Emerson College Climate Action Plan

In Support of the American College and University Presidents Climate Commitment

Prepared by SourceOne, Inc. (DE)

August, 2009

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Introduction

Emerson College is the only comprehensive college or university in America dedicated exclusively to communication and the arts in a liberal arts context. It is located in downtown Boston, at the gateway to the Theatre District and in close proximity to major media outlets. It also has a castle in the Netherlands and a small campus currently under development in Los Angeles.

Emerson College offers educational programs that prepare undergraduate and graduate men and women to assume positions of responsibility and leadership in communication and the arts and to pursue scholarship and work that brings innovation to these disciplines. Established in 1880 as a small, regional school of oratory, Emerson has evolved into a diverse, co-educational and multi-faceted degree-granting institution with a liberal arts rather than conservatory orientation. But its mission and focus remains largely the same as it was in 1880: to explore and push the boundaries of communication, art, and culture and, thereby, to contribute to the advancement of society.

As part of the College's broader commitment to sustainable development and growth, Emerson College President Jacqueline W. Liebergott signed the American College and University Presidents Climate Commitment (ACUPCC). The ACUPCC is a high-visibility effort to address global warming by garnering institutional commitments to neutralize greenhouse gas emissions, and to accelerate the research and educational efforts of higher education to equip society to re-stabilize the earth's climate.

The initial requirement of the commitment is to calculate the Greenhouse Gas (GHG) emissions inventory of the college within one year of signing the commitment. Within two years, the college must create a Climate Action Plan (CAP) which includes:

i. A target date for achieving climate neutrality as soon as possible.
ii. Interim targets for goals and actions that will lead to climate neutrality.
iii. Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students.
iv. Actions to expand research or other efforts necessary to achieve climate neutrality.
v. Mechanisms for tracking progress on goals and actions.

Emissions Inventory

Emerson College calculated its emissions inventory in the fall of 2008 for 2006, 2007, and YTD 2008. The full report is included in Appendix A. The scope of the 2008 emissions report was limited to the Boston campus and did not include satellite operations in the Netherlands and Los Angeles. It also did not include any Scope III emissions such as employee commuting or air travel, which are both required by the ACUPCC. This section aims to provide the required information that was not included in the original inventory and to present the complete picture of the College's emissions.

Employee and Student Commuting

A survey of employee and student commuting methods, distances, and preferences was taken in 2008. The survey results were extrapolated to the full College population and used with published EPA emissions factors for relevant modes of transportation to estimate the GHG emissions from people travelling to and from the campus daily (Table 1). The survey did not distinguish between different kinds of public transportation. Total commuting emissions were calculated at 1,733 metric tons CO_2-e. This is not inclusive of the Los Angeles or Netherlands facilities from which commuting data was not available. However, the faculty and student populations are small enough at the off-campus facilities for commuting to be excluded from this report.

Table 1 – Commuting Emissions Factors (EPA)

Emissions Factors for Commuting and Business Travel (EPA)				
	kg CO_2/mile	g CH_4/mile	g N_2O/mile	kg CO_2-e/mile
Car	0.364	0.031	0.032	0.374
Commuter Rail	0.172	0.002	0.001	0.172
Subway	0.163	0.004	0.002	0.164
Bus	0.107	0.0006	0.0005	0.107
Staff Weighted Average Public Trans.	0.1536	0.0028	0.0014	0.154
Student Weighted Average Public Trans.	0.1280	0.0017	0.0010	0.128

The survey results were encouraging. Most students and staff take advantage of the school's urban location and utilize one of the many public transportation options available. The vast majority of students (>85%) either walk or use public transportation to get to school. Only a small fraction (<1%) drives to school alone on a given day. With such a large portion of the students already using environmentally friendly means of transportation there is little room for improvement. Even though the students represent more than 85% of the campus population, their commuting emissions are only 58% of the campus commuting total. (Table 2)

Table 2 – Commuting GHG Emissions

	Population	Per Capita Commuting Emissions (metric tons CO2-e)	Total Commuting Emissions (metric tons CO2-e)
Students	4100	0.22	897
Staff	757	1.10	836
Total	4700	0.37	1733

The College staff members have a more variable, although still environmentally friendly, commuting mix. More staff live outside of the city than students and they tend to live farther away. The average staff member lives over 12 miles away from campus compared with less than 4 miles for students. Despite the increased distance travelled to work, only 14% of staff members drive alone to work, which helps to limit the commuting emissions of the school. While commuting emissions are far lower than they could be with a less favorable location, the total commuting emissions for the college still add up to **1,733 metric tons.** This number is assumed to remain constant as the student and faculty population has not changed substantially in recent years and is not anticipated to do so in the future.

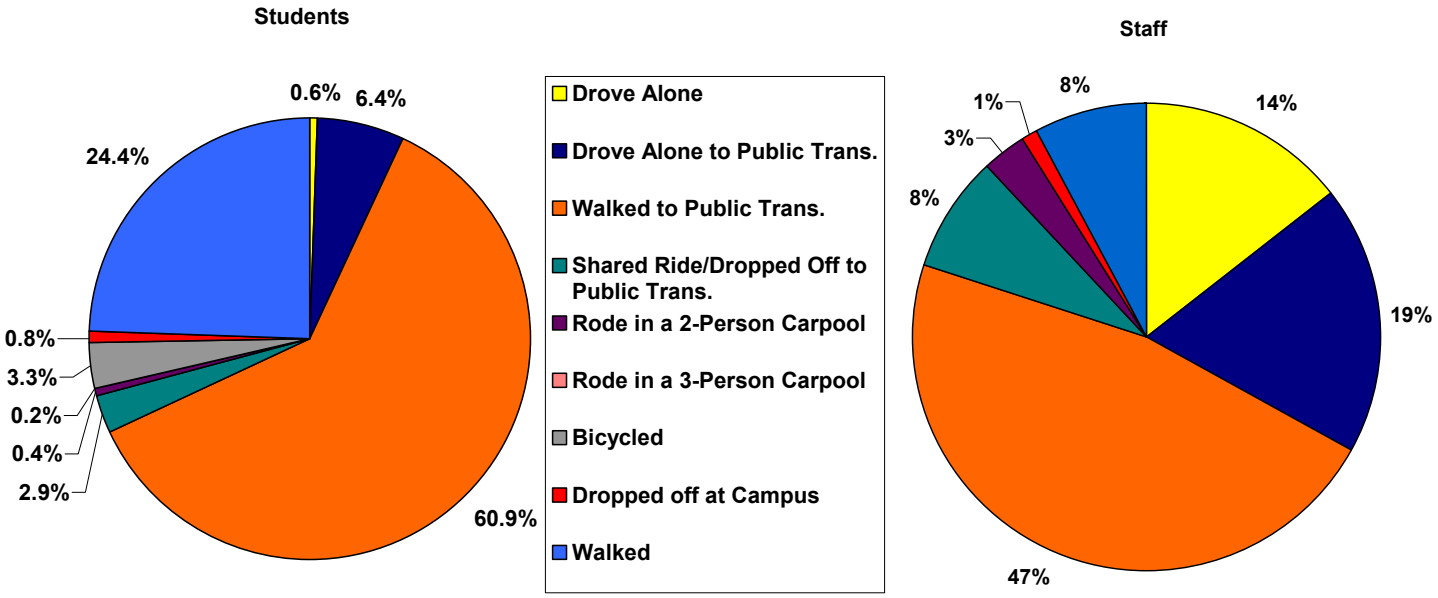

Figure 1 – Commuting choices of students (left) and staff (right)

Employee Air Travel

Emerson College does not centrally track the air travel taken by its faculty and staff on College business. While there is a travel agency that is made available for business travel, most faculty and staff book their own travel. Due to the lack of actual air travel data, GHG emissions had to be estimated using a very broad set of assumptions:

- 100 students per semester fly to California for the Los Angeles Program
- 20 Administrative trips to California per year to help set up the L.A. Campus
- 85 students per semester fly to the Netherlands for the Kasteel Well program
- Each student in the Kasteel Well program takes a several short trips totaling approximately 1,400 miles during their time in Europe
- 2 Medium-Haul trips per faculty member per year for conferences etc.

