CHAMPLAIN COLLEGE

Phase 1:

Carbon Profile Assessment Results



Prepared for

CHAMPLAIN COLLEGE

Champlain College
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1.0 Executive Summary

The dual purpose of this report is to (1) describe the results of the Phase 1 carbon profile assessment of the facilities and operations of Champlain College, and (2) serve as a guiding document as Champlain College considers further carbon management and sustainability efforts.

From 1999 through 2007, Champlain College emitted an average of 4,437 metric tons of greenhouse gases (GHG) per year. In 2007, Champlain College emitted 5,237 tons, or 2.7 tons per full-time student, compared with an average of 8.5 tons per student at ten northern US colleges. Champlain College's sources of GHG emissions are as follows:

- Combustion of natural gas at campus buildings: 1,465 tons (28%)
- Electricty purchases: 1,133 tons (22%)
- Transportation-related emissions: 2,549 tons (48.5%)
- Waste generation, fertilizer use, and leakage from refrigeration systems: 90 tons (1.5%)
- Carbon sequestration in compost and the campus' forested landscape: -20 tons (-0.4%)

Total GHG emissions at Champlain College have increased approximately 45% since 1999. When adjusted for growth in the student population, emissions have increased by an average of 0.5% per year over the nine year period. On a square footage basis, total emissions have decreased by an average of 0.4% per year over the same period.

On a per student basis, Champlain College’s emissions are some of the lowest calculated for colleges located in the northern US. This finding is due to several factors, including a low building square footage to student ratio, few energy intensive labs, a significant use of low-emission energy sources by the school’s electricity provider (Burlington Electric Department), and proactive energy and transportation management initiatives.

By continuing its work with partnering institutions such as Burlington Electric Department, Chittenden Solid Waste District (CSWD), and Campus Area Transportation Management Association (CATMA), and through spearheading new initiatives, Champlain College's efforts to assess and reduce its carbon footprint have the potential to position the school as a collegiate and community leader in addressing climate change.

Recommended next steps for Champlain College's carbon management efforts include:

- Establish GHG emission reduction and sustainability goals, indicators, and metrics in concert with systems for gauging progress toward these goals.
- Continue to integrate energy efficiency, conservation, renewable energy, and sustainable design efforts into new construction and renovation projects, informed by in-depth cost-benefit analyses.
- Expand upon the work of Sustain Champlain to broaden the team of students, faculty, and staff working to promote changes in campus policies and operations.
- Evaluate strategies and policies that address areas such as green building practices, revolving loan funds, and participation in the ISO New England Demand Response Program.

2.0 Acknowledgements

Conducting a carbon footprint analysis of a college campus is a formidable task. During this Phase 1 Assessment, Spring Hill Solutions received generous assistance from the entire Champlain College community, and would especially like to acknowledge the efforts of the following key individuals who diligently responded to requests for information:

- Lewis Barnes, Grounds Supervisor, Physical Plant
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- Tee Muhall, Executive Coordinator, Finance and Administration
- Sarah Olson, Operations Assistant, Division of Continuing Professional Studies
- Peggy O'Neill, Study Abroad Program
- David Provost, Senior Vice President for Finance and Administration
- Mary Sanbord, Administrative Assistant, Operations & Physical Plant
- Kris Surette, Public Information and News Director
- Krystal Sewell, Information Manager, Advising & Registration Center
- Sandy Thibault, Database Manager, CATMA
- Jake Yanulavich, Energy Services Engineer, Burlington Electric Department
- Rob Williams, Professor

3.0 Introduction

REPORT PURPOSE

The purpose of this report is two-fold:

1. To communicate the results of the Champlain College carbon profile assessment for consideration by Champlain College staff, faculty, and students.
2. To serve as a guide to next steps for Champlain College to consider in developing a comprehensive carbon management program.

REPORT BACKGROUND

"If higher education is not relevant to solving the crisis of global warming, it is not relevant, period." David F. Hales, President, College of the Atlantic

During the last several years, Champlain College has demonstrated a growing commitment to social and environmental responsibility, including an interest in addressing climate change. Sustainability principles are now integral to the college's master plan, suggesting an expanding appreciation for the critical links between environmental stewardship and business and academic success. In addition, Champlain College has taken concrete steps toward reducing its energy use and environmental impact. Recent examples of Champlain College's dedication to sustainability principles include:

- Proactive energy management and conservation efforts for campus buildings, including installation of variable frequency drives for mechanical systems, centralized energy control systems, efficient HVAC equipment, building insulation, and energy efficient lighting.
- Partnership with CATMA and subsidized ridership programs.
- Establishment of Sustain Champlain and student-based sustainability groups.
- Significant waste management and reduction efforts.
- Establishment of a dining services sustainability plan.
- The creation of the Associate Vice President of Campus Planning and Auxiliary Services position.
- Installation of a green roof at the IDX Center.
- Expansion of Champlain College's storm water retention system.

These examples demonstrate that the Champlain College community recognizes that emerging economic, environmental, and social justice trends require that increased attention be given to issues of sustainability. The intersection of campus operations, sustainability principles, and academics is where the potential for bottom-line savings, academic preparation, and campus recognition is at its greatest. To better understand its energy use, carbon footprint, and possible strategic cost-saving strategies, Champlain College has undertaken a baseline assessment of their current carbon emissions. These finding will enable the college to better focus its efforts on carbon reduction and leverage academic and business sustainability goals.

4.0 Assessment Methodology Overview

This assessment is conducted in accordance with the carbon accounting principles and tools developed by the GHG Protocol and Clean Air Cool Planet. The GHG Protocol is the most widely used international accounting tool for quantifying GHG emissions and provides the accounting framework for nearly every GHG standard and program in the world, including the Chicago Climate Exchange, California Climate Action Registry, and the U.S. EPA's Climate Leaders program. Clean Air Cool Planet's Campus Carbon Calculator is an inventory tool created specifically for colleges and universities. Its approach is designed to be consistent with the GHG Protocol standards. Several assumptions and estimates were made in the assessment process and are detailed in *Appendix A: Assessment Methodologies and Assumptions.*

BOX 1: ABOUT THE GHG PROTOCOL

THE GHG PROTOCOL is a unique multi-stakeholder partnership of businesses, NGOs, and governments, led by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). It serves as the premier source of knowledge on corporate GHG accounting and reporting and draws on the expertise and contributions of individuals and organizations from around the world.

Website: www.ghgprotocol.org.

The GHG Protocol standards require that three key parameters (base year, organizational boundaries, and operational boundaries) inform any business-level GHG assessment:

Base Year

The base year is the first twelve months for which the reporting organization's GHG emissions are determined. The emissions determined within the base year serve as a baseline GHG measurement against which future assessments are compared to determine progress toward GHG reduction goals. To account for fluctuations in energy use due to climatic variations, base year values can also be determined by averaging several years of historical data. For this analysis, Champlain College complied historical data based on the academic calendar years of 1999 to 2007 (July 1, 1998 – June 31, 2007).

Organizational and Operational Boundaries

Organizational boundaries determine which operations, facilities, subsidiaries and infrastructure are owned or controlled by the reporting organization. Operational boundaries determine the direct and indirect emissions associated with operations owned or controlled by the reporting organization. In this assessment, Champlain College is reporting emissions resulting from:

Buildings: Facility heating, facility electricity usage, and fugitive emissions from cooling and refrigeration equipment at Champlain College's Burlington campus and leased buildings.

Waste and grounds: Emissions resulting from waste disposal, fertilizer use, and offsets due to Champlain College's composting and forested landscape.

Transportation and travel: GHG emissions from student, faculty, and staff commuting, college fleet fuel usage, class field trips, travel to conferences and student recreational trips, travel from student hometowns to campus, and travel to study abroad locations.

Greenhouse Gas Calculations

GHG emissions are expressed in metric tons of carbon dioxide equivalent (tCO_2e), as more than one type of GHG is considered in this assessment (see Box 2). While CO_2 is the most prevalent GHG, other gases also have "global warming potentials" (GWP), which refers to its heat-trapping ability relative to that of CO_2.[1] The use of metric units such as *metric tons* and *kilograms* follows the convention of the GHG Protocol. One metric ton is equivalent to 1,000 kilograms and 2,240 pounds.

BOX 2: GREENHOUSE GASES	
THE SIX PRIMARY GHG GASES considered by the GHG Protocol are:	
CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulfur hexafluoride

5.0 Results and Discussion

Champlain College's Total Assessed Emissions

During the years 1999-2007, Champlain College emitted an average of **4,437 tCO_2e**, or **2.7 tCO_2e** per full-time student annually. In 2007, total emissions were 5,237 tCO_2e (Figure 1), or 2.7 tCO_2e per student. 5,237 tCO_2e is equivalent to the emissions from the annual energy use of over 1500 homes. Table 1 summarizes the sources of Champlain College's GHG emissions during the 2006-2007 academic year.

TABLE 1: CHAMPLAIN COLLEGE TOTAL ASSESSED GHG EMISSIONS OCCURRING BETWEEN 9/1/2006 AND 8/31/2007

Sector	Source(s)	Contribution to Total: Emissions (tCO_2e)	Contribution to Total: Percent
Buildings	Facility heating	1,465	28
	Electricity purchases	1,133	22
	Emissions from cooling & refrigeration equipment	25	.5
Transportation	Commuting, conferences & field trips, student activity & study abroad travel, & college fleet	2,459	48.5
Waste Management	Solid waste disposal	90	1.5
	Composting	-18	.34
Campus Grounds	Fertilizer	3	.06
	Sequestration in the campus' forested landscape	-1.6	.03
	Total	5,237 tons	100%

1 See Note 1, Appendix A, for more details on global warming potentials and CO_2e.

Total GHG emissions at Champlain College have increased approximately 45% since 1999 (Figure 1). When adjusted for growth in the student population, emissions have increased by an average of 0.5% per year over the nine year period (Figure 2). On a square footage basis, total emissions have decreased by an average of 0.4% per year over the same period. In 2007, Champlain College's emissions on a per student basis were some of the lowest calculated compared to other colleges in the northern US (Figure 3).

