College of Charleston
2014 Campus Emissions Report

Analysis of FY2013 Campus Greenhouse Gas Emissions

Lydia Nickolas, B.S., Jennifer Jones, M.S. and P. Brian Fisher, PhD
College of Charleston, Office of Sustainability
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P. Brian Fisher: Dr. Fisher is the Director of the Office of Sustainability at the College of Charleston. He also teaches courses on sustainability and environmental policy to undergraduates and in the Master of Environmental Studies (MES) program. He can be reached at: fisherb@cofc.edu.

Jennifer Jones: Jennifer is a MES graduate and Facilities Coordinator at the Office of Sustainability at the College of Charleston. Her thesis research focused on perceptions of sustainability in the higher educational institution. She can be reached at: jejones2@cofc.edu.

Lydia Nickolas: Lydia is a 2013 CofC graduate with a B.S. in Geology and works as Research Assistant and Data Manager for the Office of Sustainability at the College of Charleston. She can be reached at: lbnickol@cofc.edu.

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Executive Summary

In FY2013, the College of Charleston emitted a combined total of **60,327 metric tons CO_2e**[1] (equivalent carbon dioxide). This represents a footprint in the middle range for similarly sized liberal arts & sciences institutions (See *Table 1*). To put this in perspective, the College's footprint is greater than the footprints of *3* separate countries (United Nations, MDG Indicators, 2012)[2] and is the equivalent energy required to power 5,504 homes for one year[3]. The College's Scope 1 emissions (emissions from sources owned/and or directly controlled by the College) comprise 5.2% of our footprint, while Scope 2 emissions (indirectly controlled by the College such as energy production) comprise 61.4%, and Scope 3 emissions (those affiliated with the College's operations such as travel and commuting) represent 33.4% of the footprint. Energy represents the largest component of the College's footprint, a total of 65.2% of all emissions (See *Figure 1*). Transportation comprises 21.5% of total emissions, with almost 9.9% of total emissions from commuting and 10.3% from College-supported air travel. The remaining 13.3% consists of various wastes generated by the College, transmission and distribution losses, chemical/refrigerant usage, and agriculture.

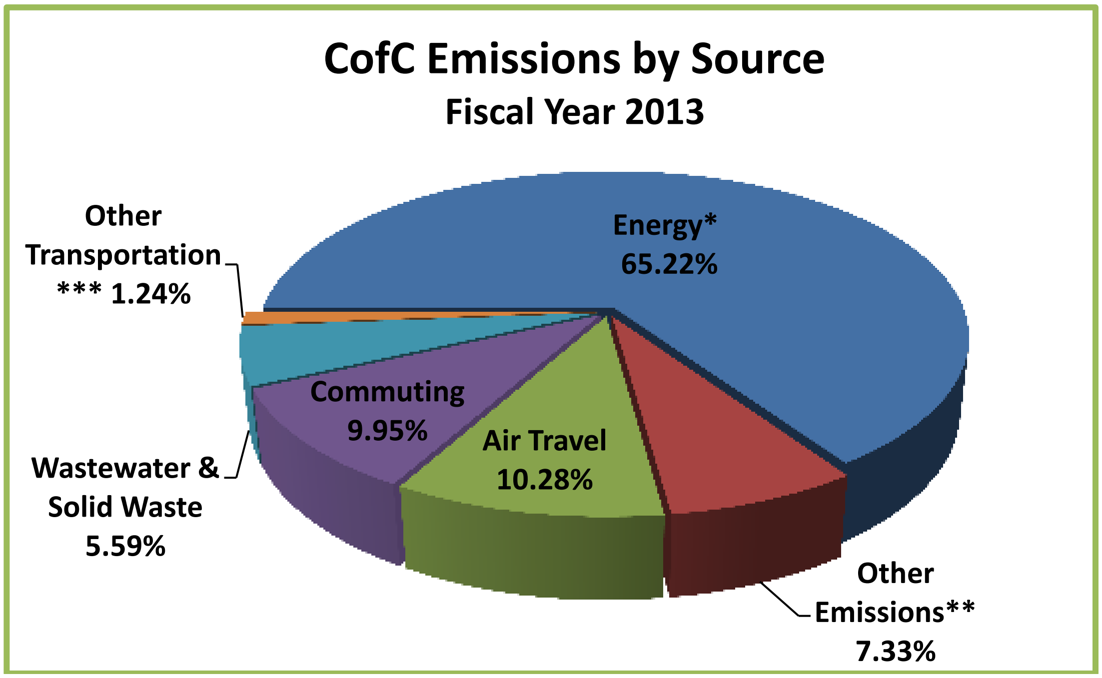

Figure 1. Breakdown of all emissions produced by the College of Charleston in FY2013.
*Energy includes electricity (56.6%), natural gas[4], propane and fuel oil (collectively 4.5%).
**Other Emissions Sources include Scope 2 T&D loses (5.6%), paper purchasing (0.31%), refrigerants and chemicals (1.12%), and fertilizer application and animal husbandry (0.05%).
***Other transportation includes directly financed ground transportation (rental cars, buses, and personal mileage reimbursement),and any on-campus travel by means of the College vehicle fleet.

[1] It is important to note that the data reported here uses location specific fuel mixes while the data reported to the ACUPCC uses an average regional fuel mix. Regional fuel mix is better suited to make comparisons with regional institutions, however using a location specific mix here reflects a more accurate picture of our emissions from electricity.

[2] Niue, Falkland Islands, and Lesotho.

[3] http://www.epa.gov/cleanenergy/energy-resources/calculator.html

[3] Natural Gas/Propane is burned on campus to produce energy and are considered Scope 1 emissions, while purchased electricity is within Scope 2 because the energy is produced off site.

From FY2011 to FY2013 total emissions **decreased from 63,198 MT CO_2e to 60,327 MT CO_2e**, representing a decrease of 4.5%. A reduction in Scope 1 emissions, which totaled 6,538 MT CO_2e in FY2011 and 3,164 MT CO_2e in FY2013, accounts for a large portion of this change. The primary cause for the dramatic decrease in Scope 1 emissions is the result of a 60.2% decrease in MT CO_2e produced by natural gas usage. During FY2013, the College experienced a lower number of heating degree days (2,152 in 2013 versus 2,712 in 2011) which lead to a decreased need for the natural gas that powers most heating systems at the College. Scope 2 emissions totaled 36,068 MT CO_2e in FY2011 and 37,014 MT CO_2e in FY2013. The minor increase (2.6%) in scope 2 emissions is a direct result of increased electricity usage, likely due to an increase in cooling degree days (2,316 in 2013 versus 1,839 in 2011). Scope 3 emissions decreased from 20,393 MT CO_2e in FY2011 to 20,150 MT CO_2e in FY2013 for a total decrease of 1.2%. This decrease can be attributed to a number of factors discussed below.

School	Total MT CO_2e	MT CO_2e / student	Student FTE (FY2013)
Coastal Carolina University*	24,580	2.8	8,706
Georgia Southern	75,675	4.0	19,086
Appalachian State	70,187	4.2	16,627
James Madison	89,724	4.6	19,484
USC-Columbia*	142,582	5.0	28,781
College of Charleston*	**60,327**	**5.7**	**10,534**
Towson University	112,625	5.9	19,160
Clemson University*	142,567	7.6	18,806
Furman University*	25,890	9.3	2,776
Wofford College*	13,899	10.6	1,312

Table 1. Comparison of total footprint and footprint per student. * represents a South Carolina Institution

When measured against other institutions of higher education, the College falls in the middle range for the majority of the footprint metrics analyzed in this report. Specifically, when compared to other South Carolina schools, the value for emissions per capita (FTE) (**5.7 MT CO2e/FTE**) is in the middle range (range 2.8 – 10.6 MT CO2/capita) as is the value for emissions per square foot (**College: 16.96 MT CO2e/1000 sq. ft.**; range 11.0 – 21.1 MT CO2e/1000 sq. ft.) (See *Table 4*). Similarly, when compared to peer institutions of similar size, setting, and educational offerings across the nation[5] (See *Table 4*), the College's per capita FTE emissions (College: 5.7 MT CO2e/FTE; range 2.7 – 6.8 MT CO2/capita) and emissions per square foot (College: 16.96 MT CO2e/1000 sq. ft.; range 7.3 – 16.96 MT CO2e/1000 sq. ft.) are toward the high end of the range nationally.[6] While these comparisons are both useful and relevant, it is important to be mindful when comparing the College with research-intensive

[5] Measured by dividing by full time students.
[6] When compared with Appalachian State, Middlebury College, University of Wisconsin-Eau Claire, and West Washington University.

Universities like Clemson and USC. Footprints are expected to be higher at these institutions because high-emission activities are inherent to laboratory research. We conclude that the College falls in the middle of the range for South Carolina liberal arts and sciences institutions for emissions per student (FTE) and at the high end of the range for emissions per square foot (of building space).

A total of 61.4% of emissions from the College are accounted for by electricity, which lies in the middle of the range (from 37.4 - 89.7%) when compared to institutions in South Carolina (Clemson, Coastal Carolina, Furman, USC-Columbia, and Wofford). Yet it is important to note that upon examination of other GHG inventories, our audit is far more comprehensive. Some institutions were unable to account for as many disparate sources of emissions, which could lead to an artificial inflation of energy emissions. Energy emissions, therefore, should represent the initial target for achieving both short and long-term emission reductions and cost savings in the present and future. This will require emphasizing three target areas: building efficiency (address through both energy infrastructure and built infrastructure), behavioral modifications, and structural improvements to how energy is delivered and consumed. Additionally, as air travel constitutes 10.3% of total campus emissions, this should represent a discussion point for the campus community. This is a sensitive issue, however, as international travel, study abroad, professional development are all essential components to our education and institutional missions. Promoting discussion on ways to balance these interests should be, nonetheless, encouraged.

As signatories of the ACUPCC (President's Climate Commitment), the College of Charleston has committed to developing and implementing a *Climate Action Plan* (CAP) that addresses how we will focus our efforts to reduce emissions. We submitted an outline of this plan in January of 2013 and continue to develop the specific strategies and objectives that will guide us toward climate neutrality. While the CAP is a necessary step toward emission reduction, we still strongly advocate for developing a more holistic and comprehensive action plan (a "Sustainability Action Plan") for campus goals and essential strategies that address the above mentioned target areas (energy and transportation) and other important sustainability initiatives (such as food, historic preservation, and justice issues). Climate and emission goals should be included within this Action Plan, not as directives but rather as outcome goals driven by addressing system inefficiencies and ineffectiveness. This requires highlighting areas for strategic investment to achieve both low-hanging opportunities in combination with higher hanging investment. This will create a sustainable pathway for greater efficiency and effectiveness while taking responsibility for the College's impact on the world around us. Careful consideration is necessary to coordinate investment in short and long runs to maximize productivity while minimizing costs. It is suggested that a comprehensive *systems analysis* of major energy, waste, food, and transportation streams (with future projections) be undertaken to identify strategies and tactics for addressing these systems at both the macro and micro levels. This analysis should focus on efficiency and organizational optimization to reach low hanging fruit, but it should also assess and identify strategies in line with the fuller spectrum of sustainability to generate more institutional and community *effectiveness*. This requires tremendous coordination across the campus, across departments and divisions. The *Office of Sustainability,* with support from the administration, is sufficiently positioned to guide the College through this process and coordinate this comprehensive evaluation and has made notable forward progress in serving as a hub for campus sustainability.

Introduction

In the face of a rapidly changing global economy and climate, uncertainty looms not only in our future, but also in our daily lives. Institutions of higher education are faced with the difficult task of equipping students with the skills and critical thinking to succeed in an increasingly competitive job market, while at the same time focusing on their own institutional longevity. As we begin to understand the scope of the impact of globalization and climate change, it becomes increasingly apparent that widespread systemic change will be required to retain our position within the global community and combat the threats associated with a changing climate.

Institutions of higher education are in a unique position to influence the efforts to solve these problems through research, collaboration, and innovation. However, without changing the ways in which they operate they may also act as obstacles. In order to remain globally competitive, it is imperative that we focus on a holistic approach to education that develops highly demanded skill sets, critical thinking, communication, and the ability to collaborate and adapt. While these efforts focus on economic and social sustainability and are typically more central to the goals of education, institutions of higher education must also serve as a model to their communities in terms of practicing policies of environmental sustainability. By acting as a hub for sustainability efforts, universities and colleges can serve as an easily accessible resource for positive change and the creation of community resiliency.

