

Emission Factors

Emission factors are the key to calculating Colgate's greenhouse gas inventory. They measure the average rate of emission of each greenhouse gas from a particular source converted to carbon dioxide equivalents (MTeCO2). Certain activities—whether it is consuming oil for space heating or using gasoline for transportation—release different greenhouse gases into the atmosphere at different rates. Fuel oil #6, for example, releases three greenhouse gases into the atmosphere: carbon dioxide, methane, and nitrous oxide. The rate of emission for each of these greenhouse gases is 11.7 kg of CO2, 0.00158 kg of CH4, and 0.000095 kg of N2O for every gallon of fuel oil #6 consumed. The emission factor for fuel oil #6 is 0.01176 MTeCO2/gallon determined by multiplying the global warming potential for each greenhouse gas by its rate of emission and adding each together (Figure 1).

Figure 1. *Determining the emission factor for each source of greenhouse gas emissions using fuel oil #6 as an example.*

Emission Factor	=	**Greenhouse Gas #1** (Global Warming Potential) X (Rate of Emissions)	+	**Greenhouse Gas #2** (Global Warming Potential) X (Rate of Emissions)	+	**Greenhouse Gas #3** (Global Warming Potential) X (Rate of Emissions)
FUEL OIL #6	=	**Carbon Dioxide (CO_2)** 1 x 11.7 kg/gallon	+	**Methane (CH_4)** 25 x 0.00158 kg/gallon	+	**Nitrous Oxide (N_2O)** 298 x 0.000095 kg/gallon
FUEL OIL #6	=	**Carbon Dioxide (CO_2)** 11.7 kg/gallon	+	**Methane (CH_4)** 0.0395 kg/gallon	+	**Nitrous Oxide (N_2O)** 0.02831 kg/gallon
FUEL OIL #6	=	**11.76 kg or 0.01176 MTeCO2/gallon**				

Emission factors for Colgate University's greenhouse gas emitting activities were taken directly from the Clean Air-Cool Planet Campus Carbon Calculator (Table 2).

Table 2. *Emission factors used to quantify Colgate's 2011 greenhouse gas emissions.*[10]

COLGATE ACTIVITY	EMISSION FACTOR
SCOPE 1	
Fuel Oil #6	0.011757907 MTeCO2 / Gallon
Fuel Oil #2	0.01004635 MTeCO2 / Gallon
Kerosene	0.01004635 MTeCO2 / Gallon
Propane	0.005440764 MTeCO2 / Gallon
Gasoline Vehicles	0.008928806 MTeCO2 / Gallon
Diesel Vehicles	0.010077767 MTeCO2 / Gallon
Refrigerent (HFC-134a)	0.589670081 MTeCO2 / lb
Refrigerent (HCFC-22)	0.771107029 MTeCO2 / lb
Fertilizer (Organic)	0.00414123 MTeCO2 / lb Nitrogen
SCOPE 2	
Electricity	0.0000596931 MTeCO2 / kWh
SCOPE 3	
Faculty/Staff Commuting	0.000386528 MTeCO2 / Mile
Faculty/Staff Commuting	0.008928806 MTeCO2 / Gallon
Colgate Cruisers	0.00024779 MTeCO2 / Mile
Colgate Cruisers	0.010077767 MTeCO2 / Gallon
Outsourced Bus Travel	0.00024779 MTeCO2 / Mile
Outsourced Bus Travel	0.010077767 MTeCO2 / Gallon
Air Travel	0.000776369 MTeCO2 / Mile
Landfill Waste (with CH4 capture and recovery)	0.174603175 MTeCO2 / Short Ton
Non-Recycled Paper	0.0012905 MTeCO2 / lb
30% Recycled Paper	0.001170973 MTeCO2 / lb
50% Recycled Paper	0.001051445 MTeCO2 / lb
100% Recycled Paper	0.00081239 MTeCO2 / lb

[10] 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.

ANNUAL REPORTING

Data collection is the most time consuming part of Colgate's Greenhouse Gas Inventory. As mentioned earlier, Colgate's fiscal year will officially change from July 1 through June 30 beginning in 2012. Going forward, we recommend that the data collection process commences in mid-October of each year (giving employees the necessary time to finish their end of the fiscal year reporting and get settled into the new academic year).

The annual data collection process will become routine, and therefore, much easier if we are consistent in the timing and type of data we request when reaching out to individuals at Colgate. Over the past couple of years, we have made a considerable effort to explain to the various departments and personnel what the purpose of the inventory is, why we are doing it, and informing them that this data will be requested again on an annual basis. We anticipate that this will help speed the data collection process for future inventories. Nevertheless, because of busy schedules and data that are not easily available, Colgate staff members will need time to meet your request. Allow a few weeks for employees to get you the data you are requesting and anticipate that you may have to make multiple requests for the same data.

Once the appropriate data is collected, it should be entered into the "***Colgate Carbon Inventory Workbook***" created by Sustainability Office intern, Andrew Pettit '11. The Workbook contains data entry fields and performs most of the necessary calculations through built-in formulas. The Workbook can be obtained by contacting Colgate's Sustainability Coordinator (John Pumilio).

Overall, we recommend that Colgate's annual greenhouse gas inventory is completed by the target date of **December 15** of each year. This allows for enough time to circulate the report (internally) before publishing online to the ACUPCC Reporting System[11] by our bi-annual deadline of January 15.

INSTITUTIONAL DATA

Tracking institutional data is useful because it establishes a frame of historical reference and facilitates the comparison of Colgate's level of emissions in relation to other colleges and universities. Furthermore, significant changes in budget allocations, population or square-footage of the built environment can have a great influence over the university's activities and energy consumption, and therefore, greenhouse gas emissions. Table 3 provides an overview of Colgate’s institutional data for Fiscal Years 2009 through 2011.

[11] ACUPCC Online Reporting System can be accessed online at http://rs.acupcc.org/.

Table 3. *Colgate's institutional data for Fiscal Years 2009 through 2011.*

Fiscal Year	Budget (dollars)			Population			Physical Size (square-feet)
	Operating Budget	Research Budget	Energy Budget	Full-Time Students	Faculty	Staff	Total Building Space
2009	$ 147,320,539	$ 614,403	$ 4,712,740	2,784	280	688	2,331,239
2010	$ 149,220,020	$ 600,220	$ 3,950,587	2,770	278	678	2,331,239
2011	$ 148,433,361	$ 592,076	$ 4,310,783	2,876	280	659	2,305,648

Budget Information

Data Requested: The operating, research and energy budgets for FY 2011.
Key Contact(s): Associate Vice President for Budget and Financial Aid (John Collins).
Data Received: The operating, research and energy[12] budgets for FY 2011 (Table 2).

Population Information

Data Requested: The number of full-time students, faculty members and staff members for FY 2011.
Key Contact(s): Director of Institutional Planning and Research (Brendt Simpson).
Data Received: The number of full-time students, faculty members and staff members for FY 2011.

Physical Size

Data Requested: The university's total building space in square-feet for FY 2011.
Key Contact(s): Associate Vice President for Budget and Financial Aid (John Collins).
Data Received: 2,305,648 square-feet

ENERGY AND WATER COSTS

Tracking energy and water costs are also useful because it establishes a frame of historical reference and allows us to perform useful climate action planning analyses. Moreover, relatively small changes in our energy and water costs per unit can have big impacts on our operating budget. For these reasons, it is useful to track energy and water costs as part of our inventory data collection process (Table 4).

Table 4. *Colgate's energy and water cost per unit, FY 2009 through FY 2011.*

ENERGY AND WATER COSTS							
Fiscal Year	Wood Chips	Fuel Oil #6	Fuel Oil #2	Kerosene	Propane	Electricity	Water
	($/ton)	($/gallon)	($/gallon)	($/gallon)	($/gallon)	($/kWh)	($/1,000 gallons)
2009	$ 40.00	$ 2.24	$ 3.50	-	$ 2.15	$ 0.043	$ 8.26
2010	$ 40.00	$ 1.39	$ 2.30	-	$ 1.45	$ 0.042	$ 9.12
2011	$ 42.00	$ 2.01	$ 2.29	$ 2.53	$ 1.52	$ 0.045	$ 9.28

[12] Energy includes budget lines 211 (Fuel: Oil and Gas), 212 (Wood Fuel), 219 (Electric). It does not include energy for transportation, nor purchase of water.