GHG emissions for the assumed annual air travel were calculated using EPA emissions factors (Table 3). The total estimated annual GHG emissions from College air travel are **700 metric tons**. This number is expected to decrease by **23 metric tons** in 2012 upon completion of the L.A. facility when such frequent administrative travel is anticipated to drop-off substantially.

Table 3 – EPA GHG Emissions Factors for commercial air travel. The emissions factors vary based on air travel distance because a disproportionate amount of fuel is used for takeoff and landing.

Airline Travel Distance	Long Haul (>>700 miles)	Medium Haul (>>300 and < 700 miles)	Short Haul (< 300 miles)	Distance Not Known
CO_2 Emission Factor (kg CO_2/passenger-mile)	0.185	0.229	0.277	0.271
CH_4 Emission Factor (g CH_4/passenger-mile)	0.010	0.010	0.010	0.010
N_2O Emission Factor (g N_2O/passenger-mile)	0.009	0.009	0.009	0.009
CO_2-e Emission Factor (kg CO_2-e/passenger-mile)	0.188	0.232	0.280	0.274

Table 4 – Emerson College air travel emissions

	Round-Trip Distance (miles)	# of Trips	CO_2-e Emissions (metric tons)
Student Trips to LA	6,000	200	225
Student Trips to Europe	7,000	170	223
Student Trips within Europe	1,400	170	67
Faculty Round Trips to LA	6,000	20	23
2 Trips per Faculty Member	1,000	700	162
			700

Netherlands Facility

Through Emerson College's semester-long study abroad program at Kasteel Well, the Netherlands, students experience different cultures first-hand, study the wide variety of Europe's communication systems, practice and improve foreign language skills, and learn about Europe's rich history and art through course offerings focused on the liberal arts, and extensive travel opportunities.

Figure 2 – Kasteel Well

Kasteel Well (Figure 2) is a national historical monument dating from the 14th century. It provides living and dining accommodations, classrooms, a student center and pub, offices and a performance area for students, faculty and staff. The surrounding grounds offer opportunities for various outdoor sports. The facility consumes both electricity and natural gas. Average annual energy usage from the facility was obtained from site personnel. Electricity emissions factors for the Netherlands as published by the U.S. Department of Energy were used to calculated GHG emissions from electricity consumption. Natural gas combustion was assumed to have the same emissions in the Netherlands as it does in the U.S.

Kasteel Well has emissions from combustion of natural gas of **363 metric tons** and emissions from electricity usage of **285 metric tons** which add up to total site GHG emissions of **648 metric tons**.

College Emissions Total

Adding the emissions from employee/student commuting, employee/student air travel, and Kasteel Well to the original emissions inventory yields a total 2007 GHG emissions figure of **11,231 metric tons** for 2007, the most recent year to be measured in full.

Mitigation Strategies

Emerson College has established 2030 as its target year for climate neutrality. The College has identified several measures that can be implemented in the short- and medium-term that will reduce energy usage and GHG emissions. Most of these projects make economic sense on their own and would be implemented even if environmental considerations were not a factor.

Commuting

The GHG emissions from staff commuting are already very low for the commuting population due to the high utilization of public transportation. However, there is still room for improvement. If half of the people who drive alone to work could be incentivized to utilize an alternative form of transportation, the emissions reduction would be an estimated 79 metric tons CO_2-e. While this is not a large number in itself, it would represent almost a 1% reduction in overall campus emissions.

The College is considering multiple strategies to encourage drivers to find alternative modes of transportation. These include scaling back the subsidized parking that some staff members receive and redirecting the money towards subsidizing public transportation passes. Another option being considered is increasing the flexibility of the hours which employees are expected to work to accommodate public transportation schedules.

There will of course be individuals who are unable or unwilling to switch to alternative modes of transportation, so only a 50% reduction in vehicle commuting is forecast. There is a good chance that these reductions will be very small because a 50% reduction in drive-alone commuters is very optimistic.

An additional reduction in commuting emissions will be achieved by the addition of ~600 beds of on-campus dorm capacity as per current build-out plans. This is part of the College's larger goal of reaching housing capacity for 70% of its students, which would make Emerson a true residential campus. While this will increase the direct and indirect emissions of the campus by adding square feet of built area, the increase will be somewhat offset by the increase in students that are able to walk to campus. The actual reduction will be difficult to estimate until students actually move in and new commuting patterns are established, but for the sake of this analysis, the GHG emissions reductions from increased on-campus housing is estimated to be 100 metric tons CO_2-e.

Buildings

As is the case with most colleges and universities, the bulk of Emerson's GHG emissions come from electricity and fossil fuel usage in buildings. While electricity and thermal products will always need to be utilized in buildings, several measures both large and small have been identified that would help to mitigate these emissions.

80 Boylston Steam Switch – The College will cease to burn natural gas in two boilers to meet the thermal loads of the 80 Boylston St. building. The college will instead purchase its steam for the building from the Trigen district steam system. District steam has a lower emissions factor

(CO_2-e/Mlb) than self-generated steam, so the overall emissions impact will be negative. The College will keep one boiler connected as a backup and then remove it once the steam service has been fully established. The estimated annual GHG reduction from this measure is **363 metric tons**. The Trigen steam company has been putting forth a concerted effort to increase the efficiency of its steam generation and distribution systems. As this effort continues, the emissions reductions associated with the 'greening' of the steam distribution should become apparent.

Dishwasher Upgrade– The College has purchased a Stero ER-66S *EnergyStar* rated dishwashers for use in its dining hall as an upgrade from its previous unit. This dishwasher will provide the college with efficient cleaning and energy saving capabilities. When compared with non-Energy Star dishwashers with similar characteristics, like the Jackson A-J 66, the ER-66S consumes 23% less energy annually. Using broad assumptions of operating characteristics, the dishwasher upgrade will reduce GHG emissions by approximately **3 metric tons**. Although a very minor reduction, this project is a good example of taking advantage of equipment upgrade opportunities at the end of useful life when substantial energy savings can be realized for only a small incremental cost.

Eliminate Dining Hall Trays – The College is considering the elimination of trays in campus dining halls. This has been done successfully at other campuses with minimal student and staff resistance. Eliminating dining hall trays saves a substantial amount of hot water that is needed to wash them at every meal. Eliminating dining hall trays has also been shown to reduce food waste because diners are more inclined to only take what they can carry. The estimated GHG emissions reduction from this measure is **8 metric tons**.

EnergyStar Purchasing Policy – The College will establish an *EnergyStar* purchasing policy for all appliances, lighting, and other plug-loads. Simply put, this policy will state that the school must purchase *EnergyStar* products whenever it is possible, and document the reason for any exceptions. The emissions reductions achieved from this measure are very difficult to forecast, but this analysis estimates that this policy will have a continuously increasing effect on campus energy usage. The ultimate GHG emissions reduction from this measure is anticipated to be **25 metric tons.**

Dorm Energy Competitions – Inter-dorm energy competitions have grown increasingly popular in recent years and have been shown to be effective in reducing dorm energy usage by up to 20% during competitions. Long-term reductions resulting from the competitions are less easily defined. For the sake of this analysis, we assume a lasting 5% reduction for each of the first 2 years and then a 2% annual reduction thereafter. This is anticipated to be the most effective mitigation measure in the long-term because it will permeate a culture of sustainability practices. The estimated GHG reduction from this measure will be **161 metric tons** in the first year, **314 metric tons** in the second year, **372 metric tons** in the third year, increasing up to **1,075 metric tons** below baseline in the 12th year.