Through this report, the Office of Sustainability at the College of Charleston evaluates one facet of our impact on the surrounding community and the globe: our emissions footprint. In the coming years, addressing the reduction of our emissions will be a critical component of our Sustainability Action Plan. However, as it is only one metric to evaluate the impact the College has on our planet, community, economy, etc. we must continue to seek out other methods to evaluate that impact and how we can work to make it a wholly positive one. Our recently appointed President, Glenn McConnell has already made several commitments to focusing on sustainability. His support will be crucial to moving forward and implementing changes that positively affect our campus and community.

As this is the second report of this nature, details about what a greenhouse gas is or the effects they have and will have on our campus, country, and the world in the coming decades are not included here. For more background information on greenhouse gases and the methodology behind our greenhouse gas audit, please reference our 2012 report.

Methods

The GHG inventory covers emissions from October of 2013 to March 2014. The process involved three stages: data collection, data verification, and analysis. Office of Sustainability Staff used the Clean Air-Cool Planet Campus Carbon Calculator version 6.5 to calculate emissions totals.

1.1 Clean Air – Cool Planet Campus Carbon Calculator

Clean Air Cool Planet (CA-CP)[7], an organization that works with colleges and universities to help better understand their contributions to global climate change, has developed a standard for tracking and measuring greenhouse gases on campuses. The CA-CP Campus Carbon Calculator, designed particularly for institutions of higher education, is used to measure and evaluate greenhouse gas emissions over time.

This Excel-based tool has three modules (CA-CP 2012):

1) inventory module, which tracks GHG sources attributable to all institutional activities and operations.
2) projections module, which extrapolates data to make future predictions of emissions at the institution.
3) solutions module, which uses life cycle cost analyses to help rank the best emissions reduction actions to take in the future.

This report focuses on the 1st module, while a Sustainability Action Plan, inclusive of a Climate Action Plan, created by the College will discuss modules 2 and 3 in greater detail. These modules are useful for tracking and displaying trends in carbon emissions, for predicting future emission trends and for helping to cost-effectively evaluate techniques to reduce emissions. Like almost all standards, this tool is based on the fundamental framework outlined in the GHG Protocol[8].

1.2 Scope of Analysis and Inventory Methods

In our aim to be as comprehensive as possible, emission sources accounted for in this report include: electricity, natural gas, wastewater, solid waste, various fuels, refrigerants, transportation, fertilizers, paper purchasing, and livestock. Based on current “best practices”, our tracking is comprehensive. That said, it should be noted that there remain gaps around value cycle emissions from the College’s food system and purchasing. As we will outline in the recommendations section, if the College is to fully understand its emissions impact, we will need to develop and utilize tools to track these emissions and include them in our mitigation strategies.

[7] More information on Clean Air - Cool Planet and its Carbon Calculator can be accessed here: < http://www.cleanair-coolplanet.org/>.
[8] The Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.

Emissions are divided into *three* different scopes (See *Figure 2*), categorized by the source of emissions and compliant with the GHG Protocol. Viewing emissions from a “scope” perspective not only allows the College to make comparisons with other institutions and reporting agencies, but also aids in targeting areas of focus when developing reduction strategies. What is included in each scope and how data were gathered is outlined below.

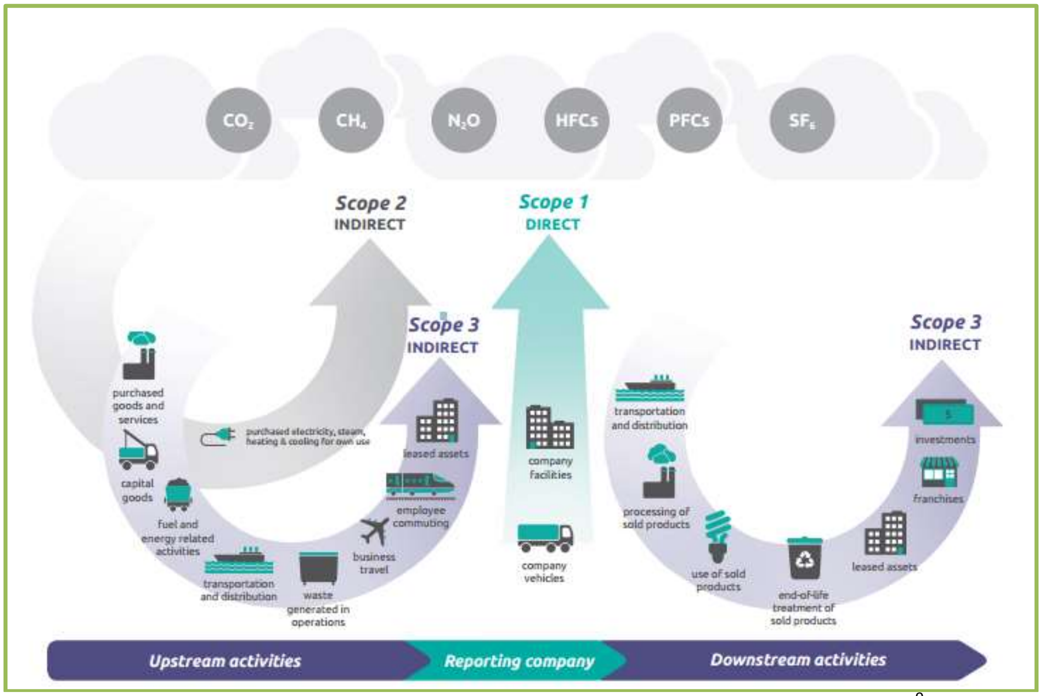

Figure 2. GHG emissions associated with each scope of the GHG Protocol.[9]

Scope 1 Emissions

These are direct emissions owned and controlled by the College. Scope 1 emissions at CofC include those from stationary campus energy sources, direct transportation from the schools fleet, refrigerants and chemicals used in facility equipment, and agricultural activities. Because most of the Scope one categories are not directly tracked by the Office of Sustainability, these data points had to be collected from a number of different sources. The College’s Physical Plant provided distillate oil, propane, and refrigerant and chemical usage data. Scope 1 energy usage data were obtained directly from monthly bills from the College’s energy provider (SCE&G) and compiled by the Office of Sustainability. Gasoline and diesel fuel usage data were collected from a number of sources including Physical Plant, Procurement and Supply Services, Patriots Point Athletic Complex, and Grice Marine Laboratory. Agricultural data pertaining to the usage of fertilizers were provided by Grounds Maintenance at both the main campus and Patriots Point Athletic Complex, while information regarding the number of livestock was provided by the Equestrian team.

[9] http://www.ghgprotocol.org/files/ghgp/public/scopes_diagram.pdf

Scope 2 Emissions

These emissions represent indirect discharges that are produced elsewhere but attributable to energy use at the College. Scope 2 emissions are primarily composed of purchased electricity, where energy is not produced on site. Scope two data were sourced directly from the College's energy provider (SCE&G) and tracked on a monthly basis by the Office of Sustainability.

Scope 3 Emissions

Scope 3 are indirect emissions beyond those covered in Scope 2, which include transportation-related activities not emitted on campus or through vehicles owned by the College, T&D (transmission and distribution) losses, and emissions related to waste disposal. This includes student, faculty, and staff commuting, travel not involving the school's fleet, solid waste, wastewater, and paper purchasing. Faculty/staff and student commuting to and from campus was estimated from the CofC Commuting Survey 2013. Directly financed outsourced travel (including air, train, taxi/ferry/rental car, bus, and personal mileage reimbursement) data were collected from a number of sources including Enterprise Rent-A-Car, the Controller's Office, Campus Recreation, and the Athletics Department. This year, we chose to include study abroad airfare within this category in order to eliminate redundancies. Landfilled waste weight is tracked monthly by the Office of Sustainability and is recorded from bills issued by an outside vendor (Republic). Wastewater data were also recorded directly from billing issued by Mount Pleasant Waterworks and Charleston Water System. Data for paper usage were supplied by Procurement and Supply Services in the form of total number of reams purchased by the College.

1.3 Important Terms

In this report there are a number of terms and abbreviations that are used to help describe different aspects of a GHG inventory. Here is list and explanation of the post pertinent terms.

TERM	SIGNIFICANCE
GHG	Greenhouse gas.
CO_2e	Carbon dioxide equivalent.
GWP	Global warming potential.
MT	Metric ton. A unit of volume that is equal to 2,000lbs.
MMBtu	One million Btus. A Btu, or British thermal unit, is a measure of how much energy is required to heat one pound of water.
FY	Fiscal Year. As the College is a state institution, it runs on fiscal years determined by the State of South Carolina. The year runs from July 1st through June 30th.
$CO2e/ft^2$	A metric of emissions intensity that measures amount of CO_2e emitted per unit of area, in this case per square foot.
CO2e/student	A metric of emissions intensity that measures amount of CO_2e emitted per student. Can be thought of as the average student's carbon footprint.
CO2e/student commuter	A metric of emissions intensity that measures the amount of CO_2e emitted via commuting for each student. Metric in this paper considers all students to be commuters.
ACUPCC	American College and University Presidents' Climate Commitment. A formal body designed to organize higher education's approach to understanding and ultimately addressing global climate change.

Part 1: Data Collection and Analysis

Key Findings: ***In FY2013, the College of Charleston emitted a total of 60,327 MT CO_2e. Purchased electricity, the greatest source of emissions, accounted for 37,013.7 MT CO_2e or 61.4% of total emissions. Student, faculty and staff commuting to and from campus was the second largest contributor at 6,004 MT CO_2e (9.9%). Air travel (6,202.5 MT CO_2e or 10.7%, of total emissions), natural gas usage (2,290 MT CO_2e or 3.8% of total emission), and Scope 2 Transportation and Distribution (T&D) losses (3,660.7 MT or 6.1% of total emissions) were also significant contributors to the College's emissions profile. Less significant contributors (collectively 6,466.8 MT CO_2e or 10.7% of total emissions) include paper purchasing, refrigerants and fertilizers, livestock, wastewater, solid waste disposal, other fuels (propane, distillate oil, and gasoline).***

For the 2013 fiscal year, the College of Charleston was responsible for 60,327 MT CO_2e. Previous GHG audits completed in 2003 and 2011 reported emissions of 43,862 MT CO2e in 1993, 46,576 MT CO2e in 1999, and 38,712 in 2001 (Linstroth and Neff, 2003) and 63,257 MT CO2e in 2011 (Fisher, et al., 2012). *Figure 3* provides a graphic representation of these changes. Complete historic data are unavailable for any other years. While emissions are generally trending upward annually, they did decrease from slightly from FY2011 to FY 2013 (See Figure 3). This decrease in emissions can be explained by more accurate data collecting processes and a decrease in natural gas usage.

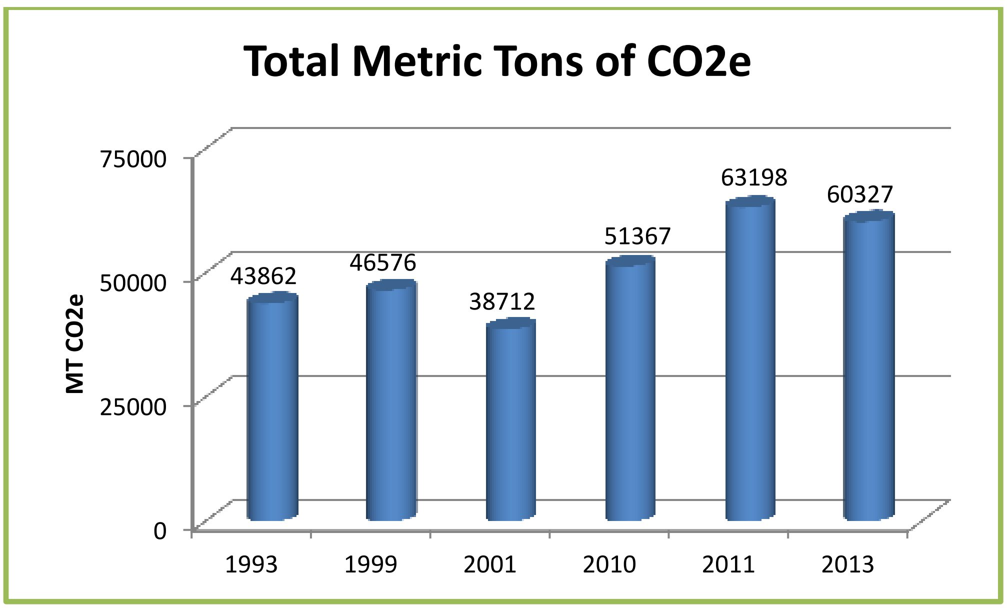

Figure 3. Total GHG emissions per fiscal year at the College of Charleston.