Fuel Oil #6, Fuel Oil #2, Kerosene, and Propane (cost per gallon)

Data Requested: Cost per gallon of fuel oil #6, fuel oil #2, kerosene, and propane for FY 2011.
Key Contact(s): Director of Purchasing (Art Punsoni) can provide the contractual pricing for all fuels.
Data Received: Cost per gallon of fuel oil #6, fuel oil #2, kerosene, and propane for FY 2011.

Wood Chips (cost per ton)

Data Requested: Cost per ton of wood chips for FY 2011.
Key Contact(s): Associate Director of Facilities and Manager of Engineering Services (Peter Babich).
Data Received: Cost per ton of wood chips for FY 2011.

Electricity (cost per kWh) and Water (cost per 1,000 gallons)

Data Requested: Cost per kilowatt-hour (kWh) of electricity and cost per 1,000 gallons of water for FY 2011.
Key Contact(s): The Associate Controller and Director of Financial Reporting (Dan Partigianoni).
Data Received: Summary of monthly billing statements with total usage and cost for both electricity and water.
Calculations: To calculate the cost of electricity per kWh and water per 1,000 gallons, we divided the total annual cost by the total annual usage. For electricity, total cost includes:

1) Normal Rate Charge. The Village of Hamilton uses primarily hydropower which is obtained from Niagara Falls. The Village is allocated a designated amount of hydropower each month to be used by its customers (including Colgate). The rate is set by the Village and does not fluctuate from month to month unless a rate change is approved by the utilities commission.
2) Purchased Power Adjustment (PPA). When the Village exhausts its hydropower allotment, they are forced to purchase "extra" electricity from the grid. These purchases are made at a different rate (and often higher rate) than our normal rate electricity.
3) Demand Charge. Demand charges cover start up and equipment costs when electricity is needed intermittently (often during peak times). Demand charges are based on maximum demand which is the greatest usage of electricity that occurred over a period, usually one month. Once established, the rate remains in effect for eleven months or until a new maximum is established. To minimize demand charges, electricity usage should be spread out over a period to reduce the peak demand that may occur during any given timeframe.
For water, total cost includes normal rate charge plus sewer costs. The Village bills Colgate in units of 100 cubic feet. Therefore, we need to convert cubic feet to gallons (one cubic foot equals 7.48 gallons) to get cost per 1,000 gallons.

BIOGENIC EMISSIONS (WOOD CHIPS)

In 1981, Colgate University began using wood chips as the primary source of energy for space heating and domestic hot water. Although the wood firing capacity of Colgate's biomass plant is only about 40 percent of the peak cold day campus steam requirement, that capacity is used year-round at nearly full load so that Colgate derives 75 percent to 80 percent of our annual heating requirement from wood combustion.

Burning wood chips for energy releases stored carbon into the atmosphere. However, according to international protocol specified in the GHG Protocol guidelines, this carbon does not add to Colgate's greenhouse gas footprint or contribute to anthropogenic climate change. Carbon released from combusting wood chips is on the natural and short carbon cycle and would eventually cycle back to the atmosphere through death and decomposition. In other words, the carbon that is released from Colgate's biomass plant

was removed quite recently from the atmosphere through photosynthesis as the tree grew. Therefore, burning wood for energy will not increase the total amount of carbon in the carbon cycle if the source of biomass comes from sustainable forestry practices.

Clean Air-Cool Planet guidelines suggest that we track emissions associated with Colgate's biomass plant, but report them separately from the rest of our emissions (Table 5).

Wood chips

Data Requested: Tons of wood chips for FY 2011.
Key Contact(s): The data can be found in the Buildings and Grounds fileshare (Wood and Fuel Reports). This report can be retrieved with the assistance of the Office Manager of the Facilities Department (Amy Davidson) or the Associate Director of Facilities and Manager of Engineering Services (Peter Babich).
Data Received: Tons of wood chips for FY 2011.

Table 5. *Colgate's emissions associated with wood chip combustion, FY 2007 through FY 2011.*

Fiscal Year	Wood Chips (Tons)	Emission Factor (MTeCO2/Ton)	GHG Emissions (MTeCO2)
2007	19,158	0.155462469	**2,978**
2008	19,714	0.155462469	**3,065**
2009	22,249	0.155462469	**3,459**
2010	23,898	0.155462469	**3,715**
2011	23,058	0.155462469	**3,585**

SCOPE 1 EMISSIONS

Scope 1 emissions are direct emissions from sources that are owned and/or controlled by Colgate University. This includes combustion of fossil fuels in college-owned facilities or vehicles, fugitive emissions from refrigerant chemicals, and emissions associated with grounds maintenance.

On-Campus Stationary Combustion of Fossil Fuels

Colgate University uses four types of fossil fuels to provide heat and hot water to campus buildings: 1) fuel oil #6, fuel oil #2, kerosene, and propane (Table 6).

Colgate's central steam plant heats 37 main campus buildings and provides the heat source for laundry equipment, domestic water heating, dining hall food preparation, laboratory, library, and ice rink humidity control, and building humidification. While Colgate's primary source of steam production comes from the campus 900 Boiler horsepower (BoHP) wood chip boiler, we use fuel oil #6 as our secondary fuel in the central steam plant. Fuel oil #2 is used as the primary heating fuel for 486,700 gross square-feet of facilities that do not have access to steam from the Central Plant. This space includes Colgate's buildings on Broad Street (e.g., fraternity and sorority houses, Sanford Field House, and others). Kerosene provides heat energy to a few select buildings including 80 Broad Street, Seven Oaks Club House and Repair Shop, Schupf Art Studio, Student Health Center. And, finally, Propane is used for fireplaces, heating, cooking, and hot water in a few buildings including a number of buildings on Broad Street, the Coop, Parker Commons, the Heating Plant, Frank Dining Hall, Bryan Dining Hall, Base Camp, Merrill House, Trap Range, 13 East Kendrick, Central Receiving, Watson House, Olin Hall, Wynn Hall, and 100 Hamilton Street.

Table 6. *Greenhouse gas emissions from on-campus stationary sources, FY 2009 through FY 2011.*

On-Campus Stationary Combustion of Fossil Fuels				
Fiscal Year	**Fuel Type**	**Consumption (gallons)**	**Emission Factor (MTeCO2/gallon)**	**GHG Emissions (MTeCO2)**
2009	Fuel Oil #6	371,457	0.011761262	**4,369**
	Fuel Oil #2	185,503	0.010049435	**1,864**
	Kerosene	-	0.010049435	
	Propane	-	0.005440764	
2010	Fuel Oil #6	283,974	0.011761262	**3,340**
	Fuel Oil #2	174,399	0.010049435	**1,753**
	Kerosene	4,604	0.010049435	**46**
	Propane	-	0.005440764	
2011	Fuel Oil #6	293,425	0.011761262	**3,451**
	Fuel Oil #2	189,944	0.010049435	**1,909**
	Kerosene	8,212	0.010049435	**83**
	Propane	32,569	0.005440764	**177**

Fuel Oil #6

Data Requested: Gallons of fuel oil #6 consumed for FY 2011.
Key Contact(s): The data can be found in the Buildings and Grounds fileshare (Wood and Fuel Reports). This report can be retrieved with the assistance of the Office Manager of the Facilities Department (Amy Davidson) or the Associate Director of Facilities and Manager of Engineering Services (Peter Babich).
Data Received: Gallons of fuel oil #6 consumed for FY 2011.

Fuel Oil #2

Data Requested: Gallons of fuel oil #2 consumed for FY 2011.
Key Contact(s): The data can be found in the Buildings and Grounds fileshare. This report can be retrieved with the assistance of the Office Manager of the Facilities Department (Amy Davidson) or the Associate Director of Facilities and Manager of Engineering Services (Peter Babich).
Data Received: Gallons of fuel oil #2 consumed for FY 2011.

Kerosene

Data Requested: Gallons of kerosene consumed for FY 2011.
Key Contact(s): Director of Purchasing (Art Punsoni) can provide annual consumption from supplier billing.
Data Received: Gallons of kerosene consumed for FY 2011.