216 Tremont St. Boiler Upgrade – The boilers at 216 Tremont St. are nearing the end of their useful life and are due to be replaced. Installing new high-efficiency equipment will

conservatively save 10% of the annual natural gas usage at the building. The estimated GHG reduction from this measure will be **25 metric tons** per year.

Shut-Down Procedures for High-Energy Rooms – With its curricular emphasis on the arts and communications, the College has several studios, theaters, and other energy intensive multi-media spaces. These spaces have energy-intensive equipment that is often left turned on unnecessarily. Room shut-down checklists will be posted in all energy-intensive rooms to encourage people to turn off equipment when they leave the rooms. The estimated GHG reduction from this measure will be **10 metric tons** per year.

Computer Lab Power Settings – The College has several computer labs with computer that are left turned on continuously. The College will coordinate with its IT department to actively manage the power settings in campus computing resources to ensure that they are only turned on when necessary. It is difficult to accurately predict the GHG emissions reductions that will be achieved by this measure because the ultimate result is unknown. However, a conservative estimated GHG reduction from this measure is **10 metric tons** per year.

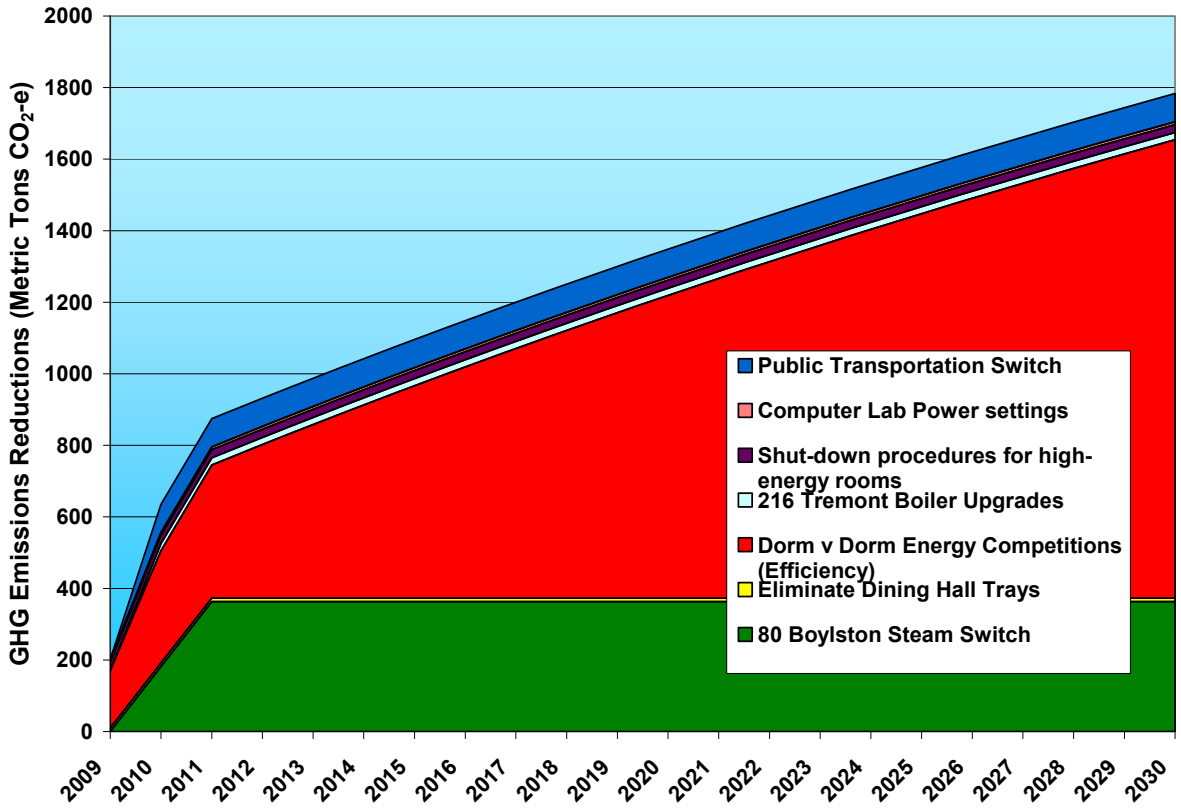

Figure 3 – GHG Emissions reductions from mitigation projects

Renewable Energy and Carbon Offsets

It is clear that while there are several opportunities to *reduce* direct and indirect emissions associated with the College there is no way to *eliminate* them entirely short of purchasing renewable energy and emissions offsets. As part of its commitment under the ACUPCC, the

College must achieve climate neutrality; i.e. net zero emissions. Therefore the College must purchase Renewable Energy Credits and Carbon Offsets to achieve that goal.

Renewable Energy Credits – The College currently purchases Green-e certified Renewable Energy Credits (RECs) from Community Wind for 20% of its campus electricity usage. In accordance with the ACUPCC commitment, the college will incrementally increase its REC purchase percentage by 8% every 2 years up to 100% of its electricity consumption by 2029. The purchased volume for each REC contract will be based on the previous year's electricity consumption times the percentage of RECs for the contract year. E.g. in 2011 the REC purchase volume will be 28% of the 2010 electricity usage of the College. The increase is incremental to limit the budget impact in any given year. Covering 100% of the College's current electric load at current prices will cost anywhere from $30,000-$60,000 per year in today's dollars. This purchase will eliminate (via offset) all of the emissions associated with the College's electricity usage.

Carbon Offsets – The College will purchase Carbon Offsets to offset emissions from direct combustion, district steam usage, vehicle fleet, and commuting. The College will only purchase offsets that have been verified by a third party to be in accordance with either the Voluntary Carbon Standard or the Gold Standard for Carbon Offsets. There are many project types that can generate Carbon Offsets, ranging from forestry to renewable energy to industrial process improvement. The College will aim to purchase offsets from projects that are consistent with its overall values and mission. This purchase will increase incrementally at a similar schedule to the REC purchase, reaching 100% of emissions in 2029. Offset pricing can vary substantially depending on what type of project is generating the offsets, but at $5/metric ton (which is expensive for voluntary offsets) the annual offset cost in 2029 will be an estimated $37,000 in today's dollars.

While REC and Offset purchase volumes will correlate to the schedule in Table 5, they may be purchased more strategically than the simple escalation laid out in the schedule. REC and Offset prices are subject to market volatility, and the College is considering a strategic purchasing approach in which it purchases partial volumes for future years at different advance dates. This will help to smooth out market volatility and at the same time allow the College to take advantage of purchase opportunities when they arise.

Table 5 – Schedule of REC and Offset purchases necessary to achieve carbon neutrality

Year	REC Purchase %	Offset Purchase %
2008	20%	0%
2009	20%	0%
2010	28%	0%
2011	28%	10%
2012	36%	10%
2013	36%	20%
2014	44%	20%
2015	44%	30%
2016	52%	30%
2017	52%	40%
2018	60%	40%
2019	60%	50%
2020	68%	50%
2021	68%	60%
2022	76%	60%
2023	76%	70%
2024	84%	70%
2025	84%	80%
2026	92%	80%
2027	92%	90%
2028	100%	90%
2029	100%	100%
2030	100%	100%

The carbon neutrality year for the College is 2029 according to the offset and REC purchase schedule. The official goal of the college is carbon neutrality by 2030. There is a buffer year built into the schedule to take into account schedule slippage for projects and REC/Offset purchases.