We will discuss emissions in further detail in two ways: by scope and then by category. Scope will address the three scopes of emissions outlined in the GHG Protocol. Categories, chosen by the authors, are meant to arrange data into a more intuitive classification.

2.1 Emissions by Scope

Scope 1 emissions accounted for 3,163.9 MT of CO_2e, or 5.2% of FY2013 total emissions (See *Figure 4*). *Scope 1* emissions are mainly derived from stationary on-campus energy sources such as burned natural gas used to produce steam for heating hot water and HVAC systems. Emissions from burning natural gas accounted for the majority (72.4%) of Scope 1 emissions.

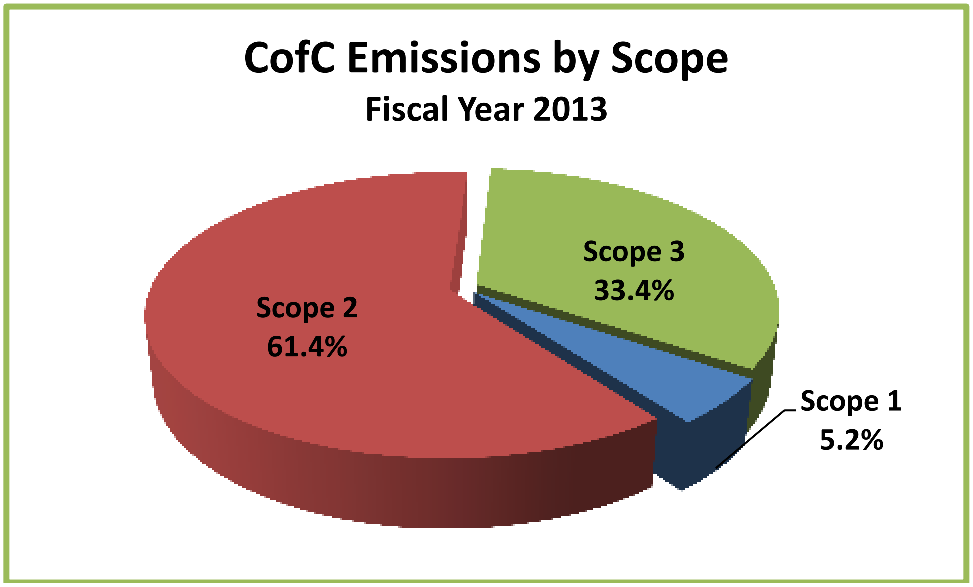

Figure 4. College of Charleston's emissions by scope for FY2013.

Scope 2 related emissions accounted for 37,014 MT of CO2e, or 61.4% of total emissions. Purchased electricity used to power buildings was the biggest source of both energy use and of total emissions for College of Charleston in FY2013. Purchased electricity is the only source of *Scope 2* emissions.

Scope 3 related emissions accounted for 20,150 MT of CO2e, or 33.4% of total emissions. Campus commuting and directly financed air travel are the main contributors to *Scope 3* emissions.

2.2 Emissions by Category

In order to provide a more intuitive division of how the College's emissions are generated, we also explain emissions by the categories below. Each section will conclude with the limitations of each set of data and list any calculations that were used to create the input figures for the campus GHG calculator.

2.2.1 Institutional Data

> Key Findings: ***College of Charleston had a student, faculty, and staff population of 13,743 in FY2013 and total campus building space totaled 3,556,696 sq. ft. These are key numbers for metrics used to compare emission's intensity across different campuses.***

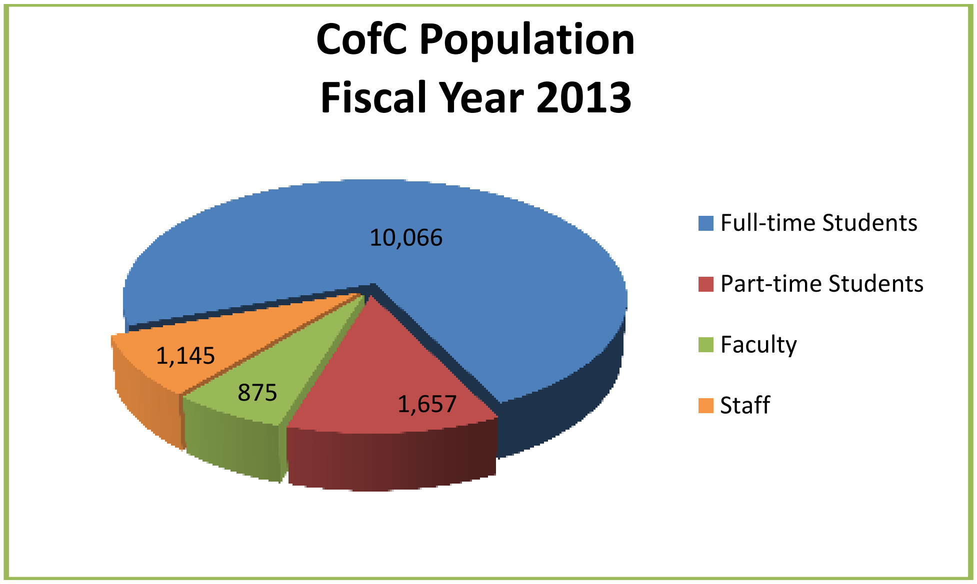

Figure 5. College of Charleston's population during FY2013.

Institutional data include annual expenses, population, and total campus building space. These data were obtained from the CofC Office of Institutional Research and the 2013 CofC Comprehensive Annual Financial Report. In FY2013 the College of Charleston total operational expenses were slightly over $224 million, $8,515,447 of which we dedicated to research, and $7,124,725 were spend on energy. These numbers represent the actual total spent by the College, however the numbers used the GHG calculator are adjusted for inflation with 2005 as a baseline. The combined population of students, faculty and staff in FY2013 totaled 13,743 and included 10,066 full-time students, 1,657 part-time students, 875 faculty members, and 1,145 staff (See *Figure 5*). This does not include the 4,401 summer school students attending the College during that fiscal year, as it is likely the majority were also students during the regular academic year.

Building space, as of the fall of 2013, totals 3,556,696[10] square feet (ft^2), 25,992ft^2 of which is classified as research space. This is an important aspect of an institution's emissions profile to document because it has been demonstrated that research space has significantly greater emissions than non-research space (EPA, 2008; Hopkinson, 2011). While student population has remained relatively stable since 2005, building space has increased by 49.3% (See *Figure 6*). The increase includes the addition of the New School of Sciences and Math building, which totals 127,576ft^2, and the Cato Arts Center, a total of 65,856ft^2, both added in FY2010 totals. Moreover, *in 2010 the College altered the manner in which it calculates building space, including adding a number of buildings that were not included prior to fall 2010*. As such, not all of the change in building space from FY2010 to FY2013 is from the addition of new buildings; the dotted line in *Figure 6* reflects this. Because the College closely tracks the data reported in this section, they are highly reliable and considered to be accurate.

[10] The officially documented building space as of FY2013 is 3,816,985 GSF; this figure includes all buildings owned, leased, and used by the College. However, there are a number of buildings which energy usage information is unavailable. For accuracy, the square footage from these buildings was eliminated and the 3,556,696 GSF figure used.

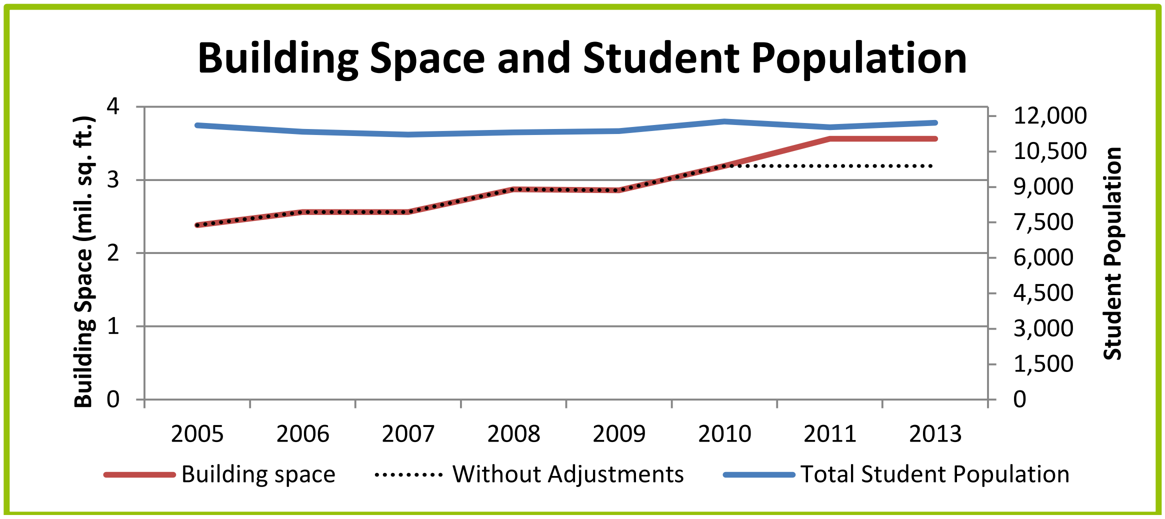

Figure 6. College of Charleston's total building space and student population from FY2005 to FY2013.

Population and building space data were utilized to create measurements of intensity that help to standardize GHG emissions for easy comparison with other colleges and universities. The two measurements of intensity used to compare emissions between institutions are CO_2e/ft^2 and CO_2e/student, which average total CO_2e emissions per square foot of building space and per student, respectively. With these data, building size and campus population will not influence emissions, facilitating cross-institution comparison. In FY2013, the College emitted **16.96 MT of CO_2e** for every 1,000 ft^2 of building space and **5.7 MT CO2e** for every student (based on FTE) (See *Table 3* and *Table 4* to compare CofC with State and National schools).

2.2.2 Energy and Utility Usage

> Key Findings: ***Energy consumption across all scopes totaled 713,552.3 MMBtu. All utilities (including T&D loses) used at the College accounted for 78.6% of the school's total emissions. Building energy use, which includes purchased electricity and other on-campus stationary energy sources such as natural gas and propane, was the highest contributor of emissions at 65.2% of total emissions. Wastewater related emissions, solid waste emissions, and other fuels collectively accounted for less than 8% of all emissions.***

In the context of this report, utilities include: purchased electricity, natural gas, distillate oil, propane, diesel and unleaded fuels, wastewater, and solid waste. Data in this section are derived from purchase invoices. Energy emissions accounted for the largest percentage of total emission in this category, totaling 713,552.3 MMBtu and 78.6% of all emissions. Other utility emissions related to wastewater and solid waste processing account for a total of 5.6% of all emissions.

Total Energy Usage

> Key Findings: ***The College consumed a total of 713,552 MMBtu of energy in FY2013. This includes energy expended for utilities, travel, and losses in energy from transportation and distribution of electricity. To put this figure into perspective, this amount of energy could***

power an average American vehicle for 343,333 miles.[11] The College consumed 650,420 MMBtu of direct energy, or energy expended on campus, the majority of which (85%) was in electricity consumption (See Figure 7). These findings reinforce the fact that any real attempt to reduce the College's carbon footprint will need to involve a strong focus on decreasing electricity usage and promoting energy efficiency.