FIGURE 1: CHAMPLAIN COLLEGE'S TOTAL ASSESSED GHG EMISSIONS 1999-2007

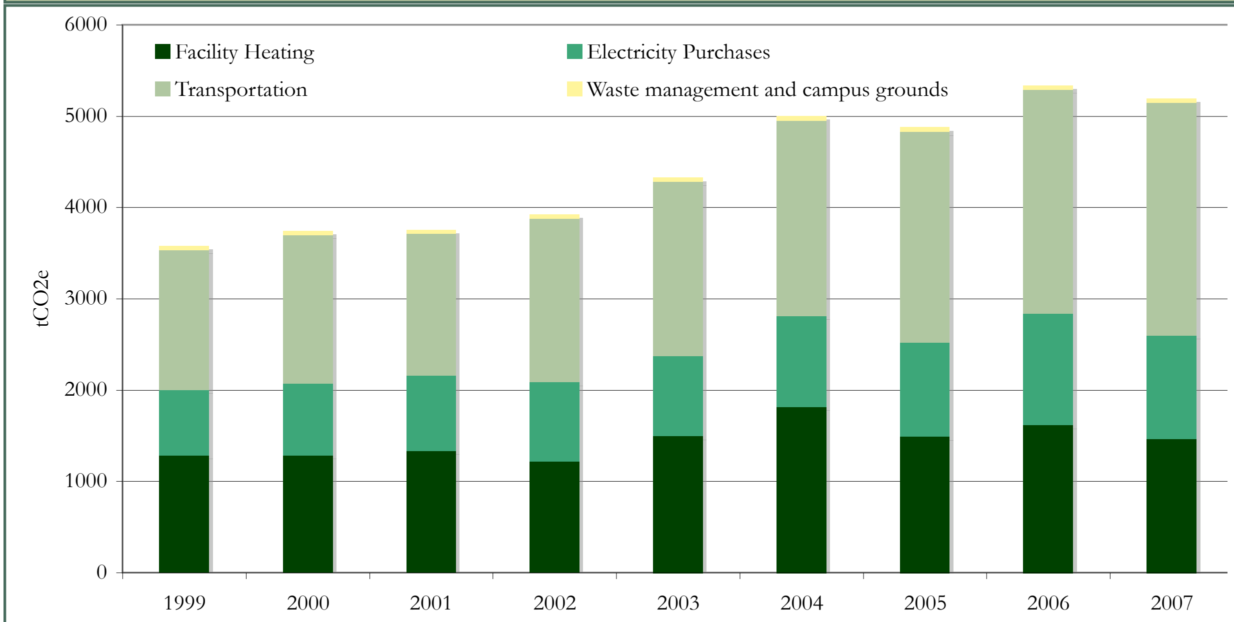


FIGURE 2: FULL TIME STUDENTS AND GHG EMISSIONS PER STUDENT 1999-2007

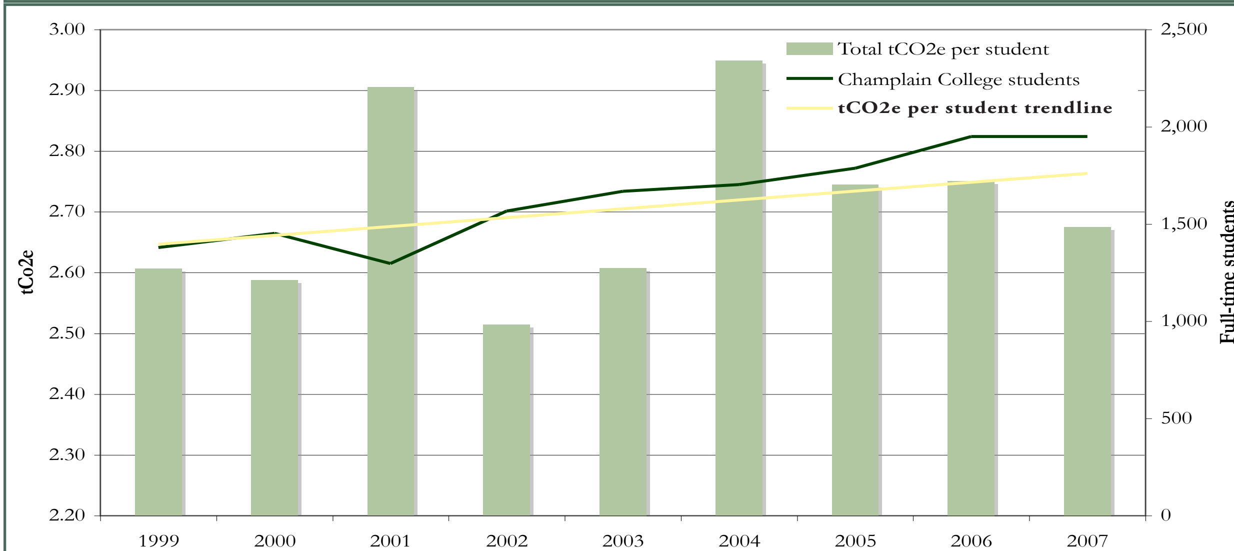
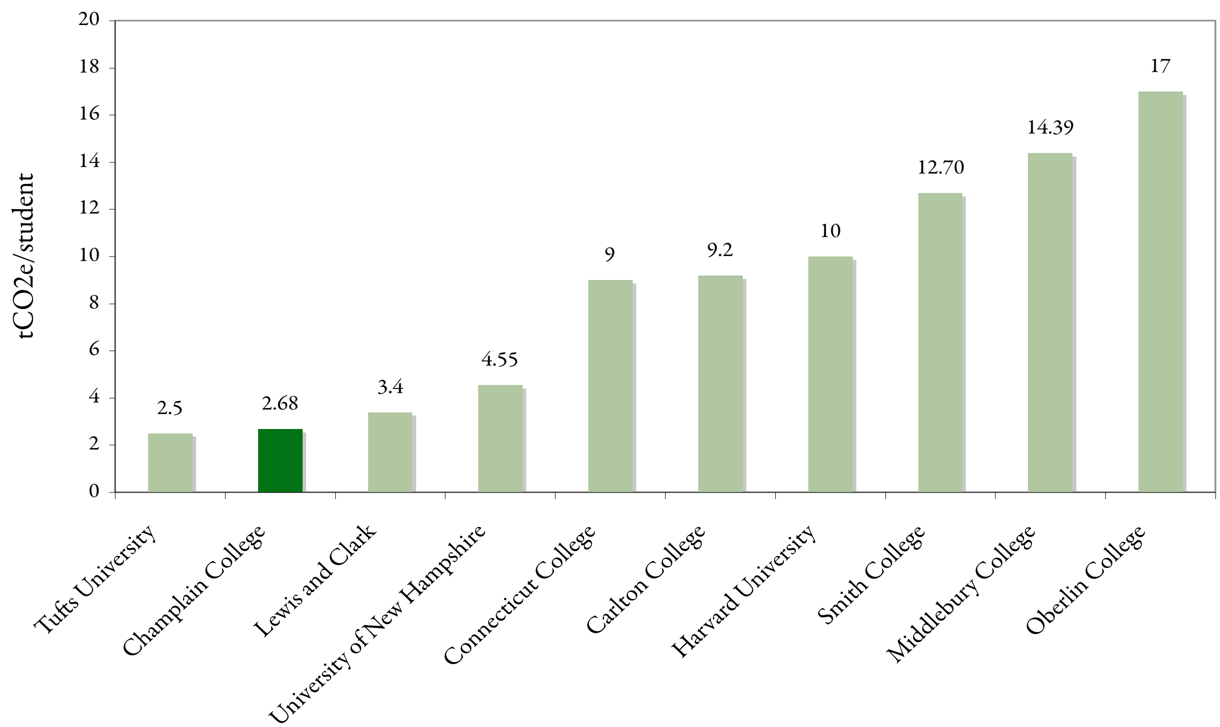


FIGURE 3: CHAMPLAIN COLLEGE'S EMISSIONS COMPARED TO OTHER INSTITUTIONS 2007



Buildings: Space heating, electricity consumption, and refrigerant leakage

The operation of facilities is typically the largest source of GHG emissions on college campuses. However, new technologies and innovative designs can reduce their impact on the climate (Box 3). In 2007, Champlain College facility heating and electricity purchase were responsible for 1,465 and 1,133 tCO2e, respectively. These emissions resulted from the consumption of 268,755 CCF (100 Cubic Feet) of natural gas for space heating and hot water production, and the use of 4.6 million kilowatt hours (kWh) of electricity.[2] Unintentional leakage from CC's air-conditioning and refrigeration systems contributed an additional 25 tCO2e into the atmosphere.

Historical GHG production due to Champlain College's buildings is strongly correlated with new building construction (Figure 3). In particular, the construction of the IDX Student Life Center and the Global Business Center in 2003-2004 increased total building GHG emissions by nearly 30%. Variations in yearly emissions can be partly attributed to climatic variations, with higher natural gas consumption in colder winters, and greater electricity consumption in warmer-than-average summers due to increased air conditioning demand. Appendix B contains a more detailed analysis of Champlain College building energy use.