Carbon Offsets and RECs are very inexpensive compared to the overall operations budget of the College. However it is important to prioritize on-campus reductions over offset projects as they will usually produce a tangible cost benefit as well as other local benefits (e.g. elimination of cafeteria trays saves energy and also reduces food waste). REC and Offset purchases do not provide any direct physical or financial benefit to the College.

Emissions Forecasts

Several future emissions scenarios were created to represent the effect of the different emissions mitigation measures discussed above on the overall emissions of the College. In the Business-As-Usual (BAU) case the emissions of the College are forecast based on current expansion plans and the assumption that no mitigation measures are implemented. The current expansion plans for the College are substantial. A new 200,000 ft^2 facility with dormitory space and classrooms is being constructed in L.A. to host a remote study program that has been operating there for many years. While this campus is being constructed with the intention of getting LEED certified, it will still represent a substantial addition to the overall GHG emissions of the college. There are also two new additions to the Boston campus that are coming on line in the next two years. The first is a 135,000 ft^2 dormitory that is intended to be certified LEED Silver. The second is a 190,000 ft^2 facility that will include a large theater, dorms, and studio space. Future energy consumption and emissions for these facilities was estimated based on their size, location, and use.

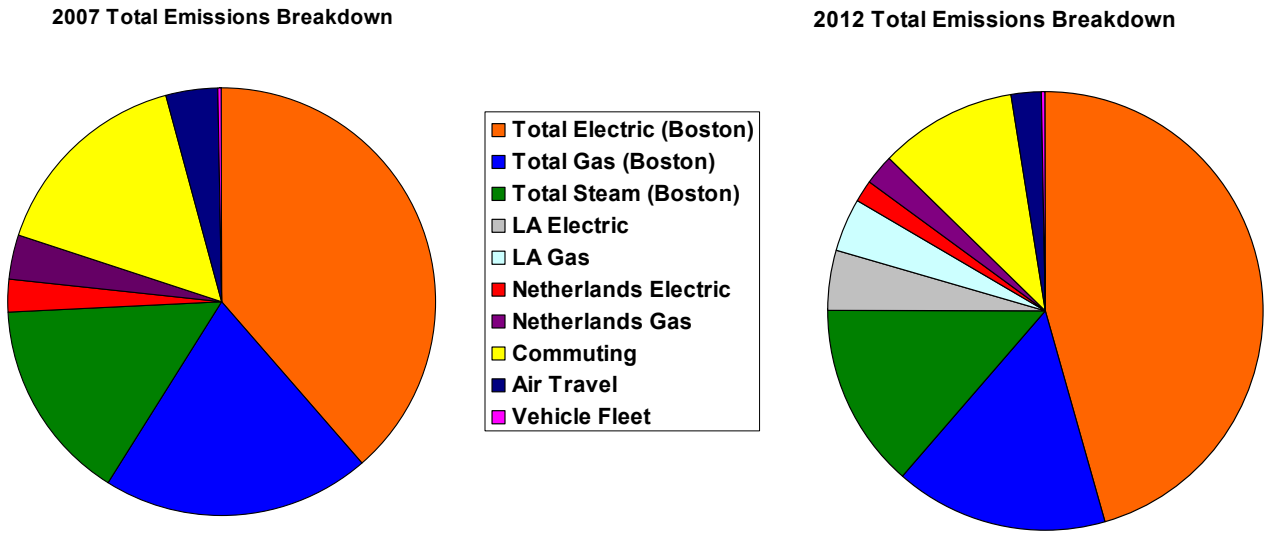

Figure 4 –Emissions breakdown by source for 2007 (left) and 2012 (right)

Both of the new Boston facilities are part of the College's efforts to increase its dormitory capacity to 70% of its student body from its current capacity of roughly 35%. The goal is to transform the College into a majority residential campus that can provide affordable housing to students that would otherwise have to find space in an expensive and limited apartment rental market. Although the addition of these new buildings will increase campus emissions substantially, the increase will be at least partially offset by students not renting apartments off-campus and by students switching to a walking commute. The emissions reductions from students living on-campus instead of off-campus is impossible to decisively quantify. The emissions reductions from the change in commuting patterns, estimated to be 100 metric tons, are discussed above.

As a result of the substantial building program of the College, the BAU case shows emissions increasing sharply into 2011 and then leveling off. There are not any other plans for new facilities or campus growth. While the campus enjoyed an emissions reduction from 2006-2007

of ~500 metric tons, that reduction is easily eclipsed by the emissions from the new facilities. The total emissions increase from the new facilities additions is **6,123 metric tons.**

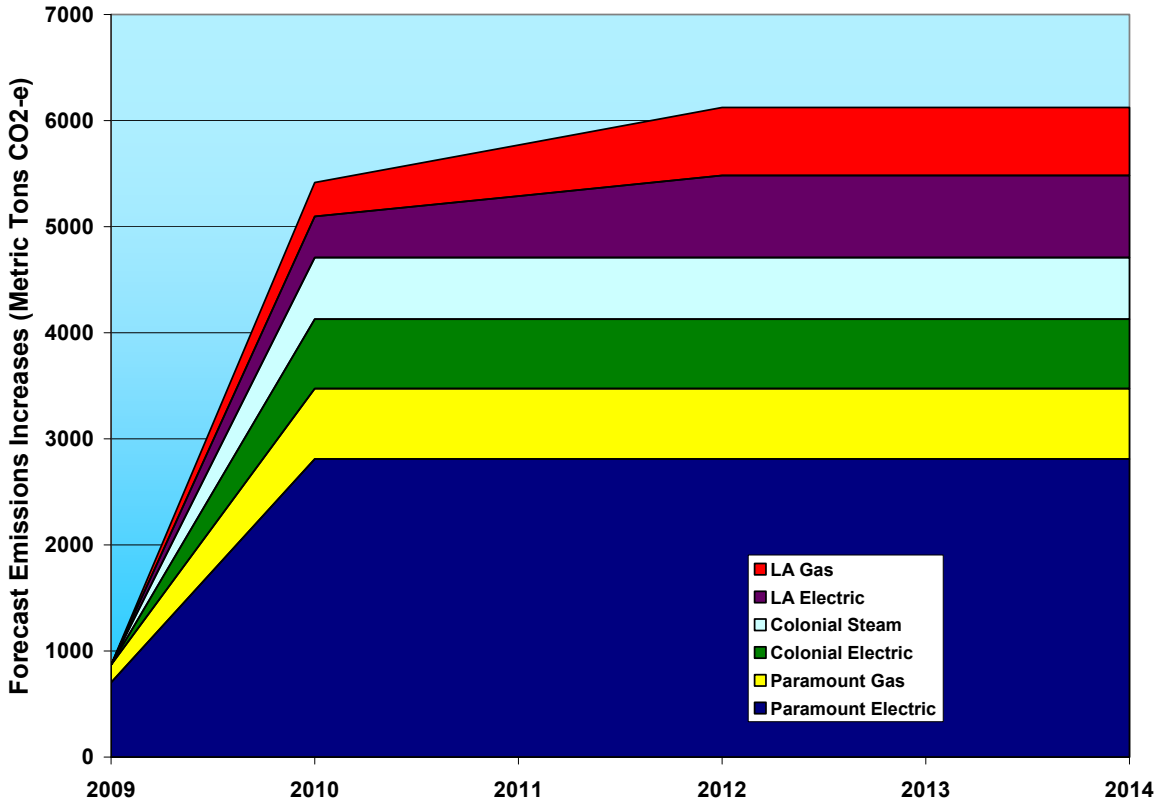

Figure 5 – Forecast emissions increases from new facilities

A second case was forecasted which looked at the emissions growth that would occur without the forecast energy efficiency measures that are incorporated into the design of the college's three new facilities; specifically the LEED certification of two of the new facilities. Emerson College is already reducing its GHG emissions from what they would be if the College paid no attention to issues of environment and sustainability.