Propane

Data Requested: Gallons of propane consumed for FY 2011.

Key Contact(s): Director of Purchasing (Art Punsoni) can provide annual consumption from supplier billing.

Data Received: Gallons of propane consumed for FY 2011.

Colgate Vehicle Fleet

Colgate University, like most colleges and universities, owns and maintains a fleet of vehicles. The decisions Colgate makes regarding the purchase and operation of this fleet has a direct impact on our institution's greenhouse gas emissions. Therefore, it is important to keep track of Colgate's fleet fuel use, as it is a direct contribution to global warming. The Colgate vehicle fleet consists of about 95 vehicles (22 student/faculty vans, 68 Buildings and Grounds vehicles, and 5 Campus Safety vehicles) and was responsible for 586 tons of greenhouse gas emissions in 2011, about 4 percent of Colgate's total emissions (Table 7).

Table 7. *Colgate's greenhouse gas emissions from university vehicle fleet, FY 2011.*

GASOLINE FLEET						
B&G Gasoline Pump	Golf Course Gasoline Pump	B&G Vehicles Fueled Off-Campus	Campus Safety Vehicles	Total Gasoline	Emission Factor	**GHG Emissions**
(Gallons)	(Gallons)	(Gallons)	(Gallons)	(Gallons)	(MTeCO2/gallon)	**(MTeCO2)**
38,892	5,426	1,855	1,605	47,778	0.008929	**427**

DIESEL FLEET				
B&G Diesel Pump	Golf Course Diesel Pump	Total Diesel	Emission Factor	**GHG Emissions**
(Gallons)	(Gallons)	(Gallons)	(MTeCO2/gallon)	**(MTeCO2)**
11,137	4,723	15,860	0.010078	**160**

TOTAL VEHICLE FLEET EMISSIONS:	586

Capturing fuel consumption for Colgate's vehicle fleet comes from four sources:

1. Buildings and Grounds gasoline and diesel pumps
2. Seven Oaks golf course gasoline and diesel pumps
3. Buildings and Grounds vehicles fueled off-campus after hours
4. Campus Safety vehicles fueled off-campus after hours

Buildings and Grounds Gasoline and Diesel Pumps

Data Requested: Gallons of gasoline and diesel consumed for FY 2011.

Key Contact(s): Golf Course Manager (Jon McConville) can provide data directly from pump use or Director of Purchasing (Art Punsoni) can provide annual consumption from supplier billing.

Data Received: Gallons of gasoline and diesel consumed for FY 2011 from Golf Course Manager.

Seven Oaks Golf Course Gasoline and Diesel Pumps

Data Requested: Gallons of gasoline and diesel consumed for FY 2011.
Key Contact(s): Director of Purchasing (Art Punsoni) can provide annual consumption from supplier billing.
Data Received: Gallons of gasoline and diesel consumed for FY 2011.

Buildings and Grounds Vehicles Fueled Off-Campus

Data Requested: Gallons of gasoline consumed for FY 2011.
Key Contact(s): Buildings and Grounds Administrative Assistant (Carrie McFall) tracks vehicle fleet gasoline reimbursements throughout the year and can provide total gasoline consumption.
Data Received: Gallons of gasoline consumed for FY 2011.

Campus Safety Vehicles Fueled Off-Campus

Data Requested: Gallons of gasoline consumed for FY 2011.
Key Contact(s): Campus Safety Administrative Assistant (Sue Marks) tracks Campus Safety gasoline use throughout the year and can provide total gasoline consumption.
Data Received: Gallons of gasoline consumed for FY 2011.

Refrigerants (HFC-134a and HCFC-22)

Colgate University has an on-campus chiller for space cooling, water fountains, and refrigerators across campus that use HFC-134a refrigerant. Additionally, the Starr Hockey Rink and the Dana Arts Center use HCFC-22. These refrigerant hydrocarbons meet all the required standards specified by the U.S. EPA in order to reduce the rate of ozone depletion. Unfortunately, hydrocarbons are powerful greenhouse gases. HFC-134a, for example, has a global warming potential of 1,430 (meaning that it is 1,430 times more potent as a greenhouse gas than carbon dioxide). Therefore, it is important to calculate the amount of refrigerant chemicals Colgate uses on an annual basis. In 2011, HFC-134a accounted for over 64 metric tons of greenhouse gas emissions and HCFC-22 accounted for over 528 metric tons of emissions (Table 8).

Table 8. *Greenhouse gas emissions from HFC-134a and HCFC-22 refrigerant chemical use, FY 2011.*

Refrigerant Chemicals							
Fiscal Year	HFC-134a Refrigerant Loss (lbs)	Emission Factor (MTeCO2/lb)	GHG Emissions (MTeCO2)	HCFC-22 Refrigerant Loss (lbs)	Emission Factor (MTeCO2/lb)	GHG Emissions (MTeCO2)	TOTAL GHG EMISSIONS (MTeCO2)
2011	108	0.589670081	**64**	685	0.77110703	**528**	**592**

HFC-134a

Data Requested: The total usage (in pounds) of the refrigerant type HFC-134a for FY 2011.
Key Contact(s): Physical Plant Foreperson (Brian Belden).
Data Received: The total usage of the refrigerant type HFC-134a for FY 2011 was 108 lbs.

HCFC-22

Data Requested: The total usage (in pounds) of the refrigerant type HCFC-22 for FY 2011.
Key Contact(s): Physical Plant Foreperson (Brian Belden).
Data Received: The total usage of the refrigerant type HCFC-22 for FY 2011 was 685 lbs.

Fertilizer Application (Organic)

Fertilizer used for campus landscaping and on the golf course release nitrous oxides into the atmosphere due to its nitrogen content. Even though nitrous oxide is 298 times more powerful as a global warming agent then carbon dioxide, Colgate's emissions from fertilizer use is relatively small (Table 9). Nevertheless, they do contribute to global warming and our annual use of fertilizer is relatively easy to track.

Table 9. *Greenhouse gas emissions from fertilizer application, FY 2009 through FY 2011.*

Fertilizer Application (Organic)											
Fiscal Year	Landscaping			Golf Course					Total Fertilizers (lbs)	Emission Factor (MTeCO2/lb)	GHG Emissions (MTeCO2)
	Nitrogen (%)	Amount (lbs)	Total (lbs of nitrogen)	Nitrogen (%)	Amount (lbs)	Nitrogen (%)	Amount (lbs)	Total (lbs of nitrogen)			
2009	21%	48,000	**10,080**	12%	8,828	12%	8,828	**1,059**	11,139	0.00414123	**46**
2010	20%	24,000	**4,800**	12%	1,075	32%	525	**297**	5,097	0.00414123	**21**
2011	20%	28,000	**5,600**	12%	1,375	22%	500	**275**	5,875	0.00414123	**24**

Organic Fertilizer

Data Requested: The type and total amount (in pounds) of fertilizer used on campus grounds and on the golf course for FY 2011. Need to know the percentage of nitrogen in the fertilizer.

Key Contact(s): Grounds Manager (Mike Jasper), Golf Course Manager (Jon McConville), and the Supervisor of Athletics Grounds (Emmett House).

Data Received: The type, amount, and percentage of nitrogen for fertilizer used on campus grounds, athletic fields, and on the golf course for FY 2011.

Comments: All fertilizers used on campus in FY 2011 were organic.

Calculations: The total amount of fertilizer (in pounds) must be multiplied by the percentage of nitrogen to get the total amount (in pounds) of nitrogen used. The amount of nitrogen used (in pounds) is then multiplied by the emissions factor to get tons of greenhouse gas emissions.

SCOPE 2 EMISSIONS

Scope 2 emissions are the indirect emissions from sources that are neither owned nor operated by Colgate University, but whose products are directly linked to on-campus energy consumption. Scope 2 emissions include all emissions generated in the production of electricity consumed by the institution.