2 See Note 2-3, Appendix A for more details on Champlain College building related emissions.

FIGURE 3: GHG EMISSIONS AND BUILDING SQUARE FOOTAGE 1999-2007

For many years, Champlain College has made a concerted effort to reduce its energy use. For example, working with the Burlington Electric Department, the college has identified priorities and implemented changes to its lighting systems. Physical plant staff have upgraded heating systems in several buildings to state of the art, high efficiency condensing boilers, and have implemented boiler control optimization. In addition, building heating and cooling controls are centrally managed, utilizing an energy efficient climate control scheduling system to avoid unnecessary energy consumption.

On a square foot basis, Champlain College's building-related emissions (5.7 tCO_2e per 1,000 sq ft. in 2007) are less than those from comparable northern colleges. For example, the University of New Hampsire's building-related emissions were 12.4 tCO_2e per 1,000 sq ft. in 2005. There are several likely reasons for this:

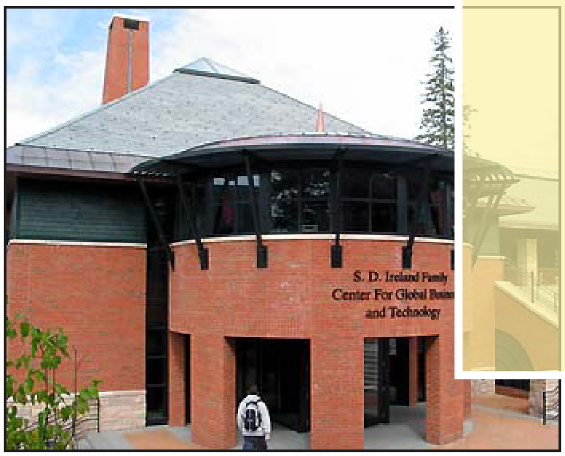
- In contrast to many colleges, Champlain College relies exclusively on natural gas for space heating. The combustion of natural produces less GHG emissions per unit of energy than any other non-biomass heating source.
- Champlain College purchases electricity from Burlington Electric Department (BED), which features a fuel mix that is approximately 68% renewable and emission-free (including 15.3%

nuclear energy). In fact, BED power sources generate nearly three times less tCO_2e per kWh than the national average.

- Champlain College efficiently uses its building space. For example, Champlain College has four times less square footage of facility space per student than Middlebury College.
- Champlain College has few energy intensive research laboratories or greenhouses.
- Champlain College's culture of conservation and environmental stewardship has led to proactive energy management and conservation practices.

BOX 3: YALE'S KROON HALL

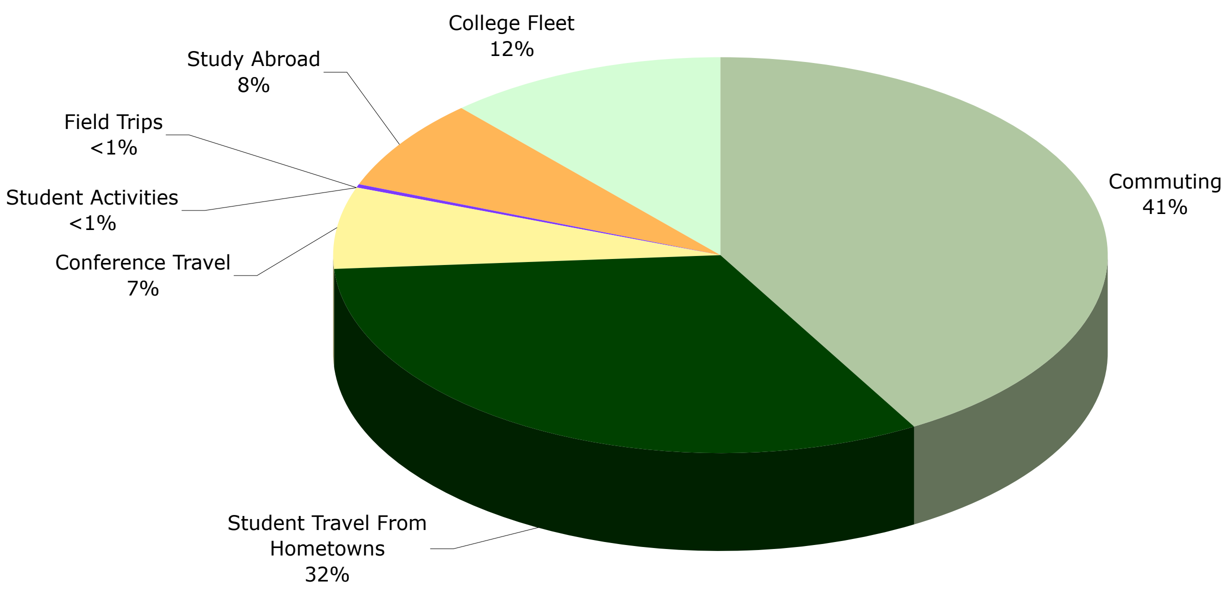
YALE'S KROON HALL, the college's School of Forestry and Environmental Studies new building, will go beyond LEED Platinum Rating while consolidating the school's operations. Among other features, the project incorporates recycling of demolition and construction waste, passive solar orientation, photovoltaic and solar thermal panels, geothermal heat pumps, natural light and ventilation, manually operable windows, green construction materials, recycled products, sustainability harvested wood, a rainwater harvesting system, and a closed loop, storm-water cleansing pond.



Transportation

Transportation-related emissions, which include fleet fuel usage, commuting, travel for study abroad programs, and travel to field trips, conferences, and student activities were responsible for about 2,549 tCO_2e, or 49% of Champlain College's total emissions in 2007. As seen in Figure 6, daily commuting was responsible for over half of the college's transportation-related emissions. Student travel from hometowns and the college's fleet made up the next largest sources of transportation-related emissions.

FIGURE 6: SOURCES OF TRANSPORTATION RELATED EMISSIONS 2007

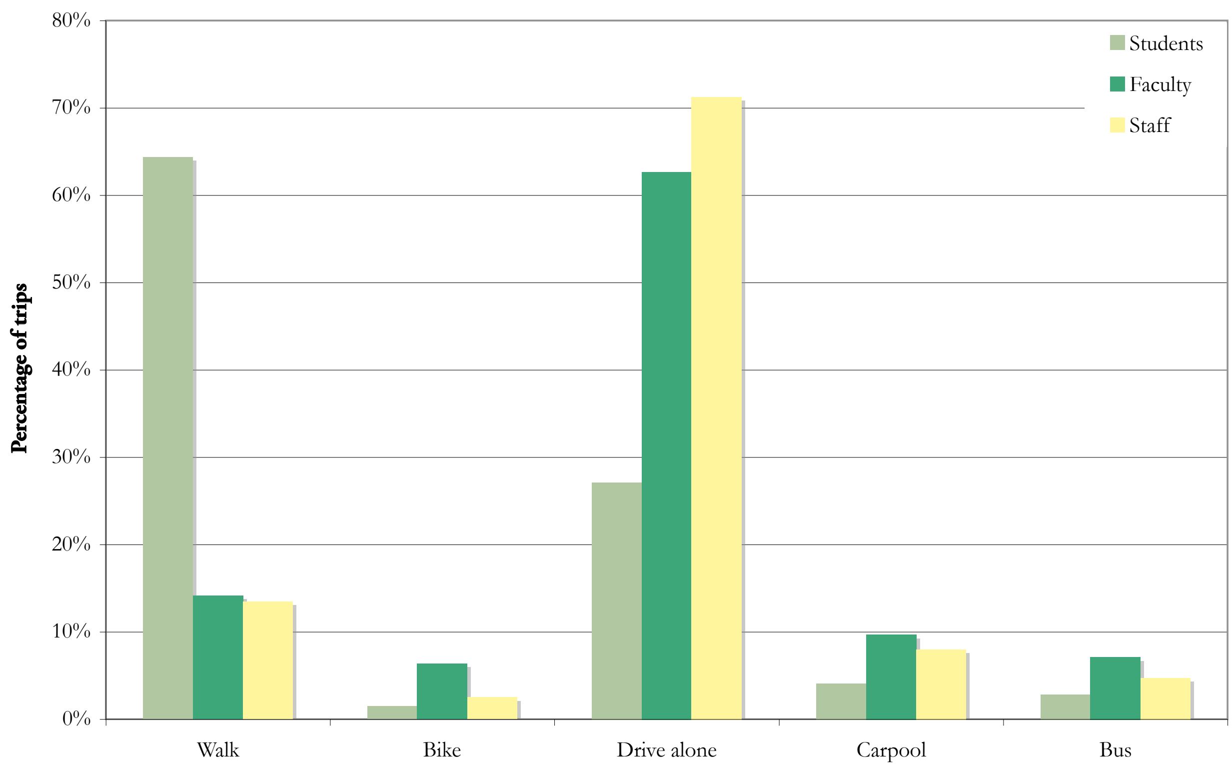


Commuting

In a course of a year, Champlain College students, faculty, and staff commute a total of nearly eight million miles between their homes and campus. While students live relatively close (the majority less than five miles from campus), the average staff and faculty member live 9 and 14 miles away, respectively. Walking, the prevalent mode of travel to campus for students, accounts for 64% of student trips. On the other hand, 70% of faculty and 57.4% of staff commute in single occupancy vehicles (Figure 7), which is an energy intensive mode of travel.[3]