The third case forecasted was BAU with projects, which includes all of the emissions mitigation measures listed in the previous section (except for REC and Offset purchases) and shown in Figure 3. If implemented, these measures will combine to reduce emissions by less than 10% below the BAU case in the long term. It is clear from this analysis, that achieving full carbon neutrality will require both RECs and Carbon Offsets.

The fourth case forecasted was BAU with projects and a staged increase in REC purchases. This measure serves to ultimately offset about half of the remaining GHG emissions of the College. The fourth case forecasted was BAU with projects, RECs, and a staged increase in Carbon Offsets. All emissions forecasts are shown in Figure 6.

There are systemic reductions in CO_2-e emissions that are anticipated to occur over the next several decades as renewable energy and high-efficiency aircraft and vehicles gain higher market

penetration. Emissions factors for vehicle mileage, commuting, air travel, and electricity usage will all decrease. The magnitude of these decreases is unknown, however, so they are left out of these forecasts.

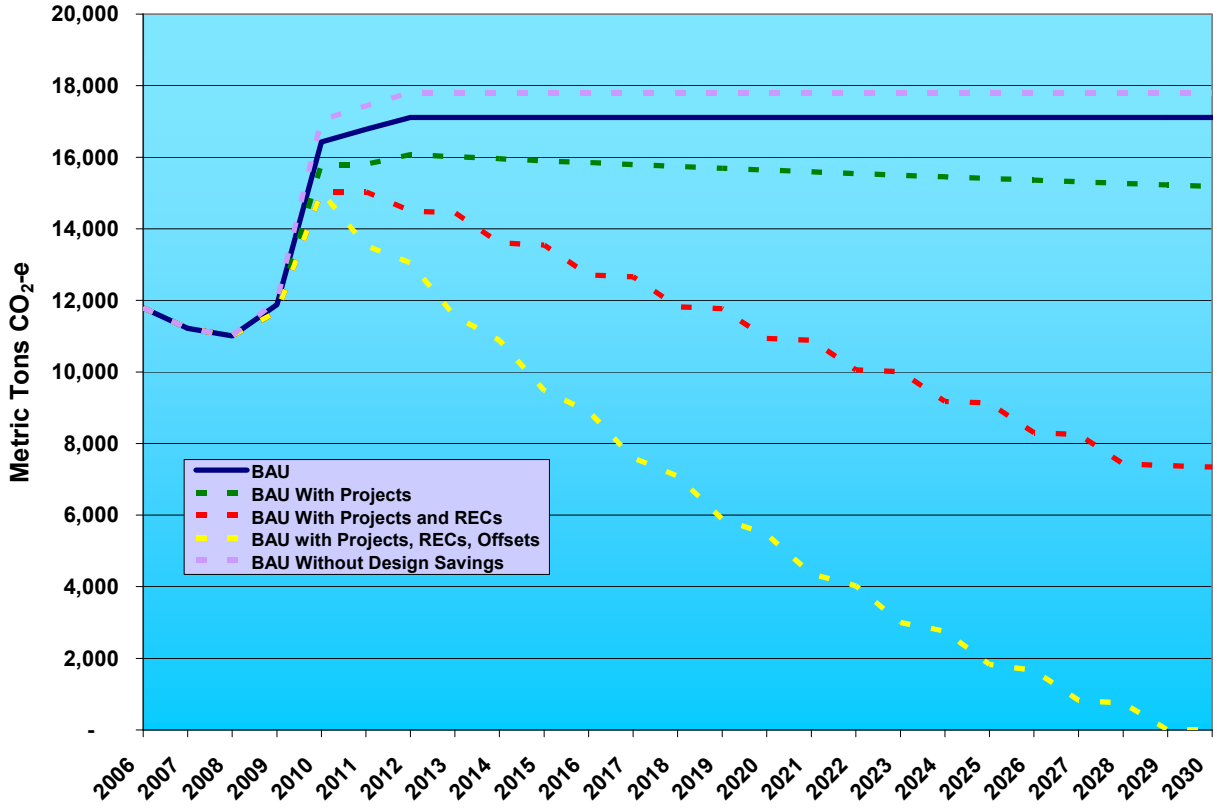

Figure 6 – Emissions forecasts for Emerson College under different emissions mitigation scenarios

Tracking Progress

Long term GHG emissions management presents challenges on multiple fronts. First, measuring GHG emissions is a time-consuming, data-intensive, and inherently uncertain process. Second, emissions mitigation measures will be executed across several departments and facilities. Third, some of the mitigation measures will require buy-in from students and staff in terms of actively reducing energy usage on campus, achieving that buy-in and the subsequent behavior changes will require continuous communication and dialogue with the students and staff of the College. Fourth, due to metering and monitoring limitations, the effects of most of the mitigation measures cannot be directly measured.

As required by the ACUPCC, the College will update its emissions inventory every other year and issue a report to the ACUPCC summarizing the emissions trends of the school. This report will contain emissions data on all College GHG sources and comment on trends that are observed.

The College will form a small Climate Change Committee that will meet on a quarterly basis to monitor emissions and manage the measurement and reporting process. This committee will also be tasked with finding additional Energy Conservation Measures that may be implemented to further reduce campus emissions. The Climate Change Committee will also be responsible for identifying legitimate verified offset opportunities to ensure the College is actually reducing its emissions.

APPENDIX A

Emerson College Emissions Inventory

Prepared by SourceOne, Inc. (DE)
October, 2008

The following emissions inventory was calculated and prepared in accordance with the General and Technical Guidelines of the U.S. Department of Energy (D.O.E.)1605(b) voluntary reporting program. Emissions were attributed to Emerson College ("the College") under the principle of financial control.

This report was prepared using data provided by Emerson College facilities personnel. All information, emissions factors, and protocols are subject to inherent uncertainties and variability. This is especially true for electricity emissions factors. Besides being unrealistically uniform over multi-state regions, the factors are also blind to time-of-day fluctuations in emissions resulting from different kinds of power plants coming on- and off-line over the course of any given day.

Emerson College is the only comprehensive college or university in America dedicated exclusively to communication and the arts in a liberal arts context. It is located in downtown Boston, at the gateway to the Theatre District and in close proximity to major media outlets. It also has facilities in Los Angeles and the Netherlands. The Los Angeles and Netherlands facilities are excluded from this inventory.

Executive Summary

SourceOne constructed this emissions inventory for Emerson College for submission to the Department of Energy 1605(b) voluntary reporting program. The largest sources of emissions are natural gas combustion, electricity usage, and steam consumption with automotive gasoline and fuel oil consumption making up a smaller but not insignificant share.

Emissions for 2006, 2007 and year-to-date 2008 were included in this inventory. Most of the YTD data for 2008 goes through August. Overall emissions reduced substantially from 2006 to 2007 and are on track to be lower still in 2008. (Figure 7)

2006 emissions were calculated to be 9,710 metric tons, which reduced to 9,206 metric tons in 2007. Emissions are on track to reduce even further in 2008. The primary driver behind these emissions reductions was the increase in consumption of district steam and a decrease in consumption of natural gas.