Purchased Electricity

In order to calculate Colgate's emissions associated with the purchase and use of electricity, we have to determine how our electricity is produced and calculate the rate of greenhouse gas emissions associated with each source. Colgate purchases electricity from the Village of Hamilton which operates as a municipal electric, water, and sewer utility. The vast majority (84 percent) of the Village's electricity is purchased directly from large-scale hydroelectric power mainly from Niagara Falls. The remaining electricity (16 percent) is purchased from the New York State grid and comes from a mix of sources including nuclear, wind, coal, and other fossil fuels. Colgate's emissions factor of 0.0000596931 MTeCO2 per kWh is significantly lower than the Upstate New York average of 0.000373082 MTeCO2 per kWh. This lower factor is based on the large amount of hydroelectric, nuclear, and wind power that makes up the Village's electricity mix. The result of this low emissions factor is that Colgate's overall emissions associated with electricity use is also relatively low making up around 10 percent of the university's total emissions (Table 10).

Data Requested: The total purchased electricity in FY 2011, in kWh.

Key Contact(s): The Associate Controller and Director of Financial Reporting (Dan Partigianoni) to provide the total purchased electricity, and the Village of Hamilton municipal electric utility (Sean Graham) to provide the source of purchased electricity.
Data Received: The total purchased electricity in FY 2011, in kWh. As of 2011, Colgate receives a monthly bill for each building from the Village. At the end of the fiscal year, Colgate's total annual electricity use needs to be manually entered and added together for each building for each month..
Calculations: The Clean Air-Cool Planet Campus Carbon Calculator has a feature that can help you determine the emissions factor for your local electricity mix. Simply enter by entering the percentages of your electricity sources into the custom fuel mix section of the calculator.

Table 10. *Greenhouse gas emissions from purchased electricity, FY 2008 through FY 2011.*

Purchased Electricity			
Fiscal Year	Total	Emission Factor	**GHG Emissions**
	(kWh)	(MTeCO2/kWh)	**(MTeCO2)**
2008	30,783,478	5.96931E-05	**1,838**
2009	31,571,030	5.96931E-05	**1,885**
2010	30,264,128	5.96931E-05	**1,807**
2011	30,883,211	5.96931E-05	**1,844**

SCOPE 3 EMISSIONS

Scope 3 emissions are all other indirect emissions attributed to our institution – those that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution. Colgate's Scope 3 emissions include faculty and staff commuting, bus commuting, employee business ground travel, air travel paid by or through the university, solid waste, and paper use. As explained earlier in this report, student commuting is considered de minimus emissions and not included in Colgate's greenhouse gas inventory.

Faculty and Staff Commuting

Most Colgate faculty and staff commute to work by driving. In order to calculate the emissions associated with this behavior, we need to determine the amount of gasoline consumed by each employee over the course of the year for commuting. We estimate this by conducting an annual survey (established in FY 2010) using Survey Monkey and distributing to the campus community over email (Appendix A). For incentive to complete the survey, we offer prizes (e.g., movie tickets, bookstore gift card, tickets to an athletic game) for a few randomly selected individuals. The survey needs to capture how many days per week and weeks per year each individual drives to campus, the distance traveled, and the average miles per gallon of their vehicle.

2011 Annual Commuter Survey

Data Needed: Gallons of gasoline consumed through faculty and staff commuting in FY 2011.
Key Contact(s): Chair of the Transportation Subcommittee (Beth Parks) administers the annual survey and analyzes the results. Administrative Coordinator, Dean of Faculty (Penny Mintel) emails the survey to the campus community via Campus Distributions.
Data Received: The 2011 Commuter Survey gave us an average of how many days per week and weeks per year each individual drove to campus, the distance traveled, and the average miles per gallon of their vehicle for the 322 individuals who completed the survey.

Calculations: Based on 322 responses, the average Colgate employee used 163 gallons of gasoline in FY 2011 to commute back and forth to work. Multiply 163 gallons by 939 employees equals 153,057 gallons in total for FY 2011. Multiply 153,057 gallons by the emissions factor for gasoline (0.008928806 MTeCO2 per gallon) equals 1,367 MTeCO2 (Table 11).
Comments: The Annual Commuter Survey should be distributed to the campus community via email in late September or early October to maintain consistency between years.

Table 11. *Greenhouse gas emissions from faculty and staff commuting, FY 2010 and FY 2011.*

Faculty and Staff Commuting			
Fiscal Year	Total Gasoline (Gallons)	Gasoline Emission Factor (MTeCO2/gallon)	**GHG Emissions (MTeCO2)**
2010	157,740	0.008928806	**1,408**
2011	153,057	0.008928806	**1,367**

Directly Financed Outsourced Bus Travel

Colgate University contracts through Birnie Bus Services, Inc. to provide free transportation service around campus and to select locations in the downtown area called the Colgate Cruiser. Birnie Bus also provides service to Colgate's athletic teams for competition away from home. There was a substantial increase in the Colgate Cruiser total gallons and emissions in FY 2011 compared to FY 2010 because Colgate added a bus and increased the overall service (Table 12).

Bus Commuting (Colgate Cruiser)

Data Requested: Gallons of diesel consumed for each of the buses that make up the Colgate Cruiser bus service in FY 2011.
Key Contact(s): The Birnie Bus terminal in Hamilton, NY (315-824-1260) provides the Cruiser data upon request.
Data Received: Gallons of diesel consumed for FY 2011 from the Colgate Cruiser bus service.

Athletics Travel

Data Requested: Gallons of diesel consumed in FY 2011 for bus service for varsity athletic travel.
Key Contact(s): Administrative Assistant, Athletics (Lori Godshalk).
Data Received: Gallons of diesel consumed for FY 2011 for bus service for varsity athletic travel.
Comments: Sport club outings use the "T" vans that are owned by Colgate, and therefore, included within the 'Colgate Vehicle Fleet' data as Scope 1 emissions.

Table 12. *Greenhouse gas emissions from outsourced bus travel, FY 2009 through FY 2011.*

Directly Financed Outsourced Bus Travel							
Fiscal Year	Cruiser	Diesel Emission Factor	**GHG Emissions**	Athletics Travel	Diesel Emission Factor	**GHG Emissions**	**TOTAL GHG Emissions**
	(Gallons)	(MTeCO2/gallon)	**(MTeCO2)**	(Gallons)	(MTeCO2/gallon)	**(MTeCO2)**	**(MTeCO2)**
2009	7,230	0.010077767	**73**	18,335	0.010077767	**185**	**258**
2010	7,144	0.010077767	**72**	18,683	0.010077767	**188**	**260**
2011	11,985	0.010077767	**121**	17,352	0.010077767	**175**	**296**

Employee Business Ground Travel

Colgate faculty and staff sometimes drive their personal vehicles to conduct Colgate business. The emissions associated with this practice are Scope 3 emissions since they are shared by the university and the individual who decides on the purpose and mode of that travel. We began capturing this source of emissions in FY 2011 with the creation of accounting code -387. Employees who drive their own cars for business are reimbursed through accounting code -387. With the total annual reimbursement cost for -387, we can determine the amount of gasoline consumed (Table 13).

Accounting Code -387

Data Needed: Gallons of gasoline consumed by faculty and staff who drive their personal vehicles to conduct Colgate business in FY 2011.

Key Contact(s): To obtain the accounting code -387 data, contact the Associate Vice President/Controller of the Accounting Office (Tom O'Neill) and the Accounting Assistant (Tracy Ogren).

Data Received: Total reimbursement cost for accounting code -387.

Calculations: The total cost of accounting code -387 was received from the Accounting Office at the FY 2011 federal reimbursement rate of $0.51 per mile. However, $0.22 per mile is awarded for the depreciation of the vehicle[13]. Therefore, we multiplied the total reimbursement cost for accounting code -387 by 57 percent to determine the amount of money spent on gasoline only (and not on vehicle depreciation). We then divided the total reimbursement cost for gasoline only by $3.05 (the national average cost per gallon of gasoline[14]) in order to determine the total gallons of gasoline consumed.

Table 13. *Greenhouse gas emissions from employee business ground travel, FY 2011.*

Employee Business Ground Travel							
Fiscal Year	Reimbursement Cost (-387)	Reimbursement for Gasoline	Total Reimbursement for Gasoline	2011 Average Cost per Gallon of Gasoline	Total Gasoline Consumption	Gasoline Emission Factor	**GHG Emissions**
	($)	(%)	($)	($)	(Gallons)	(MTeCO2/Gallon)	**(MTeCO2)**
2011	$ 286,687	57%	$ 163,412	$ 3.05	53,578	0.008928806	**478**

[13] This information was retrieved from the IRS website in "Notice 2010-88." The weblink is http://www.irs.gov/newsroom/article/0,,id=232017,00.html.