Purchased Electricity

Key Findings: ***Purchased electricity accounts for 37,014 MT of CO_2e, 61.4%, of the College's total emissions. Emissions from electricity increased 12.2% from FY2009 to FY2011 and 1.6% from FY2011 to FY2013.***

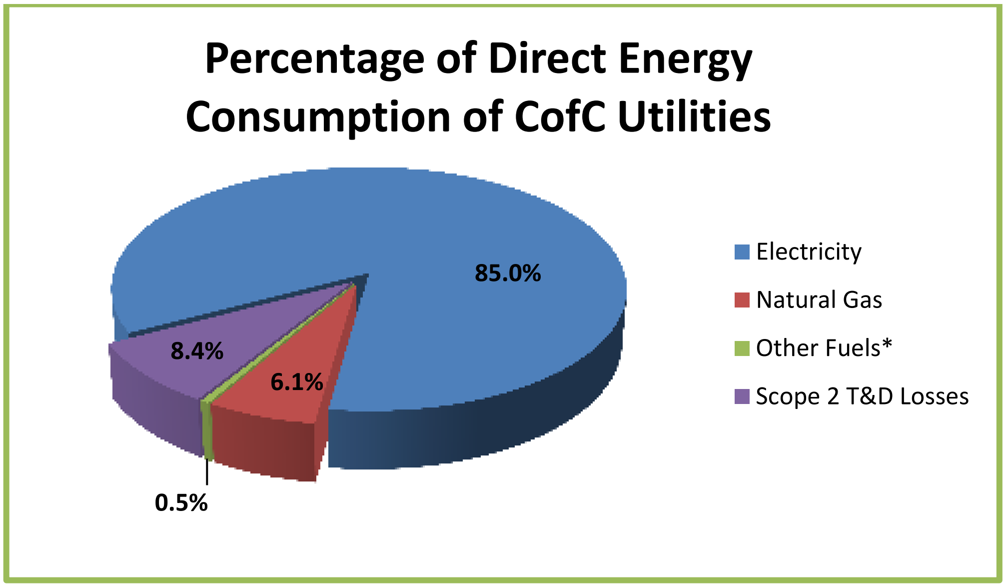

Figure 7. Breakdown of direct energy consumption. Only utilities with energy consumption occurring directly on campus are included.
*Other fuels include distillate oil, unleaded and diesel gas burned on-campus, and propane.

Electricity consumed by campus buildings, street lighting, parking garages, and any other campus infrastructure is included in this section. Data from purchased electricity was collected directly from monthly bills issued by South Carolina Electric and Gas Company (SCE&G). Within these bills, reports for electricity consumption are itemized by building or structure, however there are a number of buildings that are grouped together on the "Central Energy Grid" that are reported as one lump sum.

[11] http://www.epa.gov/cleanenergy/energy-resources/calculator.html

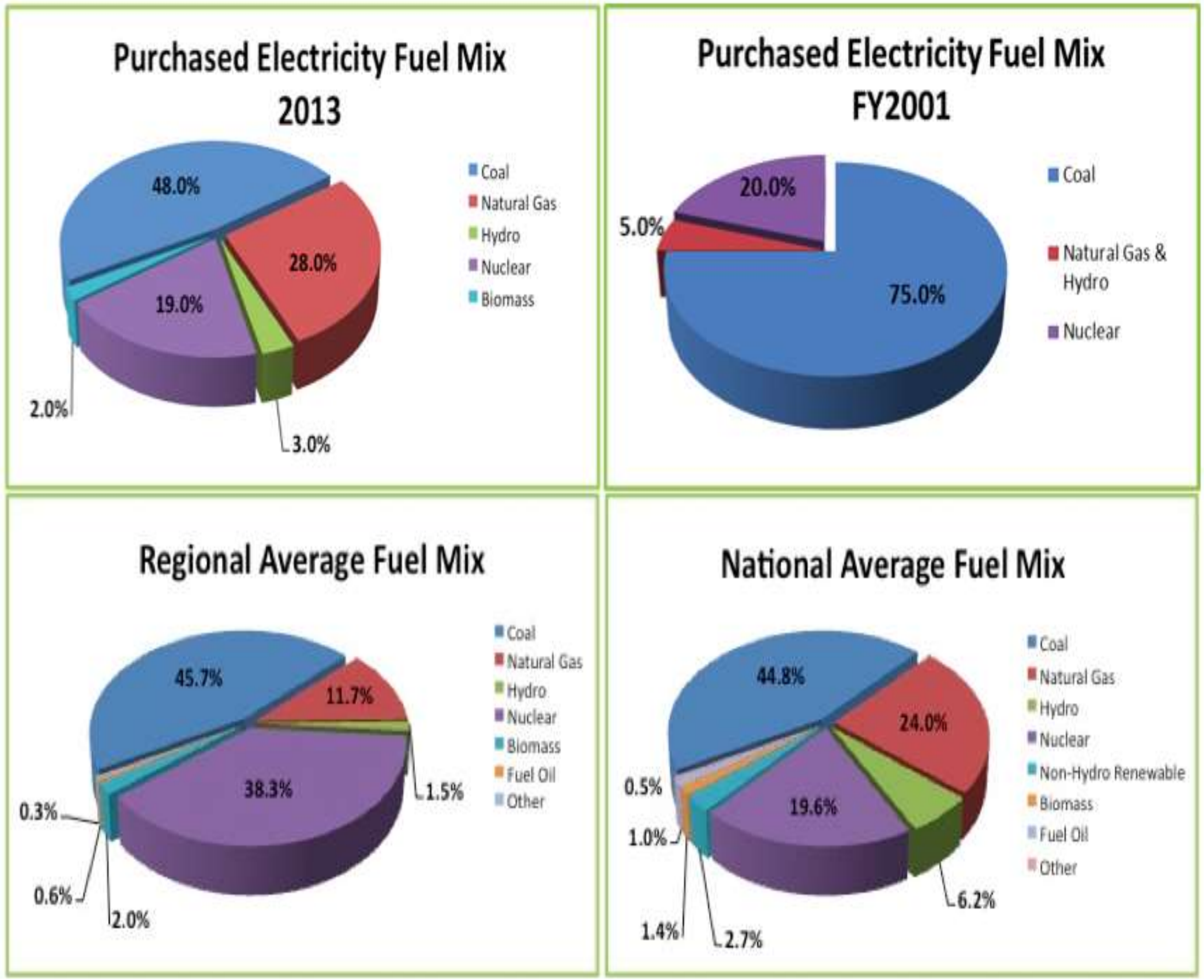

Figure 8. FY2011, FY2001, SRVC regional average and national average for electricity fuel mix.
*Includes tires, batteries, chemicals, hydrogen, purchased steam, sulfur, and miscellaneous technologies.
** Includes generation by agricultural waste, landfill gas recovery, municipal solid waste, wood, geothermal, non-wood waste, wind and solar

Buildings routed through the Central Energy Grid include the BellSouth building, the Harry M. Lightsey Center, The Marion and Wayland H. Cato Jr. Center for the Arts, Rivers Dormitory, Maybank Hall, the Rita Liddy Hollings Science Center, and the School of Science and Mathematics Building.

GHG emission calculations from electricity are based on the fuel mix used to create energy in a given area or region. It is important to note these differences in electricity fuel mixes because different means of power generation have different GHG outputs and different GWP[12]. For instance, burning coal releases more CO_2/MWh than oil, nuclear, or natural gas (World Energy Council, 2004). Purchased electricity used to power building operations at the College comes from a fuel mix that is 48% coal, 28% natural gas, 19% nuclear, 3% hydro, and 2% biomass (South Carolina Electric and Gas, 2013). Historical data from the 2003 GHG report indicate that this mix in FY2001 was 75% coal, 20% nuclear, 5% natural gas/hydro (See *Figure 8*). These data compare to a current regional (SRVC region) mix of 45.73% coal, 11.73% natural gas, 38.25% nuclear, 1.49% hydro, and 1.96% biomass (EPA, 2014), and to the most recent national average of 44.75% coal, 23.97% natural gas, 19.56% nuclear, and 6.17% hydro (EPA, 2014). With regards to the College's purchased energy mix since 2011, coal usage has increased 5%, natural gas usage has decreased by 2%, nuclear usage has increased by 8%, hydro usage has decreased by 11%, and biomass usage has increased by 1%. Overall, this represents a general decrease in the proportion of energy supplied by renewable sources. This factor, combined with an increase in usage explains the increase in emissions from electricity from 2011 to 2013.

The above information indicates how important local energy mixes are for understanding and quantifying institutional carbon impact. Looking forward, changes in how SCE&G will produce energy in the future will play a large role in how the College's carbon footprint will change and in how we shape our strategies for reducing our impact. The energy provider is set to bring online two addition nuclear power plants in 2018 and 2019, which could reduce our carbon impact by 20% or more. While any reduction is a positive step forward, it would be faulty for the College to congratulate itself for emissions reductions derived from activities not related to changes made on campus. As such, it becomes vitally important over the next few years for the College to make meaningful changes to the way we operate so that documented changes can be confidently attributed to our collective efforts to reduce our carbon impact.

Electricity from imported sources, which falls under Scope 2 emissions, is the College's highest contributor to energy use and to GHG emissions in FY2013. Imported electricity accounted for 606,733 MMBtu of energy usage and 37,014 MT CO_2e, approximately 93% of the school's total energy consumption and 61.4% of the school's total GHG emissions. Imported electricity usage has increased a total of 2.6% from FY2011 to FY2013. Emissions from electricity increased by 1.6% during the same time period (See *Figure 9*). The College also experienced a minor increase (2.5%) in electricity spending during this time period, spending $5,832,641.79 on electricity in FY2013, up from $5,691,989 during FY2011.

[12] Global Warming Potential (GWP), a measure of each gas' contribution of to climate change relative to that of carbon dioxide (Clean Air Cool Planet, 2014). For additional explanation, see the College of Charleston 2012 Campus Emissions Report.

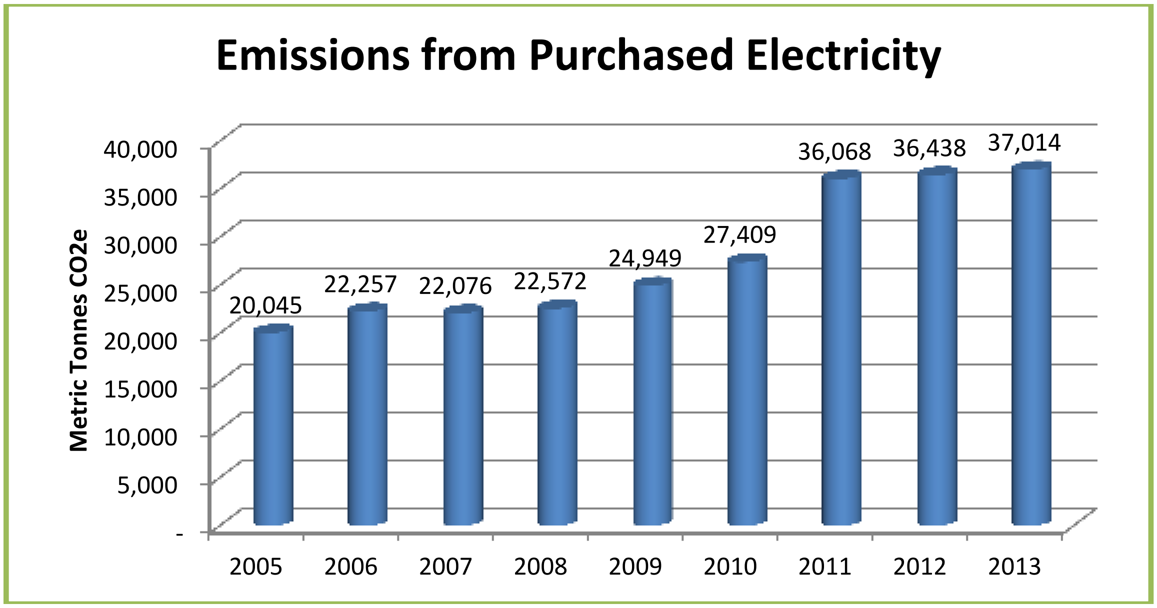

Figure 9. The College's emissions from imported electricity from FY2005 to FY2013 in MT CO_2e.

There is a clear upward trend in electricity consumption, emissions, and spending at the College. Most of the increase since 2009 is attributable to growing infrastructure and campus population (See *Figure 10*). Specifically, the addition of the new School of Science and Mathematics Building and the Cato Center of the Arts are significant contributors to increased purchased electricity. Additionally, there was an increase in the number of cooling degree days[13] in South Carolina, up by 22.7% from 2009 to 2010 (NCDC/NOAA, 2011), which required greater use of air conditioning units during those fiscal years. In fiscal year 2013, we witnessed a significantly higher amount of cooling degree days (2,316 in 2013 versus 1,839 in 2011) but a lower number of heating degree days (2,152 in 2013 versus 2,712 in 2011). As climate change leads to higher global and local temperatures, the number of cooling degree-days are expected to rise leading to greater demand for electricity. This will be a challenge in the coming decades not only locally for the College, but for institutions both in and out of higher education across the globe.