3 See Notes 4-9, Appendix B, for explanation of transportation related calculations.

FIGURE 7: STUDENT, FACULTY, & STAFF MODES OF COMMUTING 2007

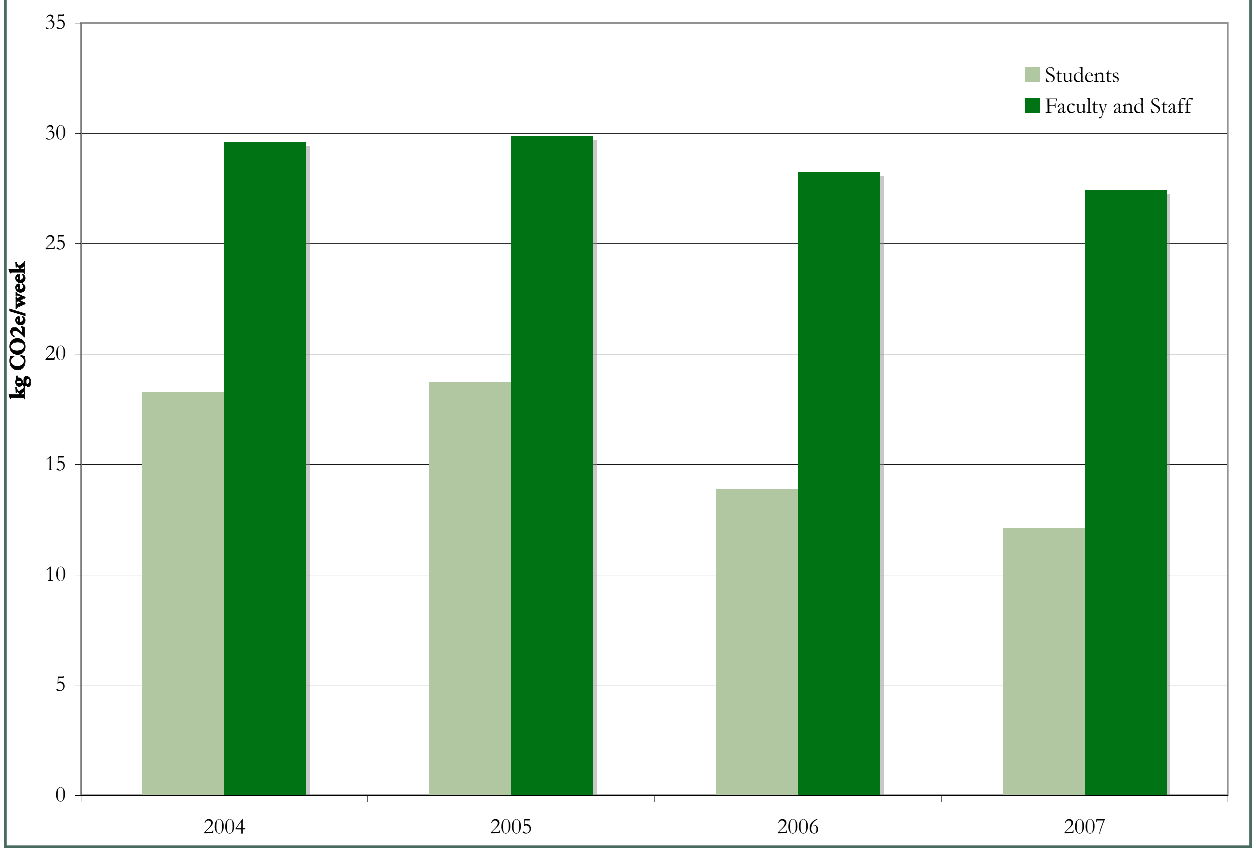


Since 2004, Champlain College has made impressive progress in reducing single occupancy vehicle travel. An analysis of historical transportation surveys shows that the use of the CATMA buses and campus shuttles has increased from being the primary mode of travel for just 1.8% of employees and 3.3% of students in 2004 to over 11% of employees and 7.8% of students in 2007. In addition, 29% more students now rely on walking or bicycling as their primary means of traveling to campus than in 2004.[4]

These two changes have had a clear impact on Champlain College's carbon footprint. In 2004, the average student commute produced approximately 18.3 kg CO_2e per week. In 2007, it decreased to 12.1 kg CO_2e, a drop of 34%. In addition, employee emissions have decreased from 29.6 to 27.4 kg CO_2e/week (Figure 8). Because of these changes, the estimated emissions due to commuting have decreased by nine metric tons between 2006 and 2007, despite an increase of 41 employees during that same period.

4 Note that these historical comparisons, derived on CATMA surveys, are based on data on "primary mode of travel," compared to the "percentage of trips" used predominately in this analysis.

FIGURE 8: PER PERSON GHG EMISSIONS DUE TO COMMUTING 2004-2007



BOX 4: UNIVERSITY OF WASHINGTON

UNIVERSITY OF WASHINGTON in Seattle, has one of the most successful college Transportation Demand Management programs. Only 24% of the 60,000 students, faculty, and staff commute to campus in single occupancy vehicles, while the others utilize alternative and less polluting means of transportation. The school's comprehensive program includes access to regular bus transit routes and vanpools, free carpool parking permits, shuttle services, bicycle lockers, covered parking, emergency rides home, car-sharing, and merchant discounts.

Website: www.washington.edu/commuterservices/get_to_uw/other/index.php/index.php/

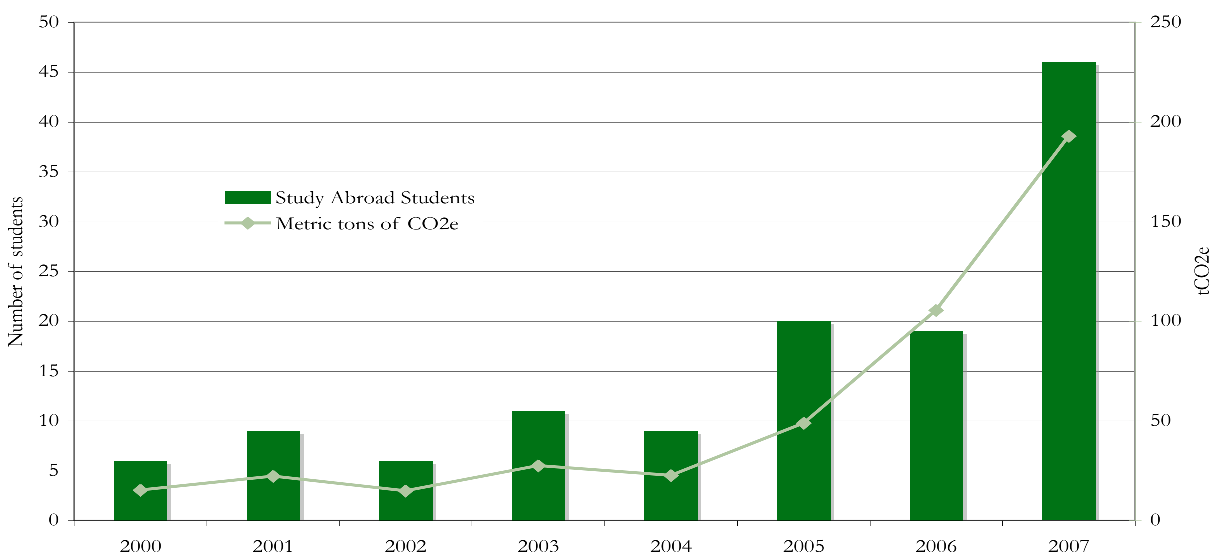
College Fleet and Shuttles

The college's Office of Physical Plant and Office of Safety maintain a total of 19 vehicles, which, along with the two campus shuttles, utilize about 20,000 gallons of fuel annually and release 294 tCO_2e (0.15 tCO_2e/student) into the atmosphere. The largest fuel consumers are the Spinner Place shuttle and the Physical Plant's work trucks. The college's vehicle fleet emissions, when standardized by student numbers, are comparable to the University of New Hampshire (0.15 tCO_2e/student), greater than Carleton (0.08 tCO_2e/student), and significantly less than Middlebury (0.67 tCO_2e/student).

Study Abroad Related Travel

In the 2007 academic year, 46 students spent a semester abroad, traveling 545,000 miles to and from the study abroad locations. Approximately 193 tCO_2e are attributable to these flights. While still small relative to other sources of emissions, their popularity and resulting climate impact has grown ten-fold since 1999, and nearly doubled between 2006 and 2007 (Figure 9).

FIGURE 9: STUDY ABROAD STUDENTS AND GHG EMISSIONS 2000-2007



Student Travel From Hometowns

In the past three years, Champlain College has attracted students from 36 states and 19 foreign countries. The average student, traveling 250 miles between their hometown and Burlington at the beginning and end of each semester, is responsible for about 0.39 tCO_2e of GHG emissions. In 2007, a total of 819 tCO_2e can be attributed to this travel, which represents approximately 32% of Champlain College's transportation-related emissions and 15% of the college's total emissions.

Field Trips And Conferences

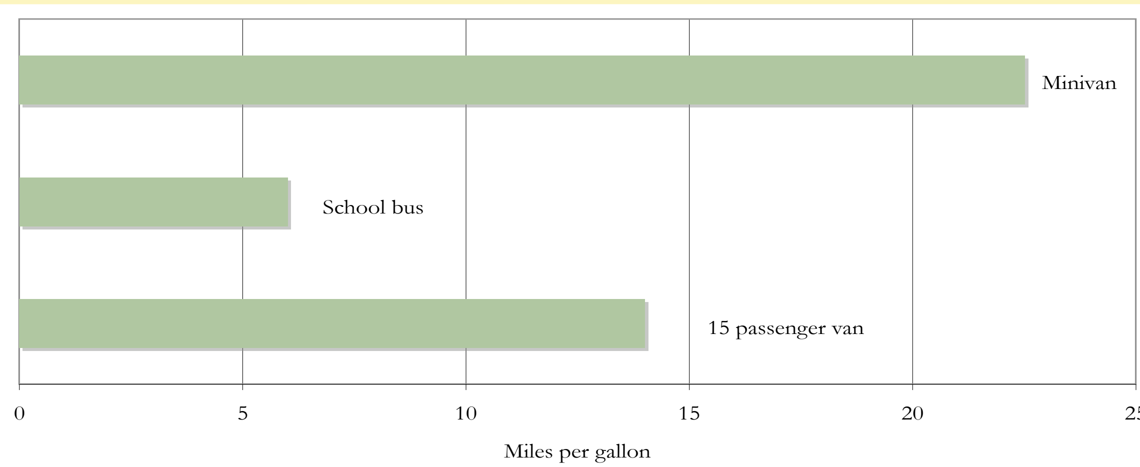
The average faculty member leads between one and two field trips annually. As most trips are local, they result in few emissions; a total of only 2.33 tCO_2e can be attributed to faculty field trips in 2007. Conference travel is a more significant source of GHG emissions and was responsible for approximately 170 tCO_2e in 2007. The average staff, faculty, and student travel to between two and five conferences annually. While most students traveled to these conferences in energy efficient busses, staff and faculty relied primarily on single occupancy vehicles and airplanes, which produce more tCO_2e per passenger mile than any other mode of travel.