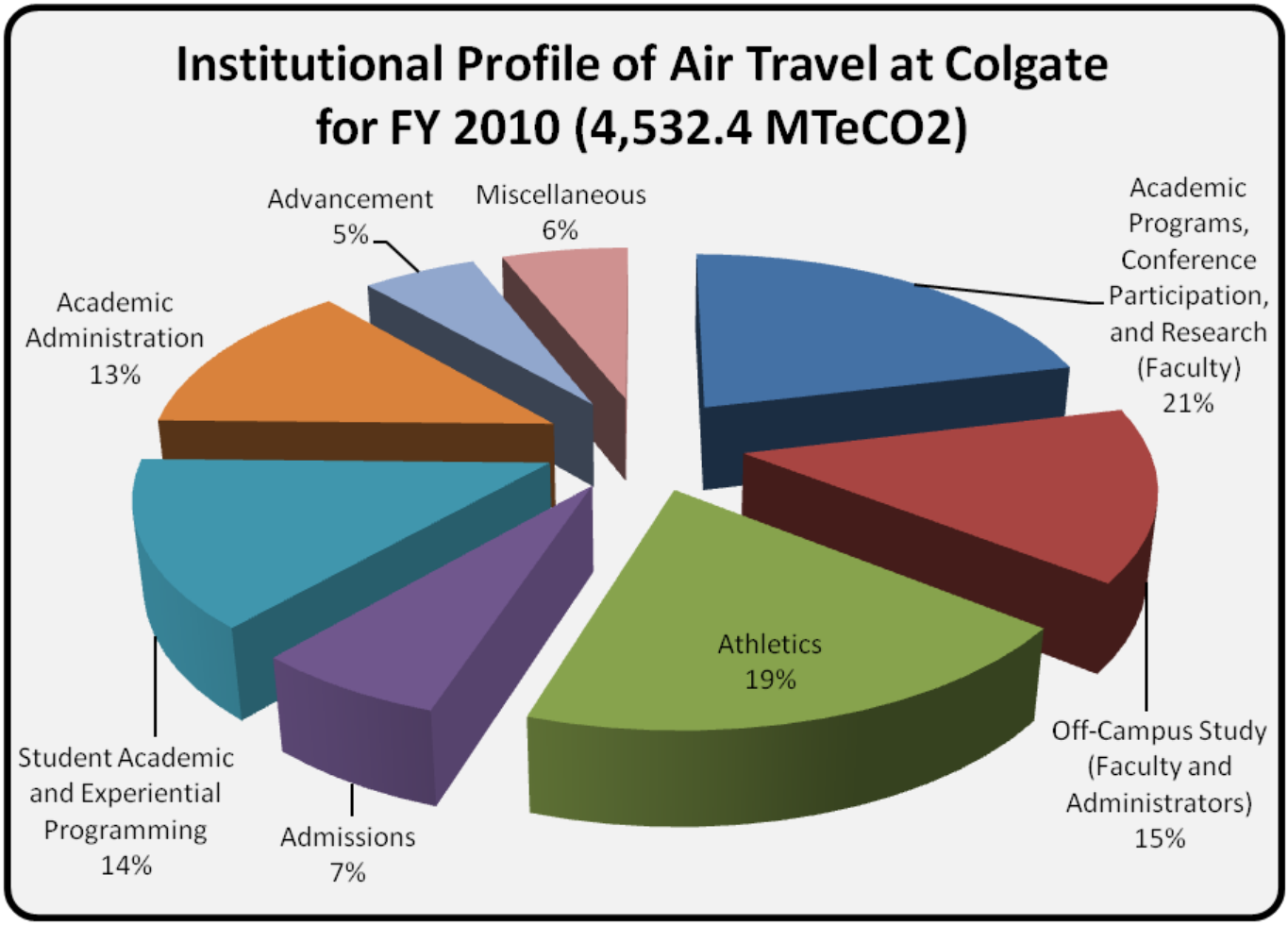
[14] To find the national average cost per gallon, we used the U.S. Energy Information Administration (U.S. EIA) website: http://www.eia.gov/petroleum/gasdiesel/. Download the "Full History" spreadsheet for U.S. regular gasoline prices. Then, we averaged the weekly data for the FY 2011.

Air Travel

Air travel plays a vital role in many university functions, a role that is arguably exacerbated by Colgate's rural location and our commitment to certain institutional priorities. Faculty travel by air to support research and conference participation, for example, and professional staff throughout the university require air travel to pursue their work. Colgate's commitment to robust off-campus study opportunities, as well as to Division I athletics, also underscores the centrality of air travel to the university's mission.

The Air Travel Subcommittee distinguished the amount of air travel by various institutional categories in FY 2010 (Figure 2). They did this both to capture a recent institutional profile of air travel at Colgate and to allow for tracking trends across the institution over time.

Figure 2. *Air travel emissions by various institutional categories, FY 2010.*



As of June 1, 2010 (i.e., the start of FY 2011), all air travel paid by the university on the behalf of faculty, staff, students, and invited guests is being tracked through the new account code -386. By compiling -386 expenditures across the institution—including budget charges, direct reimbursements, and JPMorgan charges—and adding to this other air travel expenditures such as tickets purchased on behalf of athletic teams, we are now able to efficiently capture the vast majority of Colgate's required Scope III air travel emissions. For FY 2010, as for FY 2009 (our baseline greenhouse gas inventory), our accounting office was able to determine air travel expenditures across the institution through a more labor-intensive process that involved "manually" compiling these expenditures on air travel. With the total annual expenditures for air

travel (accounting code -386), we can determine the amount of annual miles traveled and resulting emissions (Table 14). Colgate's Center for Outreach Volunteerism and Education (COVE) also sponsors alternative spring breaks and other volunteer programming requiring air travel. Annual COVE flights are also calculated into Colgate's greenhouse gas emissions (Table 14).

Table 14. *Greenhouse gas emissions from air travel, FY 2009 through FY 2011.*

Air Travel						
Fiscal Year	**Business**	**Athletics**	**COVE**	**Total**	**Air Travel Emission Factor**	**GHG Emissions**
	(Miles)	(Miles)	(Miles)	(Miles)	(MTeCO2/Mile)	**(MTeCO2)**
2009	5,960,140	19,461	5,966	5,985,567	0.000776369	**4,647**
2010	5,838,481	525,790	63,746	6,428,017	0.000776369	**4,991**
2011	6,328,300	-	246,393	6,574,693	0.000776369	**5,104**

Accounting Code -386

Data Requested: Annual air travel paid for by or through the university to conduct Colgate business in FY 2011 in miles.

Key Contact(s): The Associate VP/Controller of the Accounting Office (Tom O'Neill).

Data Received: Total 2011 air travel expenditures for accounting code -386.

Calculations: According to accounting code -386, the total money spent on faculty and staff air travel in FY 2011 was $1,177,697. 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[15], 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:

- Average cost per mile YTD October 2011 = 15.51 cents per mile. Plus taxes equals (15.51 + (15.51 x .20)) = 18.61 cents per mile = 6,328,300 miles.
- 6,328,300 miles X 0.000776336 MTeCO2/mile = 4,913 metric tons of greenhouse gas emissions (MTeCO2).

Comments: Accounting code -386 captures the vast majority of Colgate's overall business-related air travel and air travel from our athletic teams. Accounting code -386 does not capture most study abroad travel as students pay for their tickets and is not captured in our accounting systems. Also, flights paid through "funds" (as opposed to "orgs") are also not included in -386. For example, if a faculty member receives a research grant from the National Science Foundation (NSF) and travels with that money, then it is not included in our calculations as it becomes prohibitive to go through every fund number and root out air travel for the year. As a result, study abroad travel and travel for research paid for by grants are not included in Colgate's annual greenhouse gas inventory.