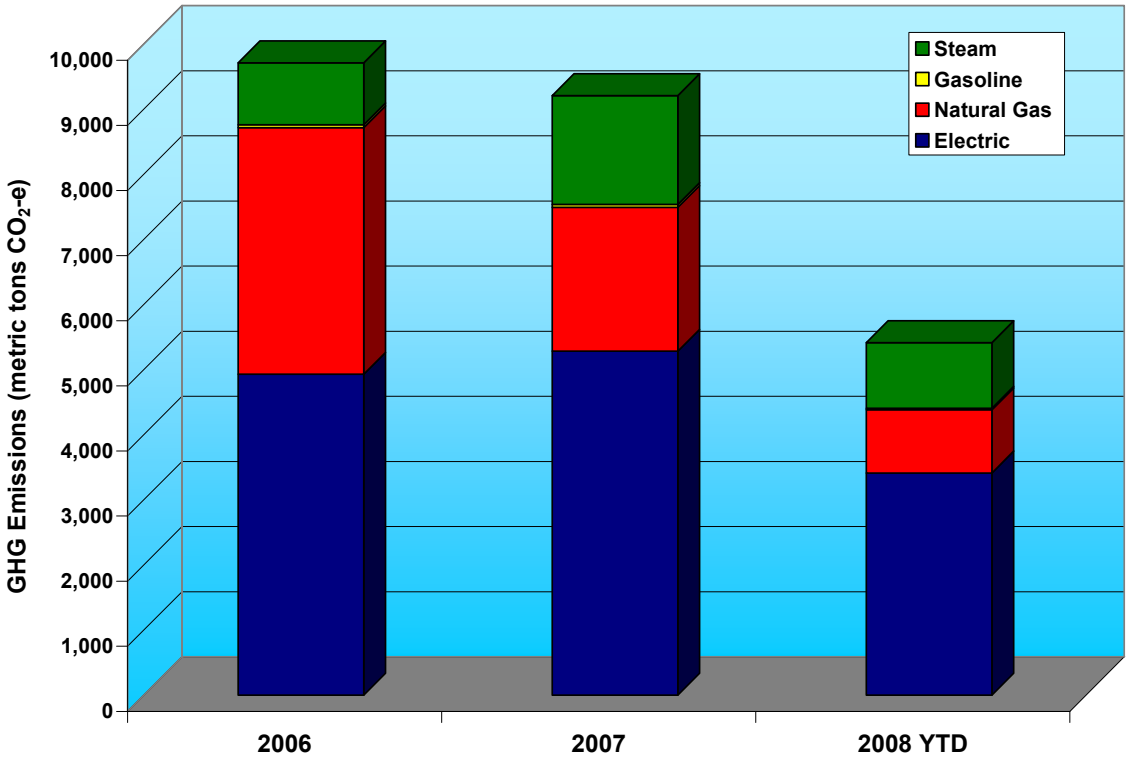

Figure 7 - 2006-2007 greenhouse gas emissions.

Accounting Scope

This emissions inventory includes Greenhouse Gas (GHG) emissions attributable to Emerson College according to the principle of financial control. This means if the College has financial control over a facility, vehicle, machine, or process that has GHG emissions, then those emissions are included in the emissions inventory. College-owned and College-controlled sites located in Boston are included in this inventory. Any campus vehicles that are owned or operated by the College are also included in this inventory.

What is not included in this inventory are what are known as Scope III emissions. These are indirect emissions from supply chain activities (e.g. manufacturing of office paper), employee air travel, employee commuting, and any other indirect emissions that could be attributed to the College. Reporting emissions from these sources is optional and they are excluded from this inventory.

De Minimis Exclusion: The D.O.E. 1605(b) program allows for up to 3% of entity-wide emissions to be excluded from the emissions inventory. Sources can be excluded on any grounds as long as it can be justified that the omitted emissions are less than 3% of the emissions total. The reasons for exclusion of an emissions source that are most often cited are insignificance, inability to monitor emissions, inaccuracy of data, lack of data, and excessive reporting burden.

Some critics say that because an estimate of emissions is required for inclusion in the *De Minimis* category, those emissions might as well be included in the overall inventory instead of having a built-in underestimate in the overall total, however small. But given the inherent uncertainties in emissions factors, especially electricity emissions factors, a very small portion of the total emissions with an even higher inherent uncertainty does not contribute to the quality of an emissions inventory enough to justify the additional effort.

Emissions Calculations

GHG emissions for fuel combustion and electricity usage were calculated using usage data (e.g. kWh) multiplied by emissions factors for CO_2, CH_4, and N_2O (e.g. lbs CO_2/kWh). The other three main GHGs (SF_6, HFCs, and PFCs) are not emitted by traditional combustion of fossil fuels or electricity usage. They are typically emitted by specific types of processes or equipment, such as refrigeration equipment for HFCs or electricity transmission and distribution equipment for SF_6. Emerson College does have refrigerated facilities which occasionally leak refrigerant. While many refrigerants are HFCs, which are potent GHGs, the refrigerant used by the College (R-22, an HCFC) is not considered a GHG by the major accounting protocols.

Table 6 - Emissions Factors Used in U.S. Greenhouse Gas Emissions Inventory for Emerson College

Source	CO2	CH4	N2O	Unit	Source
MA Electricity	1027.1	0.0534	0.0136	lbs/MWh	US Energy Information Administration, October, 2007
Natural Gas	11.6	-	-	lbs/therm	U.S. Dept of Energy, Technical Guidelines Voluntary Reporting of Greenhouse Gases (1605(b)) Program, Chapter 1, Partd C, Stationary Source Combustion, January 2007
Automotive Gasoline	19.4	-	-	lbs/gallon	
District Steam	182.3	-	-	kg CO_2/MMBTU	

Electricity emissions factors are assigned on a regional basis to reflect the generation mix that serves the load in each region. The electricity emissions factors, though published in 2007, are based on 1999-2002 emissions as calculated by the Energy Information Administration (EIA), the research arm of the D.O.E. When electricity grid emissions are next evaluated for a more recent period, the emissions factors will most likely be lower to reflect the increasing presence of renewables in the national and regional generation mixes.

Natural gas emissions factors can vary depending on the energy content of the gas. The Gas delivered to Emerson College typically falls within the 1025-1050 BTU/SCF range and is assigned the corresponding emissions factor.

CO_2 is the weakest of the main GHGs in terms of atmospheric effect per unit of gas, but it is responsible for the large majority of the enhanced greenhouse effect caused by manmade emissions. For simplicity, emissions of all GHGs are converted to lbs CO_2-equivalent based on their global warming potential (GWP). The GWP of a gas is equal to how many pounds of CO_2 it would take to create the same atmospheric effect as one pound of that gas. For example, CH_4 is 25 times more potent than CO_2 as a GHG, thus one pound of CH_4 can be counted as 25 lbs CO_2-equivalent (CO_2e). (Table 7)

Table 7 - Global Warming Potential (GWP) of the Greenhouse Gases of which Emerson College has significant emissions

Gas	GWP	
CO_2	1	These Values are from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change
CH_4	25	
N_2O	298	

Inventory Quality

There are several methods for measuring emissions from any given source that provide varying levels of accuracy. The U.S. Department of Energy greenhouse gas accounting protocol assigns a letter-grade to each popular method of emissions measurement for virtually every possible emissions source. The weighted average of the letter-grades of all of the emissions measurements provides a measure of overall inventory quality. This rating system works just like a G.P.A. in school, with A=4, B=3, C=2, and D=1. The D.O.E. requires a 3.0 weighted average or better for an inventory to be included in its registry.