Office of Student Life Travel

Champlain College organizes travel events for students each year, including skiing trips, whitewater adventures, bowling excursions, and movie nights. Most of these trips are regional in nature and rely on efficient busses and vans for transportation. In 2007, 5.2 tCO_2e could be attributed to these trips. Trip emissions have increased five fold since 1999. As student numbers and demand for trips increases, Champlain College is sponsoring more trips and renting larger vehicles for travel, increasing their impact.

BOX 5: FUEL EFFICIENCIES OF BUSES AND PASSENGER VANS

BUSES, 15 PASSENGER VANS, AND MINIVANS are the most common vehicles used for shuttling and transporting students for academic and recreational purposes. As seen in the graph below, these vehicles vary in their fuel efficiency. GHG emissions can be mimized by choosing a vehicle size that maximizes the vehicle occupancy rate.

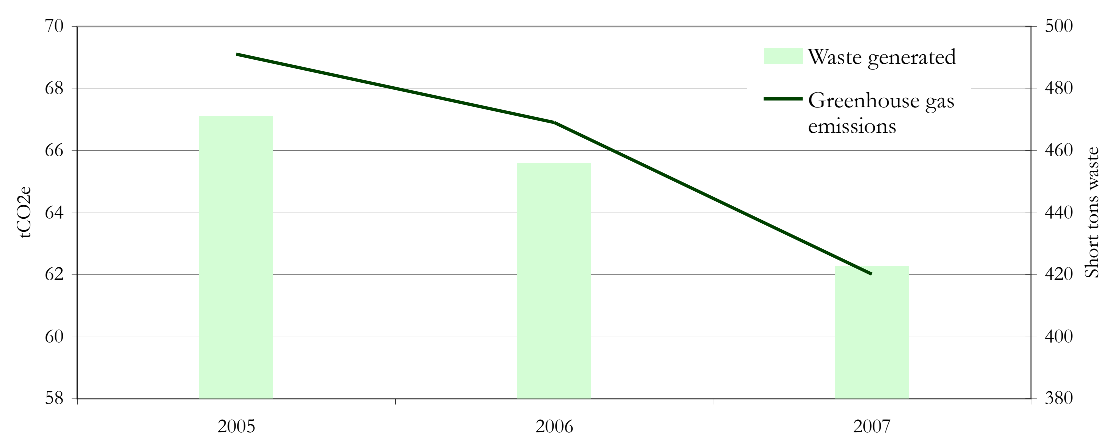


Waste Management

Champlain College produced a total of 423 short tons of solid waste in 2007 which was landfilled at Casella Waste System's facility in Coventry, Vermont. The cumulative climatic impact of waste transportation and methane off-gas in 2007 was 62 tCO_2e, after accounting for avoided utility emissions due to Coventry's landfill gas to energy project. Champlain College also sent just under 100 short tons of compost to Burlington's Intervale Compost Products. The production of this compost, rich in carbon, sequestered approximately 18 tCO_2e.[5]

By working closely with CSWD, Champlain College has made impressive efforts to reduce its landfilled waste by 11.4% since 2005 (Figure 9). This effort has had both financial and climatic benefits, saving over $10,000 per year and reducing GHG emissions by seven metric tons annually, which is more than the emissions generated due to student activity travel. Currently, Champlain College diverts 38% of its waste from the landfill through its recycling and composting efforts. This figure is higher than the national average of 32.5% and similar to the University of Vermont, but lower than leaders such as Ithaca College (Box 6).

FIGURE 9: WASTE GENERATED AND GHG EMISSIONS 2000-2007



BOX 6: ITHACA COLLEGE RECYCLING

ITHACA COLLEGE in New York, aggressively recycles office materials, metals, and food wastes, achieving a 45% diversion rate and saving $50,000 in disposal and landscaping costs a year. Students living in dorms not only recycle paper and containers but are also given paper bags specifically for food scraps. Their dining services have adopted zero waste principles and utilize compostable containers.

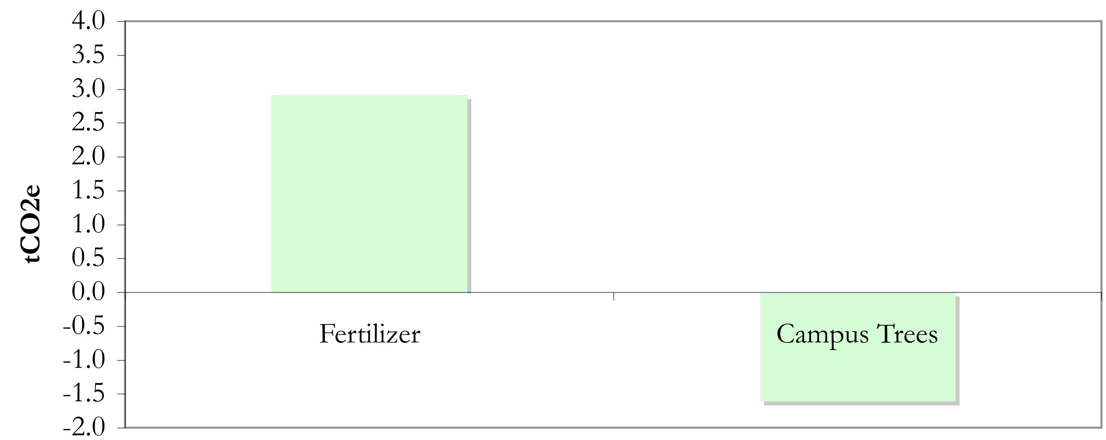
5 See Notes 12-13, Appendix A, for details on waste and compost calculations.

Grounds

Champlain College maintains its 21.8 acres of campus green space by applying both compost and organic fertilizers as soil additives. Fertilizer production is an energy intensive process. Eight tCO_2e can be attributed to the 2,300 pounds of fertilizer used annually on Champlain College's grounds (Figure 10). Because the college uses organic fertilizers, as opposed to synthetic versions, the resulting GHG emissions are 0.5 tCO_2e less on an annual basis than they otherwise would be. Champlain College grounds are also home to 221 trees, which absorb an estimated 1.6 tCO_2e of carbon annually from the atmosphere, or approximately 16 pounds per tree.[6]

Innovative colleges are increasingly incorporating native plantings and relying on natural, manure-based fertilizers (Box 7). Increasing the use of compost, unmowed areas, and native plant gardens, could provide Champlain College with new learning opporunities while benefiting native species and the global climate.

FIGURE 10: CAMPUS GROUNDS AND GHG EMISSIONS 2007



BOX 7: GREENING OF CAMPUS GROUNDS

ST. OLAF'S COLLEGE in Minnesota, has reduced by one-third the area of mowed grass on campus and switched to natural, manure-based fertilizers. Students and faculty at Marymount College, a small two-year college in southern California, have initiated several on and off campus native plantings and habitat restoration projects. Plantings have been conducted as field projects for classes, by student environmental groups, and as part of alternate spring break trips.

6 See Notes 14-15, Appendix A, for details on campus grounds calculations.

6.0 Next Steps And Opportunities For Improvements

While Champlain College has taken many steps toward reducing its energy use and environmental impact, significant opportunities remain for future action. While a complete assessment was beyond the scope of this initial report, several immediate opportunities should be considered:

- **Lighting Upgrades**: The Burlington Electric Department has identified several buildings, including the Campus Bookstore and the Hauke Family Campus Center, that continue to rely on energy inefficient incandescent lights. Replacing these lights with energy efficient fluorescent fixtures offers the college cost savings and GHG emissions reductions.
- **Demand management**: If Champlain College follows through with plans to install a back-up generator, the college should consider participating in the ISO New England 30-Minute Demand Response Program. The Program could lead to monthly income of about $1,000/month for providing energy to the grid at times of peak need. This revenue could in turn be invested in energy efficiency efforts.
- **Revolving loan fund:** Revolving loan funds provide an interest-free source of capital for energy efficiency projects. They are an effective method of removing financial barriers to beneficial initiatives. Typically, the loan is repaid by reductions in operating costs (Box 8).
- **Green building policies:** Green buildings save money, increase productivity, and serve as powerful symbols of dedication to sustainability. The U.S. Green Building Council's "Leadership in Energy and Environmental Design" (LEED) standards, first published in 2000, provide a set of construction and renovation standards and practices. A study published by the Massachusetts Technology Collaborative in 2003 reported that achieving the LEED Gold standard raised the cost of new construction by an average of 1.8% while reducing energy use by 37%.
- **Student, staff, and faculty involvement:** Colleges are increasingly turning to the knowledge and enthusiasm of their faculty and students to help with the campus response to climate change (Box 9). Champlain College has an opportunity to expand on the effort of Sustain Champlain to create interdisciplinary teams of faculty, students, and staff to develop solutions to address climate change.