[13] Cooling degree-days (CDD) and heating degree-days (HDD) are ways to measure how much energy is used to cool or heat a home on a given day. These measurements are based on the deviation from the base temperature for that day, and how long the outside temperature was outside of the base range. Base temperatures are determined by deciding the outside temperature in which a building starts heating or cooling itself. CDDs and HDDs can help explain increases or decreases in the amount of energy used to cool or heat infrastructure over a specific period of time.

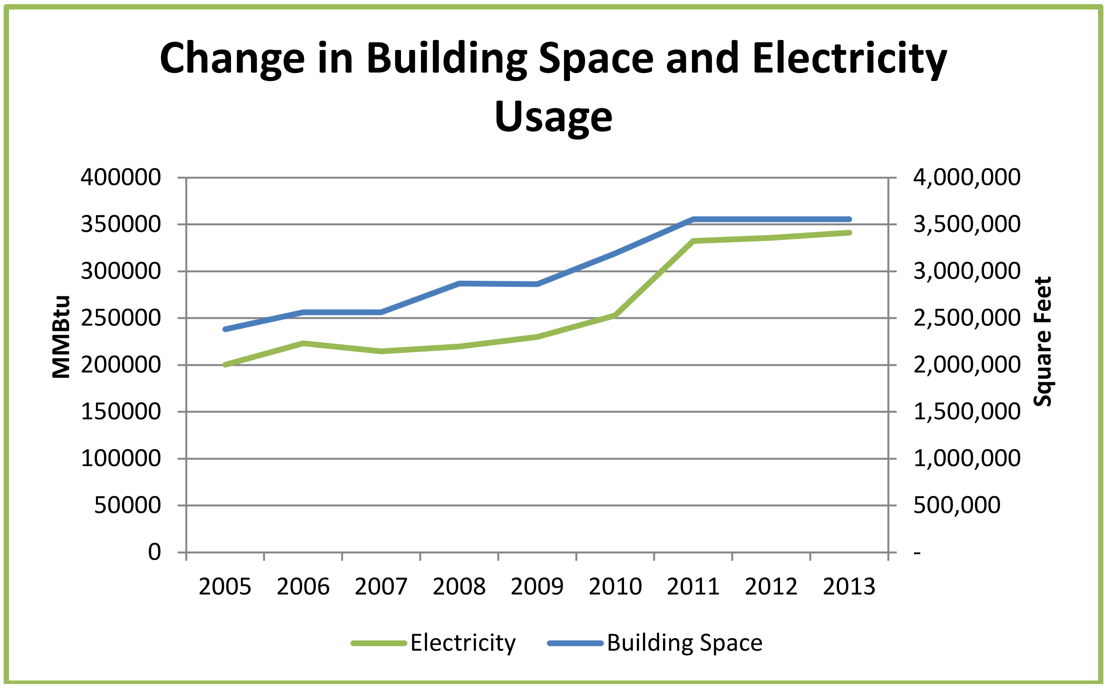

Figure 10. Change in building space and electricity usage at the College of Charleston from FY2005 to FY2013.

Because these data were reported from invoices from the College's energy provider (SCE&G), they are among the most reliable data in the inventory. Furthermore, because such a large portion of the College's footprint is derived from electricity (61.4%), we are confident in the accuracy of this inventory as a whole.

Natural Gas

> Key Findings: ***Natural gas accounted for 2,290 MT of CO2e, or 3.8% of the school's total emissions. Natural gas usage decreased significantly from 2011 to 2013 likely due to the lesser number of heating degree days. As a result, CofC had less of a need to heat the buildings and use natural gas.***

Natural gas used on campus at stationary sources falls under *Scope 1* emissions and is mostly used for HVAC operation, specifically to heat buildings. The natural gas supply at the College is interruptible and availability is largely dependent on weather conditions. If there is an unusually cold winter or electricity is in short supply in another area, SCE&G will divert its natural gas availability to these other areas and the College will not have access to this energy source. This represents a serious energy security issue. As with energy usage data, data from natural gas usage were also derived from invoices from SCE&G and is highly accurate. Like imported electricity, a portion of usage can be separated by building, while the buildings on the "Central Energy Grid" are reported collectively.

Natural gas accounted for 43,277 MMBtu of energy usage and 2,290 MT of CO2e in FY2013 or approximately 6.1% of the College's total energy consumption and 3.8% of its emissions. Annual natural gas usage, and therefore emissions, steadily decreased between FY2005 and FY2008 (See *Figure 11*), with a total emissions decrease of 15.3%. Yearly decreases occurred during this timeframe despite continuous yearly increases in the amount of heating degree days (see *footnote 14*) in South Carolina (NCDC/NOAA, 2011). These yearly decreases may have been influenced by the availability of natural gas during this time. Because the natural gas supply at College of Charleston is interruptible, our natural gas supplier likely diverted the gas supply as needed throughout this period of time. While exact amounts or periods of interruption are unknown, the College did have its natural gas interrupted periodically between 2005 and 2008. These interruptions would contribute to decreased availability and therefore decreased use in natural gas, which may also help explain some of the decrease from 2011 to 2013. Additionally, the 60.2% decrease in MT CO2e from FY2011 to FY2013 can also be explained by a lower number of heating degree days (2,152 in 2013 versus 2,712 in 2011). Prior to 2012 natural gas emissions were not tracked directly through the Office of Sustainability and were instead generated by School Dude software. We have a high level of confidence in the data from 2012 and 2013, and the data cannot be verified and could be inaccurate for the years prior to 2012.

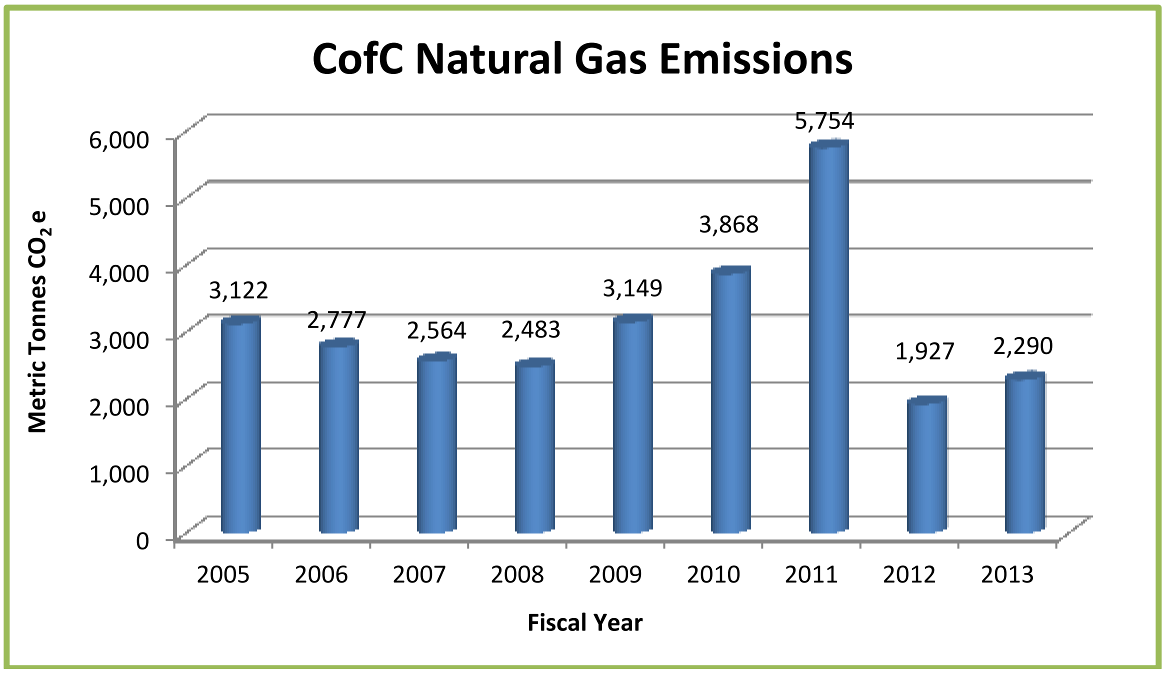

Figure 11. The College's emissions from natural gas usage from FY2005 to FY2011 in MT CO_2e.

Like imported electricity, natural gas usage and emissions experienced a surge from FY2009 to FY2011, increasing 33.8%. While additions to infrastructure would have directly influenced these increases, natural gas during this timeframe was much more readily available due to advancements in fracking technology (EIA, 2010) which increased the supply available to the College and the nation. Thus, there would have been fewer interruptions in the institution's natural gas supply, allowing natural gas to serve as a main source for heating buildings.

Natural gas spending also decreased from $941,870 in 2011 to $731,285 in 2013, a 22.4% decrease. However, increases in the institution's natural gas consumption from FY2009 to FY2011 are not directly reflected in the institution's spending due to dramatic decreases in the price of natural gas during this time period. For instance, the average national natural gas price for electric power in 2008 was $9.26 per 1,000ft^3 and dropped to $4.87 per 1,000ft^3 by 2011 (EIA, 2012). This, therefore, represents an overall reduction in both cost of energy and emissions (natural gas vs. carbon-intensive electricity), while increasing consumption of energy. These reductions, however, result from the movement toward fewer coal-dependent sources of energy by our energy provider. In order to continue to make a positive impact on both cost and emissions, it's imperative that the College focuses on methods of energy use reduction as well as a transition to "greener" sources.

Other Fuels

> **Key Findings**: ***Other fuels including distillate oil and propane gas accounted for less than 1% of the College's total emissions.***

Emissions from other fuels used at the College in FY2013 include distillate oil, propane gas, unleaded gasoline, and diesel. As they are direct emissions and burned directly on campus, these fuels also contributed to *Scope 1* emissions. Collectively, other fuels made up less than 1% of the College's total GHG emission footprint. Distillate oil, used as a backup energy source for the College's boilers when natural gas is unavailable accounted for 314 MMBtu of energy. Propane use (used for heating and cooking purposes at the Patriot's Point Athletic Complex and Dixie Plantation) accounted for 96 MMBtu of energy. Data for distillate oil and propane were obtained from administrators at Physical Plant and Patriot's Point and are considered highly reliable.

Wastewater

> **Key Findings**: ***Emissions from wastewater related activities produced 56.8 MT CO_2e, or less than 1% (.09%) of the College's total emissions.***

Emissions related to wastewater treatment and transportation fall under *Scope 3*. Data for wastewater were collected directly from bills and invoices from the Charleston Water System and Mount Pleasant Waterworks which use aerobic central treatment systems to process wastewater. These activities produced 56.8 MT CO_2e in FY2013, which is 0.09% of the College's total.

Emissions related to wastewater have increased 15.7% since FY2007, with a small increase (6.4%) from 54.3 MT CO_2e in FY2011 to 56.8 MT CO_2e in FY2013 (See *Figure 12*). The increase in wastewater emissions after FY2008 is most likely associated with additions to campus infrastructure while annual fluctuations in wastewater emissions could also be influenced by fluctuations in yearly campus population.

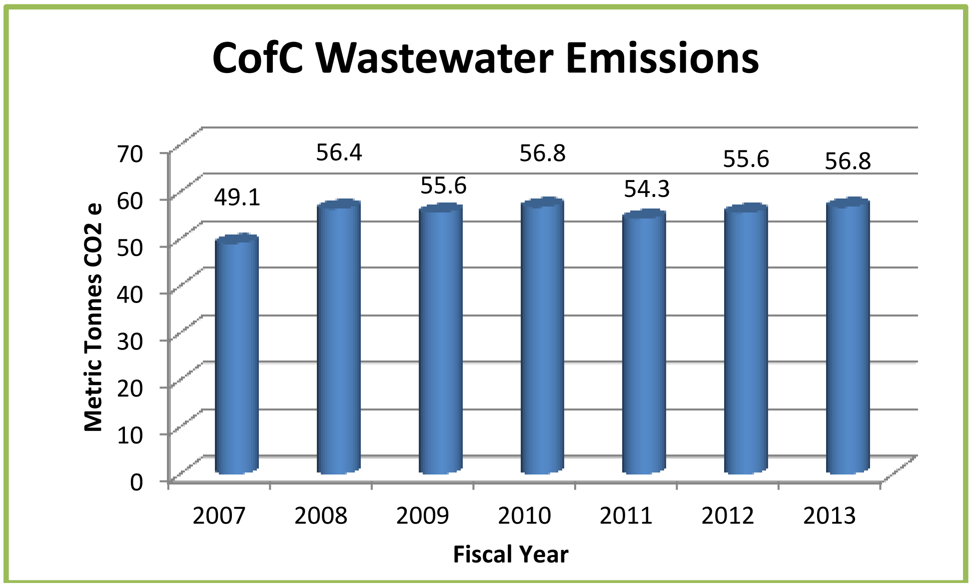

Figure 12. The College's wastewater emissions from FY2008 to FY2013 in MT CO2e.