Center for Outreach Volunteerism and Education (COVE)

Data Requested: Annual air travel paid for through the COVE in FY 2011 in miles.

Key Contact(s): Associate Director, COVE (Rachel DiDomizio).

Data Received: COVE annual flight itineraries and number of Colgate students/staff on those flights.

[15] This information was accessed online in December 2011 from the Air Transport Association of America website at: http://www.airlines.org/Pages/ATA-Monthly-Passenger-Yield-%28Fares-per-Mile%29.aspx.

Calculations: We are able to calculate the roundtrip distance between airports using Travel Math's online Flight Distance Calculator[16]. The roundtrip distance per flight is multiplied by the number of passengers to get the total passenger miles traveled (Table 15). The total air miles traveled is then multiplied by the emissions factor for air travel (0.000776369 MTeCO2 per mile) to get greenhouse gas emissions.

Table 15. *Greenhouse gas emissions from air travel sponsored by the COVE, FY 2011.*

Fiscal Year 2011 COVE Flights				
FLIGHT	**People**	**Roundtrip Distance (miles)**	**Total Passenger Miles**	**GHG Emissions (MTeCO2/Mile)**
Syracuse to Chicago	12	1,228	14,739	11
Chicago to New Orleans	12	1,695	20,345	16
Syracuse to JFK	13	429	5,573	4
JFK to Santo Domingo (Dominican Republic)	13	3,095	40,238	31
Rochester to Chicago	12	1,062	12,744	10
Chicago to Cedar Rapids (South Dakota)	12	384	4,608	4
Syracuse to JFK	10	429	4,287	3
JFK to Heathrow	10	6,224	62,239	48
Heathrow to Nairobi	10	8,039	80,391	62
Syracuse to Chicago	1	1,228	1,228	1
TOTAL	**105**	**23,814**	**246,393**	**191**

Landfill Waste

Colgate University owns two vehicles that transfer our solid waste to the Madison County Landfill and Recycling Center in the Town of Lincoln approximately 20 miles from campus[17]. One truck transports recyclables (paper, paper products, metals, plastics, and glass) and the other transports landfill waste. For the purposes of Colgate's greenhouse gas inventory, we are only concerned about the amount of landfill waste (and not recycled waste) because landfill waste emits a potent greenhouse gas (methane) as it decomposes. However, different landfills have different techniques for how they handle methane emissions and these different techniques result in different levels of greenhouse gas emissions. Therefore, it is necessary to know how the Madison County Landfill handles its methane emissions in order to determine the emission factor for Colgate's landfill waste.

In FY 2010, the Madison County Landfill installed a methane capture and electric generation system that has much lower greenhouse gas emissions per ton:

- Prior to FY 2010 **(no methane recovery)**: emissions factor = 1.0842857 MTeCO2/short ton
- FY 2010 and beyond **(methane recovery and electric generation)**: emissions factor = 0.160634921 MTeCO2/short ton

As a result, Colgate's overall emissions associated with our landfill waste was significantly reduced (Table 16).

Further emission reductions occurred because Colgate reduced its landfill waste per full-time equivalent student (FTE) through:

[16] The calculator was accessed online in December 2011 at: http://www.travelmath.com/flying-distance/.

[17] The trucks that transport Colgate's landfill waste and recyclables are fueled at the Buildings and Grounds diesel pump. Therefore, the emissions associated with the diesel trucks are captured in the diesel fuel pump data.

- improved recycling of paper and bottles and cans;
- a new electronic waste recycling program;
- a new composting program;
- decreased overall paper consumption by over four million sheets of paper; and
- increased use of reusable containers (instead of one-time use disposable containers).

Data Requested: Total annual landfill waste in short tons for FY 2011.
Key Contact(s): Associate Director of Facilities and Manager of Lands and Grounds (Mike Jasper).
Data Received: Monthly billing statements from Madison County Landfill with Colgate's tons of landfill waste.
Calculations: We added the monthly reports to get the annual total of 794 tons for FY 2011.

Table 16. *Colgate's greenhouse gas emissions associated with landfill waste, FY 2008 through FY 2011.*

Landfill Waste					
Fiscal Year	Landfill Waste	Emission Factor	GHG Emissions	Full-time Equivalent Students	GHG Emissions per FTE
	(Short Tons)	(MTeCO2/Mile)	(MTeCO2)	(FTEs)	(MTeCO2)
2007	938	1.0842857	**1,017**	2,734	**0.37**
2008	929	1.0842857	**1,007**	2,767	**0.36**
2009	813	1.0842857	**881**	2,784	**0.32**
2010	778	0.1606349	**125**	2,770	**0.05**
2011	794	0.1606349	**128**	2,876	**0.04**

Paper Consumption

Colgate University's paper consumption is tracked through two main sources: 1) departmental purchasing and 2) the Print Shop. We track the amount of paper consumed by its recycled content (e.g., non-recycled, 30 percent, 50 percent, and 100 percent), because the greater the recycled content, the lower the rate of emissions (Table 17) and the more environmentally benign.

Table 17. *Colgate's greenhouse gas emissions associated with paper consumption, FY 2010 and FY 2011.*

Paper Consumption						
Fiscal Year	Paper Type (% Recycled)	Departmental Consumption (lbs)	Print Shop Consumption (lbs)	TOTAL Consumption (lbs)	Emission Factor (MTeCO2/lbs)	GHG Emissions (MTeCO2)
2010	0%	21,613	19,888	41,501	0.001290500	**54**
	30%	42,157	9,270	51,427	0.001170973	**60**
	50%	1,825	14,664	16,489	0.001051445	**17**
	100%	21,482	950	22,432	0.000812390	**18**
	TOTAL	**87,077**	**44,772**	**131,849**		**149**
2011	0%	15,616	19,517	35,133	0.001290500	**45**
	30%	44,961	3,399	48,360	0.001170973	**57**
	50%	7,929	15,381	23,310	0.001051445	**25**
	100%	21,329	1,481	22,810	0.000812390	**19**
	TOTAL	**89,835**	**39,778**	**129,613**		**145**

Departmental Purchasing

The various departments and offices throughout campus individually order their paper through either Office Max or Staples. Since 2009, the amount of greenhouse gas emissions and overall purchase of paper from Office Max and Staples and the amount of paper used per student has been significantly reduced (Tables 17 and 18). This was accomplished by adding print-release stations in public printing areas, by setting double-sided printing as the default on campus machines in common areas, by widening margins, and through increased awareness and more conscious printing. Table 18 also highlights the overall reduction in the purchase and use of non-recycled (virgin) paper on campus since 2009.

Data Requested: The total amount of paper purchased in pounds through departmental purchasing by recycled content for FY 2011.

Key Contact(s): Director of Purchasing (Art Punsoni).

Data Received: The total amount of paper purchased in pounds through departmental purchasing by recycled content for FY 2011 from Office Max and Staples.

Comments: The Purchasing Department and the Sustainability Office strongly encourage departments to order recycled paper. We are planning on eliminating the option to purchase non-recycled paper in FY 2012.

Table 18. *Colgate departmental purchasing (sheets of paper consumed), FY 2009 through FY 2011.*

Departmental Paper Consumption							
Fiscal Year	Non-Recycled	30% Recycled	50% Recycled	100% Recycled	TOTAL	Full-Time Equivalent Students	TOTAL
	(Sheets)	(Sheets)	(Sheets)	(Sheets)	(Sheets)	(FTEs)	(Sheets/FTE)
2009	4,576,040	3,177,624	5,248	5,118,713	**12,877,624**	2,784	**4,626**
2010	2,139,901	4,173,960	180,693	2,126,931	**8,621,485**	2,770	**3,112**
2011	1,546,099	4,451,560	785,097	2,111,831	**8,894,587**	2,876	**3,093**

Print Shop

The amount of greenhouse gas emissions and overall paper consumed through Colgate's Print Shop has also been reduced since we started tracking this data in FY 2010 (Tables 17 and 19).

Data Requested: The total amount of paper purchased in pounds through departmental purchasing by recycled content for FY 2011.

Key Contact(s): Director of Document and Mail Services (Bob Keats).

Data Received: The total amount of paper purchased in pounds through the Print Shop by recycled content for FY 2011.