BOX 8: REVOLVING LOAN FUNDS

THE UNIVERSITY OF COLORADO in Colorado, recently established an "Energy and Climate" revolving loan fund to support energy efficiency measures. The $500,000 fund, created by the student government, uses capital contained in a Special Operating Reserve fund. In 2007, the student government passed legislation mandating all student-run buildings achieve climate neutrality. Website: ecenter.colorado.edu/in_the_news/press_releases/07-05-03carbon-neutral.html/

BOX 9: STUDENT INVOLVMENT

At CORNELL UNIVERSITY in New York, at least 12 faculty members from such fields as engineering, biology, architecture and communication are devoting all or part of an academic course this fall to evaluating options for Cornell to achieve a cleaner, greener campus. This is part of a university wide effort to tackle head-on the enormous challenge of creating a plan to make Cornell climate neutral. The idea behind recruiting such a broad array of subjects and expertise is to examine as many aspects of the climate neutrality problem as possible, and to involve students from a variety of disciplines in a coordinated and effective effort.

7.0 Conclusions And Key Findings

This Phase 1 carbon assessment identifies Champlain College as an institution with one of the lowest carbon footprints among its peer institutions. With these findings, the college is well positioned to take on a leadership role in addressing climate change. At the same time, the college must continue to identify new opportunities for cost savings, energy security, and environmental leadership. The key findings of this analysis are outlined below.

- Champlain College has one of the lowest carbon footprints when compared to other colleges and universities on a per student basis. This is largely due to a compact building footprint relative to the size of its student population.
- The college's heating and electricity sources, which are its two largest sources of GHG emissions, are among the cleanest in the nation.
- The college has actively pursued energy efficiency and other sustainability efforts in its buildings and operations.
- Champlain College has begun taking steps toward reducing the use of single occupancy vehicles, most notably among students. This effort led to a net drop in commuting related emissions between 2006 and 2007.
- Even without accounting for the embodied energy in their construction, new buildings are largely responsible for the historical increase in Champlain College's GHG emissions. Effectively using the college's current building space, and prioritizing building renovation over new building construction is crucial to minimizing the college's future carbon footprint.

This report provides a baseline assessment of Champlain College's GHG emissions, and can serve as a guiding document as Champlain College considers further carbon management and sustainability efforts. Recommended next steps include:

- Measure: Continue review emissions on periodic basis, using a centralized tracking system for effective monitoring.
- Mitigate: Evaluate and pursue new opportunities for conservation, efficiency, and on-site renewable energy.
- Maximize: Leverage these efforts through climate registries, recognition programs, and marketing efforts.
- Manage: Institutionalize a system for regular review, integrate findings into strategic planning processes, develop marketing material, and attract funding to support sustainability initiatives.

While Champlain College has reasons to be proud of its success, continued action is imperative if the college is to maintain its leadership role and aggressively address climate change. For example, hundred of colleges have committed to achieving reductions in their GHG emissions and to better integrating sustainability into their curriculum (Box 10), and Champlain College should consider joining them.

The current climate change crisis represents not only a serious challenge, but an opportunity for colleges to take a leadership role in addressing what is one of the most significant environmental and social issues of our time. To move beyond "low hanging fruit" requires a culture where priority is given to research and education relating to climate change and energy along with the commitment of organizational resources, staff training, and creative efforts. Champlain College appears well on its way to meeting this challenge.

BOX 10: COLLEGE GHG REDUCTION TARGETS

A GROWING NUMBER OF COLLEGES have voluntarily committed to GHG reduction policies. Early adopters, like Cornell and Tufts, set a goal of meeting the targets set by the Kyoto Protocol, and international agreement on climate change. More recently, under the framework of the American College & University Climate Commitment, more than 500 college presidents signed a commitment calling for the creation of an instituional structure, a comprehensive GHG inventory, and a strategy for carbon reduction that includes a target date, interim goals and actions, and mechanisms to track progress.

Appendix A: Assessment Methodologies And Assumptions

Note 1: Greenhouse Gasses

The six main GHGs considered by the GHG Protocol are listed below, along with their Global Warming Potential (GWP) values. Because GHGs vary in their ability to trap heat in the atmosphere, some are more harmful to the climate than others. Each GHG has a GWP, which refers to its heat-trapping ability relative to that of carbon dioxide (CO_2). For example, CO_2 is the most prevalent GHG, but methane (CH_4) is 21 times more potent, thus the GWP of methane is 21. GHGs are often reported as CO_2-equivalents (CO_2e). (Source: Intergovernmental Panel on Climate Change (IPCC), "Climate Change 1995: The Science of Climate Change.")

Primary GHGs considered by the GHG Protocol:

- Carbon dioxide (CO_2), GWP = 1
- Methane (CH_4), GWP = 21
- Nitrous oxide (N_2O), GWP = 310
- Hydrofluorocarbons (HFCs), GWP = 140 – 11,700
- Perfluorocarbons (PFCs), GWP = 6,500 – 9,200
- Sulfur hexafluoride (SF_6), GWP = 23,900

- ▶ Carbon Dioxide (CO_2): Anthropogenic carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is removed from the atmosphere when it is absorbed, or "sequestered", as part of the biological carbon cycle.
- ▶ Methane (CH_4): Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.
- ▶ Nitrous Oxide (N_2O): Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.
- ▶ Fluorinated Gases: HFCs, PFCs, and SF_6 are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases ("High GWP gases"). These gases are typically associated with refrigeration and air conditioning equipment.

Note 2: Building Related Emissions

Champlain Colleges 20 dormitories, fraternities, and sororities, and 18 academic buildings and leased properties are significant sources of GHG emissions due to combustion of natural gas in the college's boilers and furnaces, and electricity consumption. Utility use records for the years 1999-

2007, segmented by building, were provided by Champlain College Facilities staff. Due to concerns of the accuracy of provided records, 2007 utility data was also obtained directly from Vermont Gas and Burlington Electric. Based on Burlington Electric's published average fuel mix, the emission factor was calculated as .243 kilograms of CO2e per kilowatt-hour generated (kg CO2e/kWh). Due to the lack of historical data, and few significant changes in the fuel mix since 1999, the same emission factor was used for all years analyzed. For the natural gas usage, an emission factor of 5.45 kg CO2e per CCF combusted is used (Source: GHG Protocol CO2 Emissions from Fuel Use in Facilities Tool, 2006, http://www.ghgprotocol.org/calculation-tools/service-sector)

Note 3: Fugitive Emissions

HFC (hydrofluorocarbon) and PFC (perfluorocarbon) emissions – known as fugitive emissions – result from cooling and refrigeration equipment manufacturing, and leakage during both the operational life and during its disposal. In 2007, Champlain College's cooling equipment were recharged with 30 pounds of R-22 and 3 pounds of R414b. (Source: Bob Bolin, Campus Facilities). As R-22 has a global warming potential (GWP) of 1,700 that of CO2, an emission factor of 1700 kg CO2e/kg refrigerant was used to calculate emissions (Source: Clean Air Cool Planet Campus Calculator v5). Values for 1999-2006 were rescaled to maintain the same square footage to fugitive emissions as calculated for 2007.

Note 4: Transportation Survey

Data on GHG emissions due to students, faculty, and staff commuting, and conference and field trip travel was obtained through a survey distributed electronically to the entire campus community in March, 2008. 48 faculty (53% response rate), 100 staff members (53%), and 283 (15%) students participated in the survey. To check for potential survey errors, the results were compared to a recent survey conducted by the Campus Area Transportation Management Association (CATMA). While some discrepancies were noted, they were within an acceptable margin of error given biases inherent in all survey designs.

Note 5: Commuting Analysis

Survey participants were asked to estimate how far they live from Champlain College, the average number of days per week they commute, and the proportion of their trips done by walking, bicycling, driving in a single occupancy vehicle, carpooling, or taking a bus. Personal vehicles were assumed to have an average fuel economy of 22 mpg (Source: US Transportation Energy Data Book). Community members were assumed to take one round trip each day they traveled to campus. Respondents who indicated they carpooled to campus were asked to report the number of individuals in their carpool. Those who relied on public transit also provided information on their use of park and ride lots, and the distance traveled from their homes to the park and ride.

2004-2006 values were calculated by adjusting the average GHG emissions per student, faculty, and staff to reflect changes in commuting modes of travel reported in CATMA's annual surveys. Average per person emissions for 1999-2003 were assumed to be identical as those calculated for 2004. Finally, emissions for 1999-2006 were rescaled to reflect changes in the quantity of Champlain College students, faculty and staff.

Note 6: Conference Travel

Faculty, staff, and students were asked to estimate the number of conferences they attend in a typical year, and to provide specific travel data for their most recent trip. The average GHG emissions per trip were multiplied by the total number of reported faculty, staff, and student trips to arrive at a total annual emissions for survey participants. Total emissions for Champlain College was calculated by multiplying the sample total by the inverse of the response rate.

Note 7: Field Trip Travel

Faculty provided an estimate of the number of field trips they lead in a typical year, and specific travel data for their most recent trip. The average GHG emissions were calculated for their most recent trip. The average emissions per trip were multiplied by the total number of annual trips reported by faculty. Total emissions for the college were calculated by multiplying the sample total by the inverse of the faculty response rate.