Data were provided in copies of past wastewater bills. In the instance of missing data, an average of all months during that year was used in order to develop a more accurate picture of wastewater costs for the College. Additionally, each physical copy of the wastewater bill had to be converted to a digital copy, which is a time consuming process that introduces the possibility of errors. Because of these factors, actual amount of wastewater that was produced by the College may deviate slightly from reported values.

Solid Waste

> <u>Key Findings</u>: ***Emissions from solid waste related activities produced 3,315.8 MT CO_2e, or 5.5% of the College's total emissions.***

The College hires an outside vendor, Republic, to haul solid waste which charges by "pull" for each time the vendor empties a dumpster, whether it is full or not. Republic then weighs each truck, records the weight and reports it to the College. Based on these data, total weight for each dumpster was calculated and for any missing data an average weight per week for the year was substituted as an estimated value. We believe these data are far more accurate than the previous years, however the missing weeks may lead to some minor error. Also, there is likely some error resulting from the inability to account for construction and demolition debris as well as some smaller auxiliary locations. We anticipate the total waste as well as the total percentage of emissions to increase as we collect more data.

Our records indicate that the College was responsible for 1,070 short tons of landfill waste in FY2013. Emissions related to solid waste disposal accounted for 3,315.8 MT CO2e, which is 5.5% of the College's total. This represents a 30.1% decrease in the mass of waste and a 30.1% decrease in the emissions from waste since 2011. This decrease is not likely due to a reduction in waste, but rather an improvement in our tracking methods. Emissions from solid waste disposal fall under *Scope 3*.

2.2.3 Transportation

> Key Findings: ***Emissions related to all forms of transportation accounted for 13,186.2 MT of CO_2e in FY2013, which represents 21.9% of the College's total GHG emissions. Transportation emissions were the second largest contributor to the school's emissions profile behind only purchased electricity. Student, staff, and faculty commuting accounted for 45.5% of total transportation emissions while all air travel was responsible for 47.0%. The remaining emissions were related to on-campus vehicles and motorized travel by students, faculty, and staff to events, conferences, and sporting events.***

Collectively, the College produced 13,186.2 MT of CO_2e in transportation-related emissions in FY 2013 (See *Figure 13*). This accounts for 21.9% of the institution's total emissions and was the second greatest contributor to the emissions footprint. The majority of these emissions (47.0%) were attributed to directly financed air travel, including study abroad and business travel. The second largest contributor (35.2%) was student commuting to and from campus. Individual forms of travel are summarized below and include direct transportation, other directly financed travel, campus commuting and air travel.

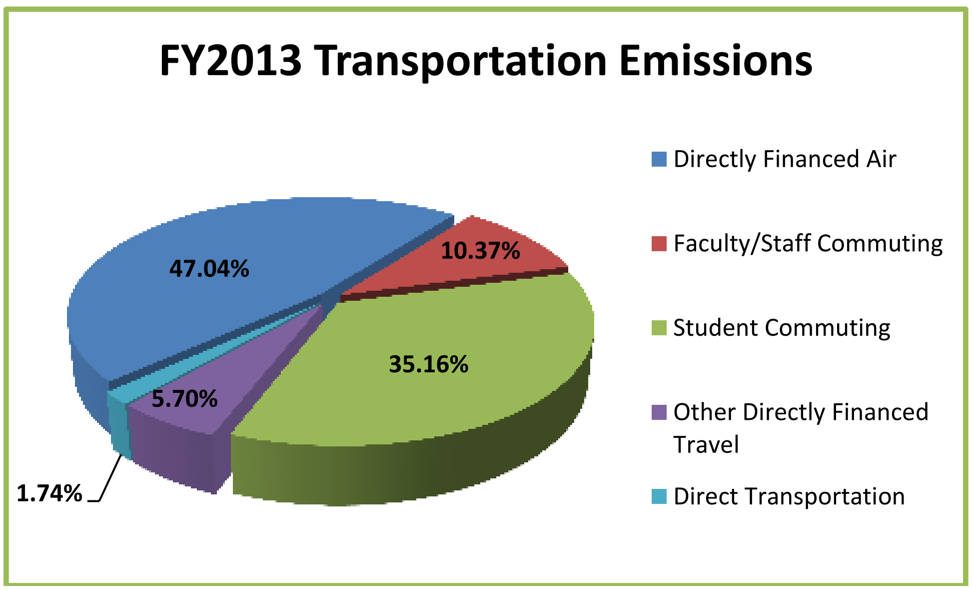

Figure 13. Percentage of GHG emissions from all forms of transportation at The College in FY2013.

Direct Transportation

Direct transportation, a *Scope 1* emission, includes all on-campus ground transportation for College purposes (e.g. golf carts for Grounds crew, campus vehicle fleet travel, boats used at Grice Marine

Laboratory). Grice Marine Lab data were provided by Grice staff. Other on-campus fuel data included unleaded gas usage provided from the Physical Plant as an annual data point consisting of gallons of unleaded fuel purchased for the central fueling tank and an annual average for diesel fuel used at the Patriot's Point Athletic Complex. Unleaded fuel and diesel fuel collectively accounted for 3,125.5 MMBtu of energy and 229.1 MT of CO_2e (0.4%).

Data from Grice are tracked on a monthly basis and can be considered to be very accurate. Data for the other sources of gasoline and diesel usage were provided directly by Procurement and reported by gallons, and consequently represent an accurate total for usage by the College.

Other Directly Financed Travel

These emissions come from faculty and staff ground transportation, most of which comes from travel to conferences, meetings, workshops, etc. Expenses were directly reported from the Budget Office as reimbursements to faculty and staff members and the reimbursement per mile rate was used to determine mileage. This rate changed on January 1, 2013 and to account for this an average of the two rated was used in the calculation. Additional mileage generated by rental car uses was reported directly from Enterprise, our vendor for rental cars, and included in the total miles. Other directly financed travel falls under *Scope 3* emissions and accounted for 751.0 MT CO2e, in FY2013, which is 1.3% of the institution's total emissions.

These numbers, however, excluded many of the additional travel emissions generated by College employees. For example, if a faculty member did not report driving their own vehicle to travel to and from a local conference, the mileage would not be included in this total. Similarly, while Enterprise is the encouraged vendor, it is not always used and any rental car mileage from other vendors is also not included. As such, it is likely that this number is an underestimation.

Campus Commuting

Population (respondent rate)	Mode of Transportation (%)					Distance (mi)					Total (N)
	Walk	Bike	Bus	Carpool	Drive Alone	Walk	Bike	Bus	Carpool	Drive Alone	
Faculty (19.89%) **& Staff** (23.93%)	3.46	7.90	17.13	8.24	63.27	1.36	4.09	13.31	10.22	12.15	**100% (442)**
Students (5.28%)	24.0	15.47	8.07	5.61	46.84	1.24	3.39	13.57	4.84	12.32	**100% (556)**
All	20.7	14.25	9.53	6.03	49.84	1.26	3.5	13.53	5.71	12.29	**100% (998)**

Table 2. Modes of transportation for College of Charleston students, faculty and staff.

Student, faculty, and staff commuting accounted for 6,003.6 MT CO_2e, which was 9.9% of the institution's total emissions for FY2013. Students were responsible for 77.2% of total commuting emissions, or 7.7% of the institution's total GHG emissions. Commuting to and from campus is classified as a *Scope 3* activity. For further details about campus commuting, see the 2013 Campus Commuting Report.

Air Travel

GHG emissions related to air travel, which falls under Scope 3 emissions, were calculated from a sum of student study abroad flights, faculty and staff flights for business purposes, and flights taken by athletic teams. Faculty and staff mileage was directly reported as a cost total, which was then converted to mileage by using an average of 12.0 cents per mile[14]. Study abroad mileage totals were derived directly from flight itineraries or by estimating itineraries. Combined air travel accounted for 6,202.5 MT CO2e in FY2013, which was 10.28% of the College's total GHG emissions. A total of 11,775,810.85 miles were travelled via plane (3,104,295.25 miles by faculty/staff and 8,671,515.6 miles by students). Of the total mileage, 61,096 miles were attributable to varsity athletics, 58,080.76 miles to athletics recruitment, 72,662 miles to student clubs, 583,333.58 miles to grant participants, and 4,387,706.8 miles to study abroad.

There are many uncertainties with these data that resulted in a number of assumptions and estimates. For study abroad, specifically, the majority of the itineraries were not available and estimations were made for likely connecting flights. Flights for study abroad programs sponsored by the College were counted as one single trip (assuming all students took one flight), while flights associated with study abroad programs sponsored by independent organizers were counted for each student as separate flights. Since it was impossible to determine if study abroad flights were taken as a group as a part of programs external to the College, accounting for each student's mileage helps to avoid underestimation. Additionally, there were many study abroad trips classified as "multi-destination" and we had no means of determining what these destinations were. An average of all study abroad trips was used for students who were listed in this category. Because faculty and staff mileage was estimated from cost these data are also speculative, however by using an upper end of the average cost per mile, it is more likely that an overestimation was made. The reliability of these data are questionable; however we deliberately leaned toward higher ends of estimations to increase the likelihood an overestimation rather than underestimate the College's footprint.

2.2.4 Other Sources of Emissions

> **Key Findings**: ***Other emissions sources including those attributable to the use of refrigerants and chemicals, paper products, agriculture (livestock & fertilizer application) and transmission and distribution (T&D) losses accounted for 7.3% of the College's total emissions. Emissions from transmission and distribution (T&D) losses from purchased electricity accounted for the majority of these emissions, or 6.1% of total emissions.***

[14] This figure was obtained by using the upper end average of figures reported in "Avoid getting ripped off by the airlines" (Seaney 2008).

To make the most comprehensive report possible, the College has also accounted for other sources of emissions such as those produced from the use of refrigerants and chemicals, from paper purchasing, and agriculture (livestock & fertilizer application). These sources may not contribute large amounts of emissions but they contribute to the overall emissions profile and to the extent possible, they should be tracked. To obtain estimates for T&D loses, we used the CA-CP calculator calculations included within the calculator.

Refrigerants and Chemicals

Emissions from the use of chemicals and refrigerants are considered to be in the purview of *Scope 1*. Refrigerants and chemical usage data, such as R-22, R-123 and R-134, were provided directly from Building and Equipment Maintenance. Combined emissions from refrigerant and chemical usage in FY2013 total 579.7 MT CO_2e, up from 462.2 in FY2011. As with electricity usage it is likely these emissions can be explained by the increase in cooling degree days; these refrigerants are used in air conditioning units.

Paper Purchasing

Total known purchases from the library and from procurement card purchases for FY2013 were estimated to be 131,991 lbs of paper and accounted for 159.4 MT CO2e. Paper purchasing falls under *Scope 3* activities. Procurement reports for purchases of reams of paper were used to estimate total poundage of paper. From these reports, the total number of reams were calculated and multiplied by the average weight of a ream (6 pounds) to find the total poundage of paper. Printer paper was the only source of paper accounted for as reams represent the vast majority of paper usage at the College. In FY2011 we accounted for more minor paper usages (such as legal pads), however it was found that these sources accounted for such a trivial amount of the total footprint that it was not worth the time it took to process the data. As a result, we expect the actual value for paper related emissions to be slightly higher than reported here.

Agriculture

The CA-CP calculator also asks institutions to report any fertilizer usage and livestock that they own or lease that are used for day-to-day operations. The College equestrian team uses 22 horses owned by the Foundation, which are boarded at Storybrook Farms in West Ashley. Fertilizer usage was reported by type (organic or synthetic) and included weight in pounds and nitrogen content by the Grounds Department and Physical Plant staff at Patriots Point. A total of 16,704 pounds of fertilizer was used. In total, agricultural activities accounted for 24.1 MT CO2e.

Scope 2 T&D Losses

Scope 2 T&D losses refer to electricity consumed, or lost, due to resistance during the transmission and distribution of generated electricity through the grid. These losses are categorized as *Scope 3* emissions and are calculated within the Campus Carbon Calculator. Potential energy lost during transmission and distribution accounted for 3,660.7 MT CO2e, 6.1% of the College's total emissions. Due to the aged infrastructure of not only the national energy grid, but more specifically of the College's centralized energy distribution method, these emissions represent far greater amounts than what could be possible with technological advances to these T&D systems.