Table 19. *Colgate Print Shop (sheets of paper consumed), FY 2009 through FY 2011.*

Print Shop Paper Consumption							
Fiscal Year	Non-Recycled	30% Recycled	50% Recycled	100% Recycled	TOTAL	Full-Time Equivalent Students	TOTAL
	(Sheets)	(Sheets)	(Sheets)	(Sheets)	(Sheets)	(FTEs)	(Sheets/FTE)
2010	1,969,109	917,822	1,451,881	94,059	**4,432,871**	2,770	**1,600**
2011	1,932,376	336,535	1,522,871	146,634	**3,938,416**	2,876	**1,369**

COLGATE'S GROSS GREENHOUSE GAS EMISSIONS

2011 GREENHOUSE GAS INVENTORY

Colgate's greenhouse gas footprint was 17,353 MTeCO2 (6.23 tons / FTE[18]) in 2009, 14,505 MTeCO2 (5.24 tons / FTE) in 2010, and 16,194 MTeCO2 (5.63 tons / FTE) in 2011 (Table 20). This includes all Scope 1 emissions (on-site stationary combustion of fossil fuels, vehicle fleet emissions, fugitive refrigerant chemicals, and emissions associated with grounds maintenance) and Scope 2 emissions (purchased electricity). Colgate calculated sources of Scope 3 emissions consistent with the ACUPCC guidelines. Scope 3 emissions include faculty and staff commuting, bus travel, employee business ground travel, air travel paid for by or through the university, landfill waste, and paper consumption.

Since 2009, Colgate has reduced its overall emissions by about 9 percent and emissions per student (FTE) by about 10 percent. This reduction is the result of a number of new practices, policies, and resource conservation and efficiency measures that have been put into place since 2009 that are further detailed in Colgate's 2011 Sustainability and Climate Action Plan[19]. The rise in overall emissions and emissions per student (FTE) between FY 2010 and FY 2011 can be explained in part by the opening of the new 15,000 square-foot Trudy Fitness Center.

[18] FTE = Full-time equivalent student.

[19] Website: https://sites.google.com/a/colgate.edu/2011-2015-sustainability-and-climate-action-plan/

Table 20. *Colgate's gross greenhouse gas emissions by source and scope for FY 2009 through FY 2011.*

FISCAL YEAR	2009	2010	2011
SOURCE OF EMISSIONS	TONS OF EMISSIONS		
SCOPE 1			
Fuel Oil #6	4,368	3,339	3,451
Fuel Oil #2	1,864	1,752	1,909
Kerosene	-	46	83
Propane	-	-	177
Vehicle Fleet	393	524	587
Refrigerants (HFC-134a and HCFC-22)	1,247	84	592
Fertilizer	46	21	24
SCOPE 1 TOTAL	7,918	5,767	6,823
SCOPE 2			
Purchased Electricity	1,885	1,807	1,844
SCOPE 2 TOTAL	1,885	1,807	1,844
SCOPE 3			
Faculty/Staff Commuting	1,626	1,408	1,367
Bus Travel (Cruisers/Athletics)	258	260	296
Employee Business Ground Travel	-	-	478
Air Travel	4,647	4,990	5,104
Landfill Waste	881	125	139
Paper Consumption	139	148	145
SCOPE 3 TOTAL	7,550	6,931	7,529
FTE	2,784	2,770	2,876
TONS / FTE	6.23	5.24	5.63
GROSS EMISSIONS	17,353	14,505	16,194

For each of the three years we have completed Colgate's greenhouse gas footprint, the stationary combustion of fossil fuels for space heating and domestic hot water remains the largest single source of emissions (Figure 3). Colgate consumes fuel oil #6, 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 fuel oil #2 in buildings not connected to the steam line. Air travel emissions are a close second. Combined, stationary combustion of fossil fuels on campus and air travel comprise two-thirds (66 percent) of Colgate's total greenhouse gas emissions (Figure 4). The drop in landfill waste emissions since 2009 can be attributed to both a reduction in overall landfill waste due to better recycling and composting and a switch to a methane capture and electricity generation at the Madison County Landfill. This switch significantly reduced the rate of emissions associated with Colgate's landfill waste production.

Figure 3. *Total emissions by source, FY 2009 through FY 2011. "Others" include fertilizer use (24 MTeCO2), Bus Travel (296 MTeCO2), and paper consumption (145 MTeCO2).*

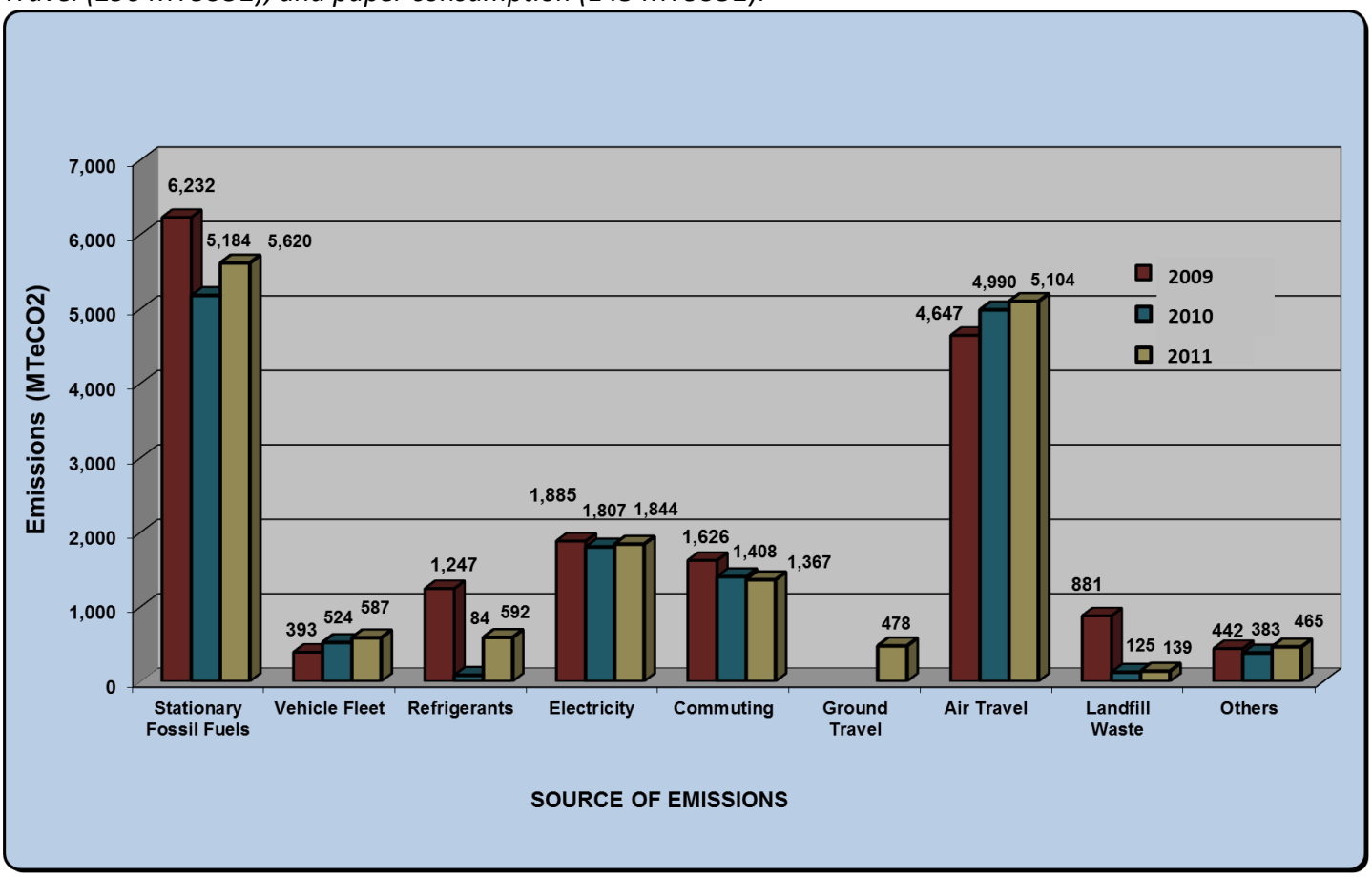
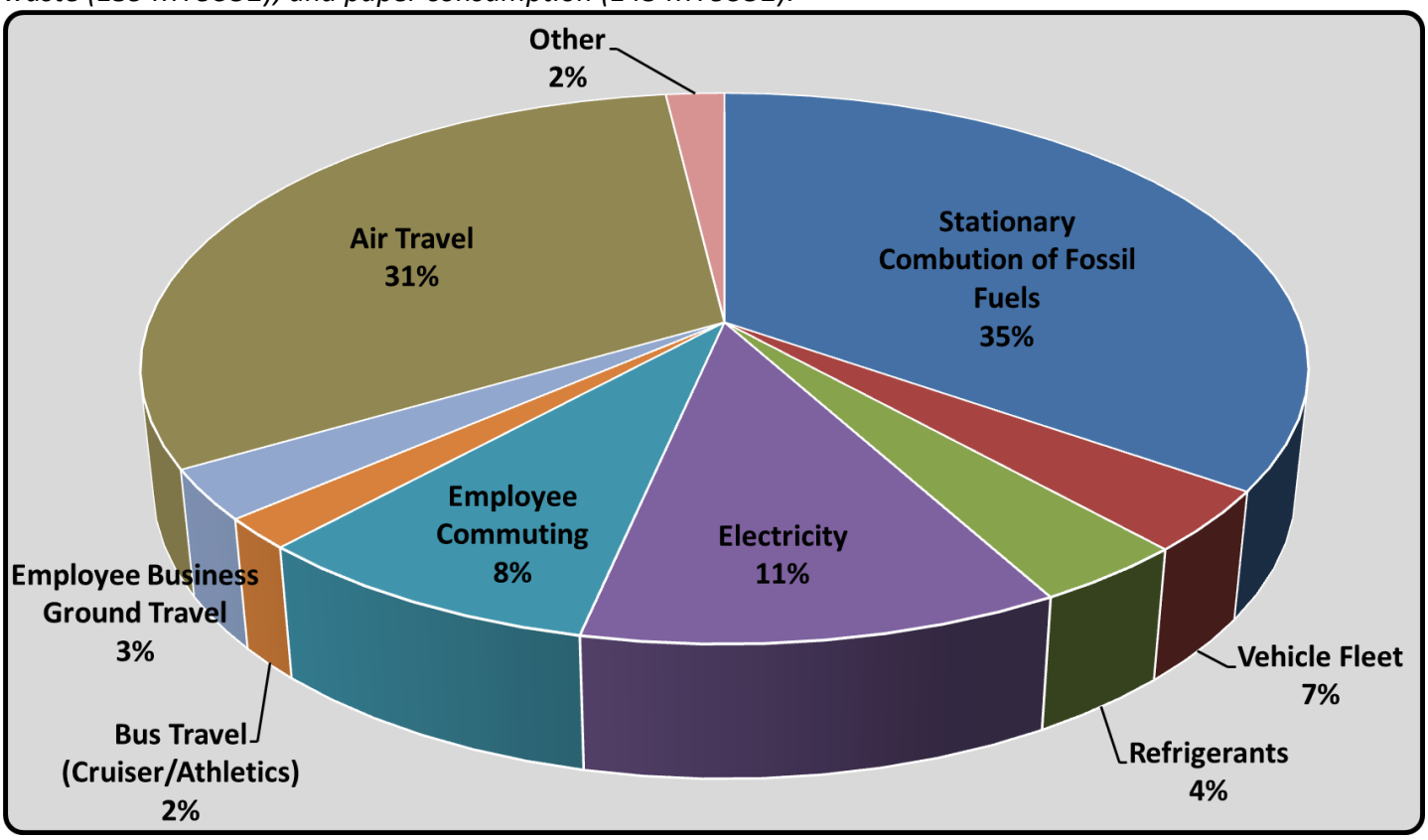