Note 8: Student Event Travel

Beth Fitzgerald Student Activities Coordinator in Champlain College's office of Student Life, provided detailed records on sports and recreation related trips for the years 1999-2007. Travel records included information on year of travel, destination, estimated round trip distance, number of trips per year, vehicle types, and number of vehicles. Due to non-centralized record keeping, this estimate does not include all college related student travel, only trips organized by Student Life. Vehicles types used by Champlain College Student Life, and their estimated fuel efficiency, are as follows:

TABLE 2 : VEHICLE TYPES AND ESTIMATED FUEL EFFICIENCIES

Vehicle Type	Fuel Efficiency (mpg)	Source
15 Passenger Van	14	Bandago Van Rental Co. http://www.bandago.com
School Bus	6 (diesel)	NREL 2000. Demonstration of Caterpillar C-10 Dual-Fuel Engines in MCI 102DL3 Commuter Buses. National Renewable Energy Laboratory.
Couch Bus	6 (diesel)	American Bus Association, personal communication with Norm Littler. February 2008.
Minivan	22.5	EPA 2008. http://www.fueleconomy.gov/
Passenger Vehicle	22	US Transportation Energy Data Book (2004)

Note 9: Champlain College Fleet

Champlain College's Office of Physical Plant and Office of Safety and Parking Office maintain vehicle fleets (Table 3). Dates of purchase, current odometer readings, and mileage at time of purchase were provided by office staff. Annual mileage was distributed evenly between the years the vehicle was in operation. The College also runs contracts with Mountain Transit to provide shuttle service to off campus sites. Annual mileage estimates was provided by Kris Sirette, Champlain College's Public Information and News Director. Fuel efficiencies were estimated through a literature review, information from company mechanics, and communication with Champlain College staff. Due to lack of data, this study does not estimate emissions due to Champlain College vehicles used between 1999-2006 but not currently in operation.

TABLE 3: CHAMPLAIN COLLEGE VEHICLE FLEET

Vehicle	Model	Hours	Miles	Average Gallons / Hour	Average Miles / gallon	Years in operation	*Gallons per year*
Volvo[1]	L20 Loader	399		0.751		3	*100*
Bobcat[2]	853	1315		12		15	*88*
Bobcat[2]	863	298		1		9	*33*
Bobcat[2]	553	284		1		11	*26*
ASV[3]	RC30	230		1.43		5	*64*
Dodge[4]	Ram 1500		126400		114	7	*1642*
Chevy	Dump 3500		9570		11	2	*435*
GMC	1500		74026		14	12	*441*
GMC	1500		53566		14	3	*1275*
Chevy	Van		30282		14	7	*309*
Chevy	1500		11649		14	2	*416*
Chevy	2500		2882		14	1	*206*
GMC	1500		162181		14	13	*891*
Subaru	Forester		13274		19	1	*699*
Chevy	Van		29271		15	7	*279*
Chevy	Van		29366		15	7	*280*
Jeep			81821		7.5	10	*1091*
Jeep			26813		12.95	2	*1035*

1. Personal Communication with Bob West, Volvo Mechanic
2. Personal Communication with Lewis Barnes, Champlain College
3. Personal Communication with ASV Mechanic, Detroit
4. City MPG for Dodge, Checy, GMC, and Jeeps obtained from http:www.fueleconom

Note 10: Study Abroad Travel

Each year, between 15 and 110 Champlain College Students study abroad. Records on the number of students and their destination country were provided by Peggy O'Neill, Study Abroad Coordinator, Office of International Programs. This study includes GHG emissions resulting from one roundtrip flight from Burlington, VT to the study abroad location, per student, per year. Travel distances were calculated using an online distance travel tool. Destinations were assumed to be the geographic center of each country, except for Canada, where the majority of students were assumed to be studying in Montreal, and Argentina, where the city of Buenos Aires was used as the destination. All students traveling overseas were assumed to make one connecting flight to Boston, Massachusetts.

Note 11: Transportation Related tCO_2e Factors

A common set of emission factors, obtained from Clean Air Cool Planet Campus Calculator v5, was used for all ground travel calculations. They are as follows:

- Gasoline: 9.03 kg CO2e/gallon
- Diesel:10.08 kg CO2e/gallon
- Inner-city bus: .193 kg CO2e/passenger km

Emissions resulting from Champlain College air travel are calculated using the following emission factors, as recommended by the Climate Neutral Network, the TRADEOFF Project, and Native Energy:

- Short flights (less than 500km): .30 kg C02e/passenger km
- Medium flights (500-1600 km): .24 kg CO2e/ passenger km
- Long flights (Great than 1600 km): .22 kg CO2e/passenger km
- Radiative Forcing Index = 2.0

Native Energy provides a thorough explanation regarding the use of these factors on their website (www.nativeenergy.com):

Shorter flights are more fuel intensive because of the significant amount of altitude gain relative to the length of the flight itself. On a short trip, a large portion of the energy per mile is devoted to climbing and landing, compared to cruising. That means shorter trips are more carbon intensive. Depending on whether your travel fits into the short, medium or long haul category, we apply a CO2 emissions factor of 0.64, 0.44 or 0.40 lbs of CO2 per passenger mile, respectively. This gives us the direct CO2 emissions from your flight. [These factors are from the GHG Protocol Commuting Emissions Tool v 1.2] In addition, we apply an RFI (radiative forcing index) of 2.0 to the direct CO2 emissions from air travel, resulting in total CO2 equivalent emission factors of 1.28, 0.88 or 0.8 for short, medium and long haul flight segments. By doubling the direct CO2 emissions, our goal is to account for the overall global warming impact of air travel for all air emissions - not just the CO2 - such as the warming effect of contrails. In its 1999 Special Report on Aviation in the Global Atmosphere, the Intergovernmental Panel on Climate Change (IPCC) estimated the RFI from air travel in 1990 to be between 2 and 4, averaging 2.7 times the carbon impact alone.

More recently, the TRADEOFF project of The Fifth Framework Programme of the European Commission of the EU, suggested an RFI of 1.9. The Climate Neutral Network recommends use of a 2.0 times factor on the short haul rate for all flight miles.

Note 12: Waste Management

Data on waste generation in 2007 was obtained from Lewis Barnes, Champlain College Office of Physical Plant. Historical quantities for 2005-2006 were calculated by rescaling 2007 values by differences in annual billing records. Calculations for years 1999-2005 were rescaled to maintain the same student to waste ratio as calculated for 2005.

Note 13: Compost

Champlain College delivered 240 yards of food waste and brush to Intervale Compost Products in 2007, equivalent to about 98.4 short tons (Source: Bob Perry, All Cycle). An emission factor of -.183 kg CO2e per short ton of compost was used to calculate the greenhouse emissions due to compost production (Source: Clean Air Cool Planet v5). As compost is considered a form of carbon storage that reduces climatic impacts, calculated emissions are negative. Values for 1999-2006 were rescaled to maintain the same student to compost ratio as calculated for 2007.

Note 14: Fertilizer Application

In 2007, Champlain College applied 1600 pounds of 12-0-6 and 4500 pounds of 6-0-0 organic fertilizer on its campus grounds (Source: Lewis Barnes, Grounds Supervisor, Champlain College Office of Physical Plant). GHG emissions resulting from the use of this fertilizer were calculated using the Clean Air Cool Planet v5 calculator. Historical annual fertilizer applications were assumed to be similar to 2007 quantities. For fertilizer applications, an emission factor of 3.44 kg CO2e/ lb organic fertilizer (91% nitrogen) was used. (Source Clean Air Cool Planet v5).

Note 15: Forested Landscape

As trees absorb carbon from the atmosphere, they can be considered a tool for sequestering carbon. A recent study conducted in New York City based on the US Forest Service carbon sequestration model "UFORE" estimated the city's 5.2 million trees sequestered 42,300 metric tons of carbon annually, or 16 pounds per tree, per year. Using the average sequestration rates calculated for New York City, Champlain College's 221 trees on its campus grounds were calculated to sequester about 1.6 tons of carbon annually.

The tCO2e emission factor used in this study (.147 tCO2e/short ton waste disposed in a landfill with methane recovery and electric generation) were obtained from Clean Air Cool Planet, and were derived from an EPA report Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks (2006). The emission factors were developed through an extensive life-cycle analysis (LCA) that calculates both emissions generated from waste disposal activities and avoided emissions.

There are several sources of both types of emissions generated due to waste. These include emissions from methane releases as biogenic products (i.e. paper) decomposes in a landfill, emissions related to transporting waste to a landfill or recycling facility, and nitrous oxide released in incinerating facilities. Waste disposal activities can also reduce the amount of GHGs in the atmosphere. Landfills are seen as a means of storing carbon using internationally accepted emissions accounting guidance, as biogenic products in landfills do not completely decompose. This prevents the CO2 that would have been generated from the natural decay of these products from reaching the atmosphere. Furthermore, electricity generated at incinerators and at landfills that feature methane capture facilities can be seen as reducing carbon emissions from traditional fossil-fueled power plants.

However, EPA does not recommend using all emission factors presented in their Life Cycle Analysis in a greenhouse gas inventory when the CO2e released as a result of producing the products are not counted. Following Clean Air Cool Planet's approach, we disregarded the emission factors that take into account the carbon storage of biogenic products in a landfill and factors specific to waste recycling.

Note 16: Cross College Comparisions

Previously published greenhouse gas inventories were reviewed to compare results across college campuses. When necessary, data on student numbers and building square footages was obtained by contacting college facility managers. The following colleges were compared in this assessment: Tufts University, Lewis and Clark College, University of New Hampshire. Connecticut College, Carlton College. Harvard University. Smith College, Middlebury College. and Oberlin College.

Appendix B: Building Energy Use and Comparisions

From 1999-2007, Champlain College consumed an average of 265,000 CCF (100 Cubic Feet) of natural gas for space heating and hot water production and purchased 3.8 million kilowatt hours (kWh) of electricity. In 2007, Champlain College consumed just under 270,000 CCF, and purchased 4.6 million kilowatt hours kWh. Fifty-five percent of the college's spacing heating and 47% of electricity purchases were for the college's twenty dormitories and fraternities.