2.3 Institutional Comparison

> <u>Key Findings</u>: ***College of Charleston emitted CO_2e at a rate of 16.96 MT CO_2e /1,000ft^2, 5.7 MT CO_2e / student. Emissions per student lies in the middle portion of the range for other institutions in South Carolina and similar national institutions, however, emissions per 1000 square foot are on the higher end of the range. These numbers are useful for tracking year to year changes in efficiency and for benchmarking against other institutions.***

In this section, the College is compared to other higher education institutions in South Carolina and to national peer institutions[15] with similar characteristics (Table 3). The Office of Sustainability identified Towson University, James Madison University, and Georgia Southern as institutions that share similar characteristics to the College (in terms of location, size, and institution type) that also had GHG audits to compare numbers to. Comparing GHG emissions between institutions of higher education can help clarify performance levels, create standard metrics and best practices. It can also illuminate what areas should be focused on to achieve cost-effective emissions reduction. However, making these comparisons can be challenging and includes biases since not all institutions are directly comparable, and not all institutions calculate their footprint in the same way nor use the same metrics in different departments/divisions. Consequently, school to school comparisons can be useful but must be approached with caution.

2.3.1 Energy Efficiency Comparisons

Two indicators of energy efficiency that were analyzed include CO_2e/1000ft^2 and CO_2e/full time equivalent (FTE) student. These metrics account for differences in population and building space on campuses over time, and thus allow for more equal comparisons of year to year emissions for institutions over a period of time. Additionally, they facilitate better comparisons between institutions since these numbers standardize for population and space differences. In FY2013, the College of Charleston produced GHG emissions at a rate of **16.96 MT CO_2e** /1000 ft^2 and **5.7 MT CO_2e** per FTE.

Per capita carbon dioxide emissions is a metric that depends on a number of different institutional variables that can differ greatly from school to school. For example, Clemson is a doctoral-granting institution with a large population of students conducting research, which is known to be a more

[15] Institutions obtained from available reports of institutions identified by the College as peer institutions. The College considers Clemson, Coastal Carolina, University of South Carolina, Appalachian State, University of Wisconsin Eau Claire, and Western Washington to be official peer institutions.

emission intensive activity (Hopkinson, 2011). Additionally, colleges with a high percentage of on-campus housing or those located in urban areas with residence halls nearby and/or access to public transportation may have lower student commuter emissions. Because of these factors, per capita emissions are most useful for internally comparing a particular institution's year-to-year changes. By comparing this metric against previous years, an institution can more effectively track progress in reducing emissions per student since growth is accounted for in this metric. The College of Charleston's annual per capita emissions are within a similar range of other South Carolina schools (See *Table 4*). However, when compared with schools with similar student population and profiles, the College ranks in the higher range of emissions per capita (see Coastal Carolina and national institutions in *Table 4*).

School	Total MT CO_2e	Scope 1 Emissions % of Total	Scope 2 Emission % of Total	Scope 3 Emission % of Total
College of Charleston	**60,327**	**5.2%**	**61.4%**	**33.4%**
USC-Columbia*	142,582	21.02%	68.91%	10.43%
Clemson University*	142,567	20.76%	47.55%	31.68%
Towson University	112,625	11.98%	38.59%	50.95%
James Madison	89,724	18.38%	68.85%	12.93%
Georgia Southern	75,675	7.01%	84.62%	8.37%
Appalachian State*	70,187	29.22%	37.44%	33.56%
Furman University	25,890	18.81%	59.86%	24.16%
Coastal Carolina University*	24,580	2.45%	63.88%	37.23%
Wofford College	13,899	2.93%	89.65%	7.42%

Table 3. Comparison of three "scopes" of campus' footprints. Scope 1 and 2 combined represent the campus *energy* footprint. CofC's *Scope 3* footprint is larger than many other institutions suggesting that we have a smaller energy footprint. This could be from multiple factors, including that other schools focused more on calculating their energy footprint, than other *Scope 3* emissions which are much more difficult to attain. *schools considered official "peer institutions".

Unlike per capita emissions, CO_2e emitted per 1,000 square feet is a metric that is more comparable across institutions in similar climactic regions. While a number of factors may influence emissions per square foot, such as climate, type of institution, and fuel mix, both fuel mix and climate are more consistent across the state. Thus, a more accurate analysis can be made by comparing the College emissions per square foot to other schools in South Carolina. The College is in the middle range compared to other institutions in South Carolina (See *Table 4*). Clemson and Coastal Carolina have a higher emission per square foot, however Clemson and USC-Columbia are research institutions with larger footprints. When measured against its national peer institutions, the College has the highest emissions per square foot. However, in comparing across states both fuel mix and climate become more influential. Fuel mixes used around the country vary by region, with some using a higher mix of coal. Mixes with higher percentages of coal will emit more CO_2 per an amount of equal energy than those using less coal (IPCC, 1996). Compared to other similar institutions in different climate regions, the College of Charleston emits much more CO_2e emitted per 1,000 square feet (See *Table 4*).

School	MT CO_2e / student	MT CO_2e / 1000 sq. ft.	Building space (sq. ft.)	Student Population
College of Charleston	**5.7**	**16.96**	**3,556,696**	**10,554**
Clemson University	7.6	21.1	6,756,514	18,806
Coastal Carolina University	2.8	18.3	1,344,638	8,706
Furman University	9.3	11.0	2,351,548	2,776
University of South Carolina-Columbia	5.0	11.4	12,454,921	28,781
Wofford College	10.6	15.9	876,197	1,312
Appalachian State University*	4.5	14.4	5,180,656	16,627
Middlebury College*	6.8	7.3	2,564,867	2,742
University of Wisconsin-Eau Claire*	3.9	16.2	2,458,901	10,163
Western Washington University*	2.7	10.6	3,531,187	14,121

Table 4. Comparison of MT CO_2e emitted per student and per 1000 sq. ft. against other institutions in South Carolina and the College's national peer institutions. Data are taken from ACUPCC reports. Most recent year of data reported to ACUPCC was used if 2012 data were unavailable. *Denotes a peer institution located outside of the state of South Carolina

Building efficiency may be much lower for College of Charleston's infrastructure because the average campus building age is 104 years old[16] (Office of Facilities Planning, 2012). This should be a factor to consider when planning future strategies for reducing GHG emissions. While costly, renovating outdated major campus infrastructure could greatly reduce emissions per square foot and the College is committed, both through the ACUPCC and *2012 Campus Master Plan* (Campus Master Plan, 2012) to do so. Additionally encouragement stems from the with SC state law requiring any new construction to be at least a U.S. Green Building Council's LEED Silver standard rating or better.

[16] Calculated by averaging the age of all buildings owned, leased and used by the College.

Part 3: Changes from FY2011 to FY2013

From FY2011 to FY2013 total emissions **decreased from 63,198 MT CO_2e to 60,327 MT CO_2e**, representing a decrease of 4.5%. This reduction is mainly accounted for by scope one emissions, totaling 6,538 MT CO_2e in FY2011 and 3,164 MT CO_2e in FY2013. The primary cause for the dramatic decrease in scope 1 emissions is the result of a 60.2% decrease in MT CO_2e produced by natural gas usage. During FY2013, the College experienced a lower number of heating degree days (2,152 in 2013 versus 2,712 in 2011) which lead to a decreased need for natural gas, which powers most heating systems at the College. Scope 2 emissions totaled 36,068 MT CO_2e in FY2011 and 37,014 MT CO_2e in FY2013. The minor increase (2.6%) in scope 2 emissions is a direct result of increased electricity usage, likely due to an increase in cooling degree days (2,316 in 2013 versus 1,839 in 2011). Scope 3 emissions decreased from 20,393 MT CO_2e in FY2011 to 20,150 MT CO_2e in FY2013 for a total decrease of 1.2%.

As mentioned previously, the 4.5% decrease in scope 1 emissions can be explained by the significant decrease in the usage of natural gas. However there are a number of other changes to be noted. Emissions from direct transportation demonstrated an increase of 199% (up from 77 MT CO_2e in FY2011 to 229 MT CO_2e in FY2013). This rather significant change can be attributed to the fact that our new data collection method allowed us to account for several campus vehicles that were missed in the last audit. Refrigerant and chemical usage demonstrated a 44.0% increase (up from 403 MT CO_2e in FY2011 to 580 MT CO_2e in FY2013) mainly due to an increase in the usage of refrigerants used in air conditioning units. Again, the increase in cooling days is a likely culprit for this increase. Fertilizer application also decreased by 11,348 pounds which resulted in a 23.9% decrease in MT CO_2e from agricultural sources even though the College was responsible for an additional 7 horses in FY2013.

Scope three emissions also exhibited a number of changes from FY2011 to FY2013. Faculty/staff commuting emissions increased from 1,297 MT CO_2e in FY2011 to 1,367 MT CO_2e in FY2013 (total increase of 5.4%). Both bus riding and carpooling rates increased, however the average miles of travel distance was longer. Student commuting emissions decreased from 4,833 MT CO_2e in FY2011 to 4,636 MT CO_2e in FY2013 (total decrease of 4.1%), despite having a greater number of commuters. This overall decrease can be attributed to a 4% decrease in automobile usage, a 3% increase in carpooling, and a 2% increase in bus usage. Of note, rental markets in Charleston saw increases in average prices during this period of time and the fallout from the 2008 recession was still being felt. These are possible contributors to this fluctuation. To tease out if these are behavioral change choices that will stick long-term, and therefore have a continuing effect on the College's carbon profile, more chronological data are needed. We will revisit this in the FY2015 GHG audit.

Emissions from directly financed air travel (including study abroad flights) increased by 17.4%, up from 5,285 MT CO_2e in FY2011 to 6,202 MT CO_2e in FY2013. This increase is likely a result of a combination of better inventory methods, a larger number of students utilizing study abroad programs, and an increased amount of general travel by flight. Emissions from solid waste decreased by 30.1%. Due to the large amount of data that were missing in FY2011 (and was subsequently estimated), it is hard to speculate on the reasons for this decrease. However, we are confident in the validity of the data for FY2013. Emissions from wastewater increased from 54.3 MT CO_2e in FY2011 to 56.9 MT CO_2e in FY2013 as a result of an increase in water usage. Emissions from paper usage decreased from 468.5 MT CO_2e in FY2011 to 159.4 MT CO_2e in FY2013 (for a total of 66.0%). This decrease can be explained by a change in inventory method, which only accounted for reams of paper used due to the negligible contribution of paper related emissions to the overall total. Scope 2 T&D losses increased very slightly (2.6%) as a result of increased energy usage on the campus.

Due to many of the changes in data collection methods mentioned above, we believe the accuracy of the FY2013 audit is much greater than FY2011. As such, FY2013 will be used as our baseline year from this point forward.

Part 4: Recommendations

The following recommendations are intended to help College of Charleston further align itself with the GHG reductions goals promoted by the ACUPCC and to create accurate and comprehensive emission inventories. The recommendations are developed based on The College's historical footprint and data analysis. Some recommendations are aimed at helping improve the data collection process for future greenhouse gas reports, while others are aimed at facilitating building and energy efficiency and systematic GHG reductions at the College. None are mutually exclusive and prioritization of those elements should be pursued through macro (systems) and micro (efficiency) analyses.

4.1 Procedural

Procedural recommendations are aimed at improving the efficiency and accuracy in which data are collected and reported. These recommendations are developed based on suggestions provided during the collection process by students, staff and faculty who worked to gather data for this inventory, and through retrospective analysis of the methods and process of data collection.

Create a more comprehensive inventory

While ancillary campus locations such as the North Campus, Patriot's Point Athletic Complex, Dixie Plantation, and Storybrook Farm are included in this inventory, there are a number of off-campus locations that are not. There are some larger considerations that must be explored before committing to expanding the inventory, while Patriot's Point is clearly part of the footprint, questions remain about the North Campus and Dixie (as the foundation owns the property). The first step is to definitively establish the parameters of our campus for creating an accurate footprint.