Figure 4. *FY 2011, percentage of gross emissions by source. "Other" includes fertilizer use (24 MTeCO2), landfill waste (139 MTeCO2), and paper consumption (145 MTeCO2).*



CARBON OFFSETS AND NET GREENHOUSE GAS EMISSIONS

2011 GREENHOUSE GAS INVENTORY

Thus far we have examined Colgate's activities that add greenhouse gases into the atmosphere. However, we also need to consider activities that sequester and/or avoid emitting greenhouse gases in order to determine our net carbon budget. In FY 2011, Colgate's only source of offsets included the annual rate of carbon sequestration of our existing forest. Described below. As a result, Colgate's net greenhouse gas emissions in FY 2011 is 14,955 MTeCO2 (Table 21).

Forest Preservation

Colgate University's forests sequester carbon each year. The university owns 835 acres of established forestland and another 277 acres of forests emerging from old pastureland through natural succession. Establishing a formal, long-term commitment to conserve these lands as "undeveloped" open space would guarantee continued sequestration of carbon and contribute to Colgate's goal of climate neutrality, in addition to the many other public benefits and ecosystem services this land provides. This was established in Colgate's 2007 Forest Stewardship Plan. Until we take actual field measurements, we can estimate the annual rate of carbon sequestration by the type and age of Colgate's forested land by using established U.S. Forest Service estimates as detailed below.

Annual rate of carbon sequestration of Colgate's forested lands: **1,239 MTeCO2**

- Annual sequestration rates were approximated by Alex Doms '14 as a research project in Professor Cardelus's F-SEM 124 class in Fall 2010.
- By referencing the 2007 Forest Stewardship Plan, Doms '14 determined that Colgate owns 450 hectares (1,112 acres) of land, with 338 hectares (835 acres) forested versus 112 hectares (277 acres) of open space.
- 225 hectares (67 percent) of the forested management units are Maple/Oak-dominated.
- 113 hectares (33 percent) of the units are Hemlock-dominated.
- After applying respective species sequestration rates, 4 MTeCO2/year/hectare for Maple-dominated and 3 MTeCO2/year/hectare for Hemlock-dominated, to the management units, Colgate's forests sequester **1,239 MTeCO2/year**.
  - 900 MTeCO2 = 225 hectares X 4 MTeCO2/year/hectare for Maple-dominated
  - 339 MTeCO2 = 113 hectares X 3 MTeCO2/year/hectare for Hemlock-dominated

Table 21. *Colgate's offsets and net greenhouse gas emissions, FY 2009 through FY 2011.*

CARBON OFFSETS AND NET GREENHOUSE GAS EMISSIONS						
Fiscal Year	Total Emissions (MTeCO2)	Total Carbon Offsets (MTeCO2)				Total Net Carbon Emissions (MTeCO2)
		Forest Sequestration	Renewable Energy Credits	Carbon Offset Purchases	Total Carbon Offsets	
2009	17,353	1,239	-	9	1,248	16,105
2010	14,505	1,239	-	-	1,239	13,266
2011	16,194	1,239	-	-	1,239	14,955

CONCLUSION

2011 GREENHOUSE GAS INVENTORY

The 2011 Comprehensive Greenhouse Gas Inventory for Colgate University calculated Colgate's greenhouse gas emissions for FY 2011 in relation to our FY 2009 baseline. Since 2009, the university has reduced its gross emissions by 9 percent (from 17,353 MTeCO2 in FY 2009 to 16,194 MTeCO2 in FY 2011) and reduced our emissions per student (FTE) by 9 percent (from 6.23 MTeCO2/FTE in FY 2009 to 5.63 MTeCO2/FTE in FY 2011). The stationary combustion of fossil fuels (fuel oil #6, fuel oil #2, propane, and kerosene) and air travel continue to remain our largest source of emissions comprising two-thirds (66 percent) of our overall footprint.

We estimate that Colgate's existing forested lands sequester approximately 1,239 tons of carbon annually. This leaves the university with a 14,955 MTeCO2 carbon budget for FY 2011.

On September 15, 2011, Colgate's Sustainability and Climate Action Plan was approved by President Jeffrey Herbst and our senior administration. The Plan is a guiding document to climate neutrality in 2019 and includes 27 projects that will reduce our campus carbon footprint. As we implement the plan, we anticipate achieving a 35 percent reduction in emissions from our FY 2009 baseline by FY 2015.