The grades for emissions calculations in this report are as follows: Calculations of CO_2 emissions from natural gas and electricity usage receive an 'A' according to the D.O.E. The calculations of emissions imported steam receive a 'B'. The steam emissions get a 'B' because the emissions factor is D.O.E. default number as opposed to a factor specific to the Trigen Boston steam system. The calculations of gasoline usage in campus vehicles receive a 'C', being based on rough fuel economy information and estimated mileage. The weighted average rating for Emerson College's emissions inventory has decreased from 3.89 to 3.76 from 2006 to 2007. This is because of the greater portion of steam-related emissions in the inventory. (Table 8)

Table 8 - Emissions inventory quality ratings for methods used in calculating Emerson College's carbon footprint

Source	Grade	2006 emissions (metric tons)	2007 emissions (metric tons)	2008 YTD emissions (metric tons)
Electricity Usage	A	4,927	5,280	3,411
Natural Gas	A	3,787	2,209	970
Gasoline	C	45	45	172
Steam	B	950	1,672	1,008
GPA		**3.89**	**3.81**	**3.76**

Campus Emissions

Scope 1 Emissions **-** Direct emissions from the campus are from the combustion of natural in campus boilers, kitchens, and other heating units. The rest of the scope I emissions are emitted by motor vehicles. The emissions were calculated using fuel-specific emission factors multiplied by fuel usage.

Scope 2 Emissions **–** The indirect emissions from the campus sites are from the purchase of electricity from the regional grid and steam from the Trigen Boston steam network.

De Minimis **Exclusion –** Small amounts of CH_4 and N_2O are emitted in the combustion of natural gas and gasoline. These amount to less than 1% of emissions from either of the fuels, and are left out of the inventory for simplicity. Also excluded is the small amount of fuel oil that is used for backup generation units. These units are only fired up for regular testing that is very brief. Rough calculations estimate annual fuel oil emissions at less than 10 metric tons, which is well below the *de minimis* exclusion threshold. The third exclusion is the fugitive leakage of refrigerant. The data on refrigerant deliveries is not readily available, so direct leakage cannot be estimated. However, discussions with facilities personnel indicate that the vast majority of the refrigerant used on campus is R-22. R-22 is an HCFC which is very harmful to the ozone layer, but it is not included as a GHG under the D.O.E. GHG accounting protocol. Fugitive leakage of other refrigerants is assumed to be minimal.

Key usage data used in calculating the emissions inventory for Emerson College is shown in Table 9.

Table 9 - Usage data from GHG sources

Source	2006 usage	2007 usage	2008 YTD usage
Electricity Usage (kWh)	10,517,218	11,270,513	7,280,674
Natural Gas (therms)	713,717	416,255	182,842
Est. Gasoline (gallons)	5,115	5,115	2,643
Steam (Mlbs)	11,489	20,216	12,192

Emerson College has increased its use of Trigen district steam from 2006 to 2008, replacing a substantial portion of its natural gas demand (Figure 8). District steam has a lower emissions factor on a MMBTU basis than self-generated steam, so this shift has helped improve the carbon footprint of the campus substantially. Despite increased electricity usage, overall campus emissions dropped 506 metric tons from 2006 to 2007.

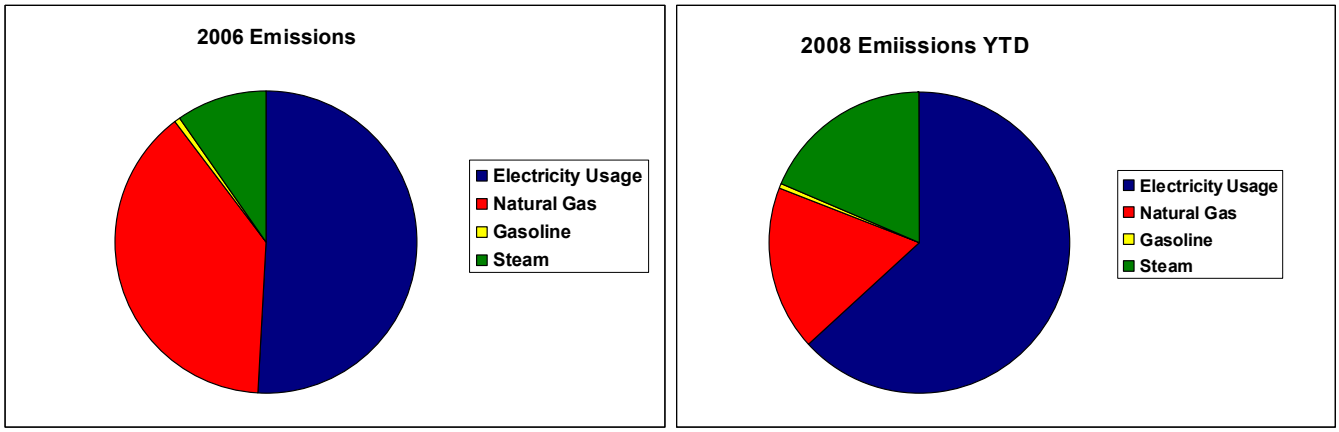

Figure 8 - 2006 emissions distribution for 2006 and 2008 YTD

Emerson College has a small vehicle fleet described in Table 10. Vehicle fuel economies and annual mileage were estimated, yielding a very uncertain result for annual GHG emissions. However, total vehicle emissions make up a sufficiently small portion of overall emissions that uncertainty of fuel usage is not of significant concern.

Table 10 - Estimated Annual Vehicle Emissions

Dept	Vehicle Type	Est. Fuel Economy (mpg)	# of Vehicles	Est. Miles/yr	Est. Gallons/yr	Est. CO_2e/yr (metric tons)
Athletics	Van	14	8	5500	3142.9	27.7
Pubic Safety	SUV	13	1	4000	307.7	2.7
	Shuttle Van	14	1	12000	857.1	7.6
Facilities	Pickup	13	1	4,000	307.7	2.7
	Van	14	1	7,000	500.0	4.4
Shuttle Bus (2008 Only)	Small Bus	7	1	1,200	171.4	1.5
					TOTAL	46.6

Overall emissions decreased 5.2% from 2006 to 2007 and are on track to be even lower in 2008. This is especially remarkable in light of a 7% increase in electricity usage over the same period. (Table 11)

Table 11 - GHG Emissions Breakdown by Source

Source	2006 Emissions (metric tons CO_2-e)	2006 % of Total	2007 Emissions (metric tons CO_2-e)	2007 % of Total	2008 YTD Emissions (metric tons CO_2-e)	2008 YTD % of Total
Electricity Usage	4,927	50.75%	5,280	57.36%	3,411	63.02%
Natural Gas	3,787	39.00%	2,209	23.99%	970	17.92%
Gasoline	45	0.46%	45	0.49%	23	0.43%
Steam	950.2	9.79%	1672.1	18.16%	1,008	18.63%
TOTAL	**9,710**	**100%**	**9,206**	**100%**	**5,413**	**100%**

Table 12 – Emissions Breakdown by Scope

Source	2006 Metric Tons	2006 %	2007 Metric Tons	2007 %	2008 YTD Metric Tons	2008 YTD %
Direct Emissions	4,782	49.3%	3,926	42.6%	2,002	37.0%
Indirect Emissions	4,927	50.7%	5,280	57.4%	3,411	63.0%
TOTAL	9,710	100.0%	9,206	100.0%	5,413	100.0%

GHG emissions *intensity* is a popular metric that is often examined in emissions inventory studies. Emissions intensity is the amount of GHGs per some unit of activity that is indicative of operational tempo of the organization. This way organizations can showcase improvements in efficiency and emissions performance in the context of overall operational tempo. An absolute reduction in GHG emissions of 10% is not a great achievement if enrollment has dropped by 50%. Likewise, a 10% increase in absolute emissions is a great achievement in the context of 50% growth in enrollment.

The proper metric varies with the type of organization. A large bank might want to look at CO_2/$ of revenue. A manufacturing company might want to look at CO_2/unit of production. Being a school, SourceOne determined the appropriate emissions intensity metric to be CO_2/student. Full-time enrollment has been increasing while overall emissions have been decreasing. This results in large decreases in GHG intensity when coupled with the reduction in absolute emissions. (Table 13, Figure 9)

Table 13 - Enrollment and emissions data for 2006-present. 2008 emissions and intensity are forecasts.