In addition, beginning the process to examine our footprint with more depth is necessary, one that includes the full value chain of operation. This should begin to include the supply chain as well as waste stream footprints—particularly with areas like technology, agricultural and supplies. Another large gap in our inventory exists when examining our Foodprint (footprint of the food system) at the College. As the tools become available, the College should put effort toward including these data. In an effort to address this problem, MES candidate Ashlyn Spilis Hochschild has begun work to determine a method to calculate our foodprint as part of her thesis. During her project, Ashlyn combed through invoices for each dining hall to determine what was purchased and where it was sourced. These data were then input into a calculator (very similar to the one used for this audit), however the sheer volume of information was too much for the calculator to handle and the calculations it was able to produce were limited; sourcing documented distribution centers but not original farm origin. This further demonstrates the need to develop a standardized tool to account for these emissions in order to have a comprehensive understanding of an institution's impact.

Prioritizing GHG inventory efforts

Increasing the priority of sustainability at CofC should be given due consideration, which includes future emissions auditing. While direct communication and collaboration with various stakeholders and campus departments has improved since the first audit, improvement is necessary for a timely and accurate report in the future. The stakes will increase with every report. We require accurate data to identify leverage points in the system along with accurate measures of deficiencies and successes, all of which requires seamless and reliable reporting. The *Office of Sustainability* must continue to build relationships and explain the importance of the GHG inventory to departments across the College. This second report is another step in that direction and making it readily available is key to furthering the success of future GHG audits and for creating stronger institutional effectiveness.

Standardized data collection and reporting

One of the biggest barriers to data collection was the lack of a standardized method or system to access and compile data. In addition, the data must be accessible and relatable to anyone on campus that may require the information. Often times, the manner in which various departments tracked data was not aligned with our assessment techniques or tools, and on some occasions, data were not tracked at all. This has been a problem for all sustainability efforts (not just this audit) and so it requires a heightened level of focus and organization.

For the most recent audit, the *Office of Sustainability* had independently tracked most of the utilities data (electric/gas, water, waste, composting, and recycling), which represents a very large component of the inputs to the calculator. However, a vast portion of the data still has to be coordinated from offices and departments across campus. After conducting the FY2013, the Office has met and coordinated with a number of other departments in order to aid in developing ways to maintain records so that the collection process is streamlined, accurate, and mutually beneficial. While this audit was certainly more streamlined than the one conducted in 2012, we hope to continue to improve the quality and accuracy of future inventories. Additionally, once a standardized means of collecting data is implemented, the College will be able to accurately track and compare longitudinal changes in emissions. Longitudinal comparisons are essential for facilitating reducing emissions and identifying areas of improvement due to change made by the College. The impending implementation of the AIM MyCougarCampus Software is a major step in this direction. This software could serve as the platform for this standardized data collection method.

4.2 Operational

Operational recommendations are aimed at developing initiatives that will reduce emissions generated by the College in its day-to-day operations. These recommendations will help the College work toward the ACUPCC commitment of achieving carbon neutrality by our goal year of 2050 and to meet the financial, community, and climate related sustainability goals outlined in the *2012 Campus Master Plan*. These recommendations are derived from the data presented in this report.

4.2.1 Focus on energy

This GHG report outlines the dominant role energy consumption plays in the generation of GHG emissions at the College; it accounts for 78.63% of emissions. The first priority should be a comprehensive systems' analysis of energy and energy systems. While the College cannot (directly) control the type of fuel used to generate imported electricity, the institution can take steps to improve both how efficiently energy is being used and by targeting energy demand. This can be addressed both structurally with more efficient processes and behaviorally with programs aimed at changing how the campus community uses energy at the College. As the College spent over $7 million on energy in FY2013, reductions in usage and increases in efficiency should be a top priority not only in regards to climate goals, but must become a top fiscal priority, as well. Because this area is so complex and requires knowledge developed by an expert over the course of a career, we strongly recommend the College hires a full-time energy manager. This is a standard practice for institutions of higher education. Here in Charleston, both MUSC and Trident Technical College have full-time energy managers.

4.2.2 Energy delivery evaluation and analysis

The infrastructure of the energy delivery system at the College is an aged, centralized system that is operating close to capacity. Because of capacity limitations, further expansion on the current system might be problematic. Therefore, developing a future strategy for both structural delivery of energy and more efficient delivery methods is necessary. The *Campus Master Plan* suggests an expansion of the College's physical space, and for this, the energy delivery system must be examined, and strategies developed not only to meet the future spatial needs but also for the expansion into alternative sources of energy (e.g. geothermal, solar, etc.). Finally, the *Campus Master Plan* acknowledges the highly inefficient steam generated energy plant currently utilized at the College, and represents another area for critical evaluation. Sustainable alternatives such as a geothermal or solar hot-water system should be considered, an idea in-line with the *Campus Master Plan* (Campus Master Plan, 2012). Further exploration of new means to deliver energy at the College is necessary for both short-term (e.g. supplementing the steam-generation) and long-term—as a way of creating a sustainable energy path.

4.2.3 Building efficiency

The College's footprint of **16.96 MT CO2e/1000ft^2** is one of the highest of higher education institutions in South Carolina or among national peers (See *Table 3* and *Table 4*). The analysis *strongly* suggests that our buildings are extremely inefficient. A significant amount of this inefficiency can be attributed to the age of the buildings at the College of Charleston; however, retro-fits that are sensitive the historical nature and preservation of our buildings are available. However, the College has experienced a 13.8% decrease (over $960 thousand less) in energy expenditures over the last two years. For the College, one of most productive ways to reduce emissions is to focus on improving both energy efficiency (i.e. how energy is consumed in buildings) and building efficiency (i.e. how effective buildings are in minimizing the energy needed to operate). Buildings consume energy at different rates, which is largely dependent on the activities that occur in each one. For instance, laboratories and dining halls may consume energy at much higher rates than residence halls and classrooms because of equipment and ventilation needs (Hopkinson, 2011). Strategic prioritization of the least efficient buildings can lead to dramatic cost savings coupled with emission reductions.

The first step to achieving building efficiency is to audit individual buildings to determine cost-savings priorities and to strategically focus renovations and retrofits. These audits should include both overall energy usage in each building, and detailed examinations of operations within each building. For many buildings this is easily facilitated as they are individually metered to examine these data. Expanding the metering system to all campus buildings will be helpful not only in this audit, but in monitoring future energy use for meeting both policy targets and to stimulate proper incentives for behavior modification. Energy Dashboards or EIS (Energy Information Systems) provide whole energy use information for buildings (Granderson, 2009). Dashboards or EIS can be used for a wide-variety of sustainability activities such as benchmarking, base-lining, anomaly detection, energy rate analysis, etc. (Granderson, 2009). While the College has the beginnings of a dashboard system, it is underutilized. We suggest investigation of EIS for the entire campus but particularly for areas that have high inefficiency rates or buildings where the occupants can shift behavior significantly (e.g. residence halls).

Once high-consuming targets have been identified, there are various cost effective ways to immediately reduce energy use while concomitantly reducing emissions in these buildings. It is recommended that the College begins to install low cost retrofits with short payback periods that can greatly reduce energy use and emissions. The *2012 Campus Master Plan* already advocates renovating and redeveloping underperforming infrastructure as a means of sustainable campus growth (Campus Master Plan, 2012). Many of these retrofits are related to changes in lighting, basic weatherizing, and retro-commissioning, and are generally considered “low hanging fruit”. It is recommended that the College begin to focus on low-hanging fruit upgrades while investing the savings generated from these initiatives back into more costly capital projects for more sustainable pathways. *It is critical that a natural capital stream is developed to retain savings to invest in higher-hanging fruit and more sustainable capital improvements.*

These strategies also provide an opportunity for the College to improve its financial sustainability, a goal from the College’s Strategic Plan that is incorporated into the Campus Master Plan (Campus Master Plan, 2012). Savings from low hanging fruit projects can be reinvested back into additional initiatives that can further reduce costs for larger, longer term capital projects such as renewable energy installations and complete building renovations. While these larger projects have a higher upfront cost, they create large savings over the long term. In addition, new building ventures and renovation projects should strongly consider the benefits of a variety of efficiency and energy sources in strategic ways.

4.3 Behavioral Changes

Even if every building on campus was running at top efficiency the College would still generate a significant carbon emission footprint. It is also essential that the College begin to create, implement and support strategies and policies for reducing energy use by campus community members. This can include anything from personal appliance use to HVAC operating habits. For instance, one free strategy that can greatly reduce energy use for HVAC systems is to reduce heating temperatures by one or two degrees during the winter or cooling in the summer (FWS, 2010). If tied into computerized monitoring systems programmed to coordinate building activity with energy needs, it will also yield substantial savings. Additionally, the reduction of HVAC functionality during non-core operating hours and improving building controls so that temperature can be more effectively controlled will reduce HVAC energy use.

Focus on Transportation

As the second largest contributor to campus GHG emissions (21.85% of the total footprint), transportation also needs to be a focus of future reduction initiatives. Specifically, student commuting represents 7.69% of the total footprint, and because many students live within three miles of campus, this represents a productive path for endorsing alternative transportation such as carpooling or biking. However, in the *2011 Commuter Survey*, students repeatedly explained their fear of biking because of the lack of bike lanes and danger of motorized vehicles. One of the main reasons campus community members commuted to campus alone was because of a lack of carpool partners and the *Campus Master Plan* also identifies safety issues with campus walking and biking lanes (Campus Master Plan, 2012). One conclusion drawn from the commuter data was the need to develop an online carpooling network to incentivize carpooling as a viable alternative transportation option. Working with BCDCOG, the OOS has helped to establish this on campus but it is rarely used. Focus on advertising and developing this program is crucial to working toward and redirection in commuting habits. Also, designing bike routes for students and faculty could greatly decrease vehicular emissions from transportation to the College while helping promote sustainable transportation goals outlined in the *Campus Master Plan* (Campus Master Plan, 2012).

Future Development with Sustainable Building and Materials

The *2012 Campus Master Plan* has already acknowledged that sustainable building provides long-term financial benefits (Campus Master Plan, 2012). Energy efficient retrofits and redevelopment strategies should be considered in the planning process in order to reduce future building operations costs. Local materials should be used as part of the reducing our impact at all sectors of the value chain, particularly the supply-chain.

4.4 Institutional

As discussed in the Introduction, climate change is an outcome of unsustainable systems. Therefore we should generate policy and campus best practices that address these unsustainable systems as the core mission of the *Office of Sustainability*. Meeting climate goals should be part of that larger vision but it should not represent the core of campus sustainability. With a focused eye on emissions and climate goals, we suggest a broader mission for sustainability.

In this light, there are ***four*** primary institutional goals that should be on the immediate horizon.

1. Create a **Sustainability Action Plan** by December, 2016. Under the ACUPCC obligations, we have filed a formal Climate Action Plan (CAP) that provides a goal for carbon neutrality (a net zero carbon emission footprint) as of *January, 13, 2013*. We suggest that the goals and objectives for a CAP are incorporated into a broader Sustainability Action Plan that outlines our vision, goals and objectives, as well as strategies and tactics for institutional sustainability as well our contributions to societal sustainability. We further suggest that a committee be created to facilitate this Plan and involve a broader number of stakeholders. The Office has begun to develop this with the Sustainability Planning Network but will require administrative support to prioritize this network.

2. We suggest a broader, more interconnected perspective for understanding problems in higher education and promote **use of C.O.R.E** (Curriculum, Operations, Research, and Engagement). This approach promotes diversity of stakeholders to envision the interconnection of issues and to resolve them through collaborative networking. Sustainability in higher education requires more than just picking low-hanging fruit in internal operations or in academic learning. It requires strong and effective communication, systems thinking, and collaborative networking. We must take a holistic, systems approach in working toward these institutional goals (above), which will ultimately create a closer community with more open discourse. Fostering a system that focuses on collaboration and open exchange between a diverse number of parties will significantly enhance our ability to solve the problems we face, including reducing the College's carbon footprint. Due to the systemic nature of these issues, it is critical to involve participants in all areas of our campus in creating solutions.

3. We suggest a **proactive integration of sustainability into the curriculum** at the College. This is a process, of course, that requires not only definitional clarity and theoretical depth, but more importantly, applied and experiential as part of the learning process. This report can be starting points for many classes in helping students understand their influence and impact on the world around them. Because students have a large impact on day-to-day activities of the College and the policies that govern them, they are a critical building block of systemic change. In order to make significant changes in terms of our carbon footprint, it

is important to insure that each person recognizes themselves as a contributor to the system.

4. We strongly suggest making sustainability a top priority at the College. In the face of growing economic uncertainty, shifting job markets, and global climate change, creating resilience through a focus on sustainability is critical to the future of the College and all institutions of higher education. As an institution of higher education it is not only our duty to equip our students with the skills and abilities to be successful, but to act as a model for the community.

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