When standardized by British Thermal Units (BTU), a common unit of energy measurement that accommodates for both electrical and heating fuel sources, Champlain College's IDX Student Life Center, Hauke, Information Commons, and Global Business Center, 381 Main St., Summit, and Aiken were the largest net consumers of energy among academic buildings and dormitories (Figures 11B and 12B). On a square foot basis, Champlain College's newest dormitory, 381 Main Street, is also its energy efficient one. Cushing Hall, built in 1872, is the least efficient. Despite the presence of energy intensive computer equipment, Foster Hall appears to be the college's most energy efficient building, while The Gallery, built in 1838 and the home for its Radiography program, uses the most energy on a per square-foot basis (Figures 13B and 14B).

FIGURE 11B: ENERGY USE IN ACADEMIC BUILDINGS 2007

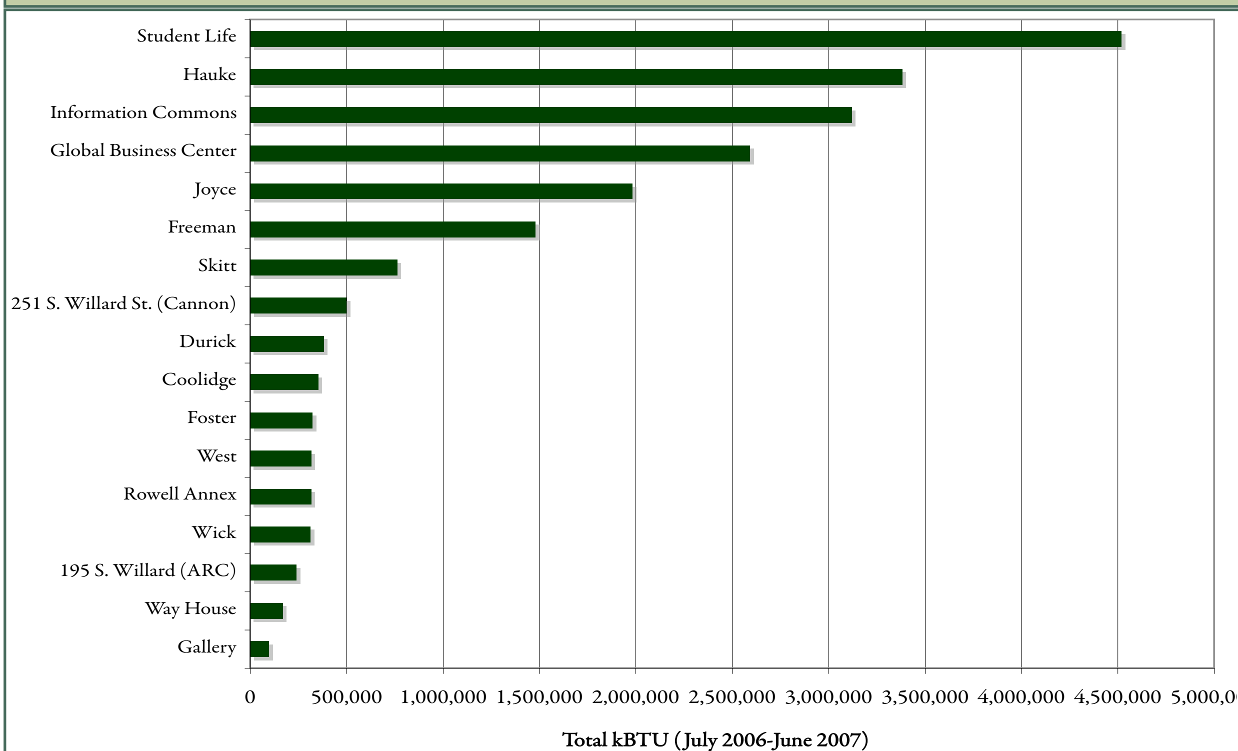


FIGURE 12B: ENERGY USE IN DORMITORY BUILDINGS 2007

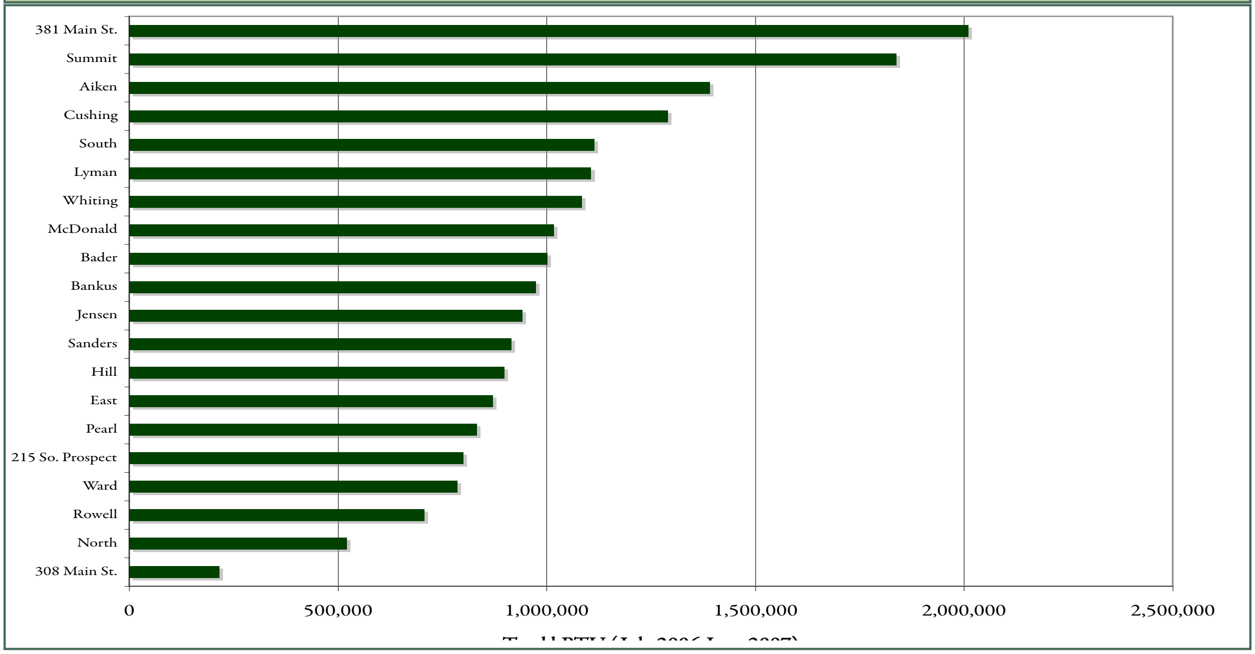


FIGURE 13B: ENERGY USE PER SQUARE FOOT IN DORMITORY BUILDINGS 2007

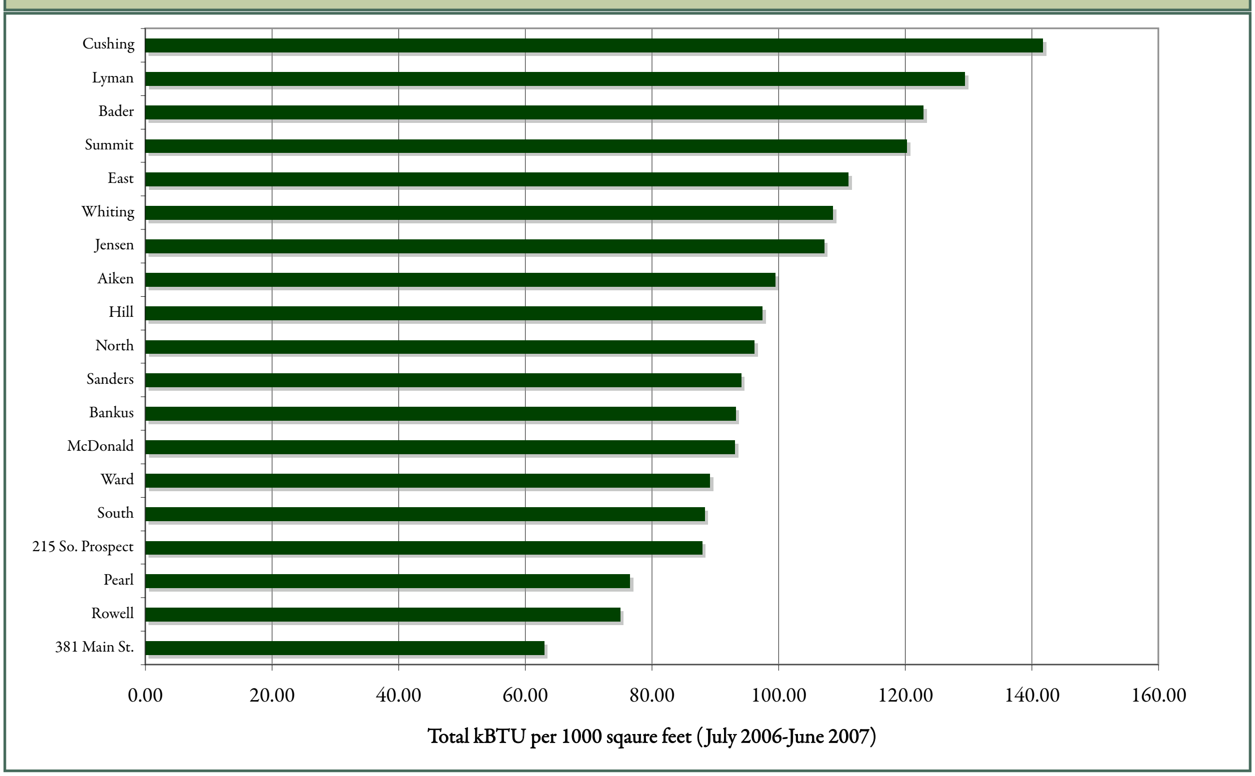


FIGURE 14B: ENERGY USE PER SQUARE FOOT IN ACADEMIC BUILDINGS 2007