	2006	2007	2008 YTD
Avg. Number of Full Time Students	3,521	3,595	3,865
CO2-e Emissions (Metric Tons)	9,710	9,206	8,119
Metric Tons CO2-e/Student	2.76	2.56	2.10

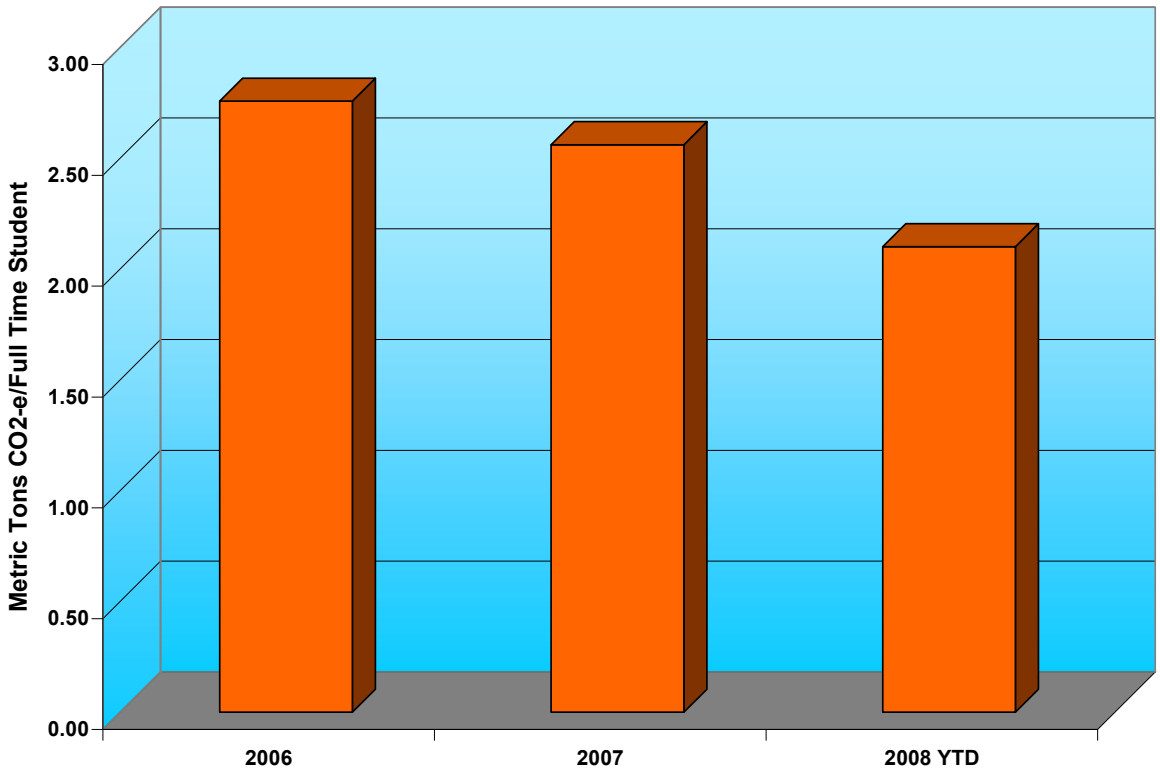

Figure 9 - Emerson College emissions intensity. 2008 intensity is a forecast.

Summary

Emerson College has reduced its carbon footprint from 2006 to 2007 by 506 tons, or 5.2%. This substantial decrease was accomplished despite an increase in electricity usage. The lead cause for the reduction was the increase in steam purchased from the Trigen district steam system and a corresponding decrease in natural gas usage. The Trigen system has efficiencies and economies of scale that are difficult to achieve with onsite steam generation. Any future increase in the use of Trigen district steam can be expected to have a further beneficial effect on campus GHG emissions.

Additional emissions savings can be found in energy savings, specifically electricity usage which has been increasing in recent years. Utilities offer a multitude of incentives for efficiency measures that can help simple actions like equipment and lighting upgrades have rapid paybacks.

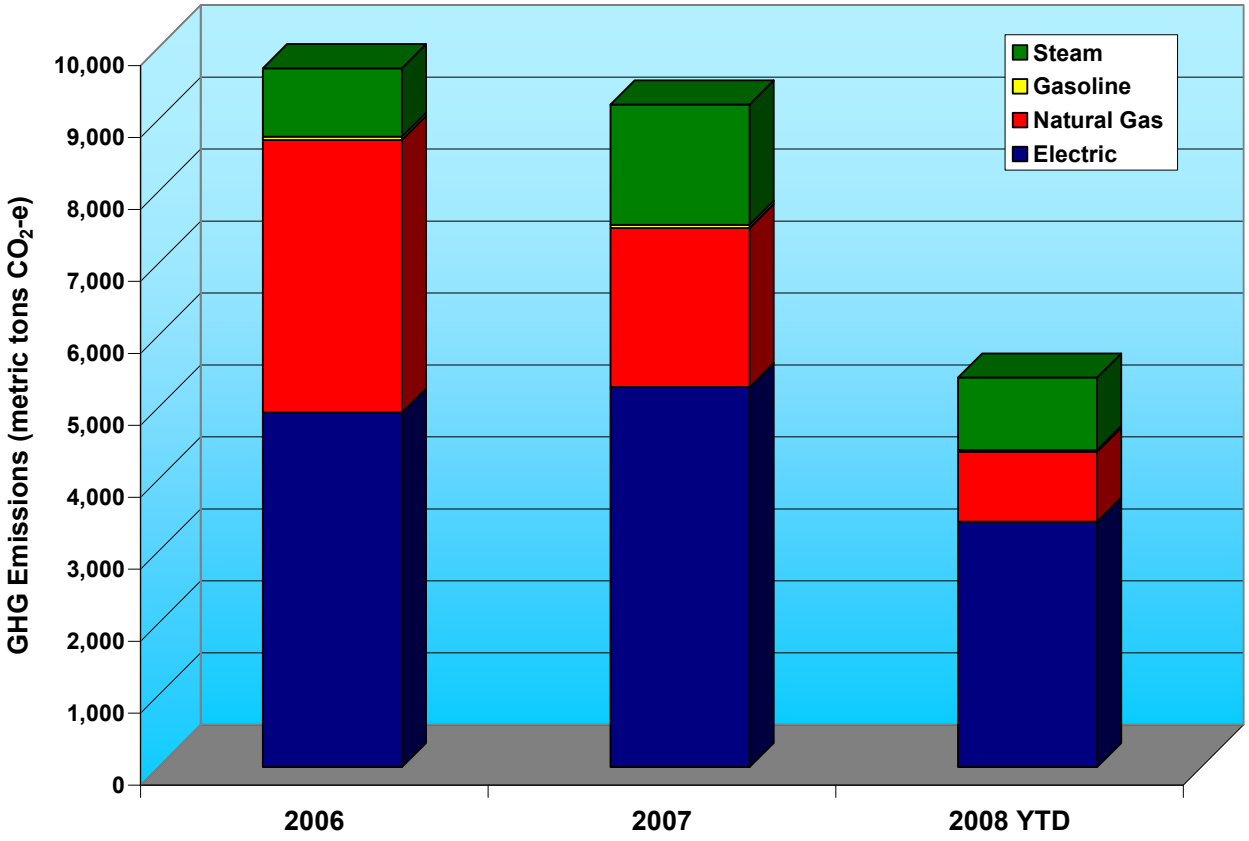

Figure 10 – Emissions summary