

## **Introduction:**

The Campus Environment Committee (CEC), in collaboration with President's Cabinet and Facilities Services, has conducted a comprehensive campus greenhouse gas emission inventory. This inventory quantifies the gases released by college-related activities that contribute to global climate change. We utilized an energy management firm to help us with survey design, data collection and verification. They are an independent consulting firm that works on comprehensive energy and carbon management programs for educational facilities across the country.

This initiative is driven by Goal III (Informed, Responsible Citizenship) of Skidmore's Strategic Plan, which states in part that Skidmore will "enhance our ability to function as a socially and environmentally responsible corporate citizen," and "make the Skidmore campus an environmental laboratory, increase our emphasis on responsible planning for sustainable operation and continue efforts to reduce the College's 'environmental footprint'."

One of our primary goals in this process was to establish a quantitative baseline of Skidmore's greenhouse gas emissions to inform our carbon reduction goals and strategies and thereby contribute to our overall goals for sustainability.

## **Rationale:**

Climate change mitigation has risen to the forefront as one of the most critical issues facing society today. The Intergovernmental Panel on Climate Change (IPCC), the international scientific body charged with evaluating the causes of climate change and its potential impacts, stated in its most recent report, "Unmitigated climate change would, in the long term, be *likely* to exceed the capacity of natural, managed and human systems to adapt." (IPCC, 2007) Some observations of climate change include: "increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level" (IPCC, 2007). According to a report released on January 21<sup>st</sup>, 2010 by the National Aeronautics and Space Administration (NASA), the past decade was the warmest on record (since 1880). These observations are followed by observed effects of climate change, which include: changes in terrestrial biological systems such as bird migration patterns, changes in species' geographical ranges, changes in disease vectors, and increases in coastal damage from flooding in many areas (IPCC, 2007). These are just a few of the changes that are beginning to arise due to the influence of climate change. Although these changes are coming faster than scientists anticipated, according to the IPCC, "Societies can respond to climate change by adapting to its impacts and by reducing GHG [greenhouse gas] emissions (mitigation), thereby reducing the rate and magnitude of change" (IPCC, 2007).

## **Greenhouse Gas Background**

A greenhouse gas (GHG) is a gas that is transparent to solar radiation but opaque to infrared (or heat) radiation. That is, a greenhouse gas permits the sun's rays to reach the earth, but prevents infrared radiation from escaping back into space. Excess greenhouse gases in the atmosphere interfere with the mechanism by which the planetary temperature is regulated.

The most abundant and naturally occurring GHG in the atmosphere is water vapor, followed by carbon dioxide (CO<sub>2</sub>). There are naturally occurring (biogenic) sources of GHG and human-generated (anthropogenic) sources of GHG.

Various GHG react in different ways in the atmosphere. The IPCC has quantified these characteristics by determining the global warming potential (GWP) of various gases. The GWP is a metric for how much a given mass of a greenhouse gas will contribute to global warming. CO<sub>2</sub> was given a value of 1 by atmospheric

scientists, and all other GWP are based on this metric. For example, methane has a GWP 23 times that of CO<sub>2</sub>, so it has a value of 23.

Using the GWP of each gas, scientists can convert emission amounts of each individual gas into an equivalent carbon dioxide emission amount (or Carbon Dioxide equivalent, CDE), so all the emitted greenhouse gases can be added together to obtain a total footprint. For example, 1 metric tonne of emitted CO<sub>2</sub> (GWP of '1') plus 1 metric tonne of emitted methane (GWP of 23) equals 24 metric tonnes of CDE (MTCDE)<sup>1</sup>.

According to the GHG Protocol, there are six anthropogenic (human-generated) gases to inventory.

1. Carbon Dioxide (CO<sub>2</sub>) - Enters the atmosphere through the burning of fossil fuels (oil, natural gas, coal, and gasoline), solid waste, trees and wood products. CO<sub>2</sub> is also the result of various chemical reactions in manufacturing or raw resource extraction.
2. Methane (CH<sub>4</sub>) – Is emitted during the production and transport of coal, natural gas, and oil, and results from livestock, agricultural practices, and decay of organic wastes.
3. Nitrous Oxide (N<sub>2</sub>O) – Is emitted during agricultural and industrial activities and is a byproduct of combustion of fossil fuels and solid waste.
4. Hydrofluorocarbons (HFCs)
5. Perfluorocarbons (PFCs)
6. Sulfur Hexafluoride (SF<sub>6</sub>).

Numbers 4,5, and 6 are generically called fluorinated gases, which arise from chemical processes, and are used in a variety of substitutes for previously identified ozone-depleting substances. These are typically emitted in small quantities, but they are potent GHG. Various forms of fluorinated gases have GWP from 300 to as high as 3300 times greater than an equivalent measure of CO<sub>2</sub> alone<sup>2</sup>.

### **Greenhouse Gas Emission Inventory Background:**

A greenhouse gas emission inventory is a report that documents the total GHG footprint, in metric tonne carbon dioxide equivalents (MTCDE), for which the College is either directly or indirectly responsible.

GHG emissions arise from the consumption or use of carbon-based fuels, products, and chemicals in the following activities: to condition space, produce goods, generate purchased electricity, transport people and products, and build, operate, and maintain facilities, housing, and grounds.

Several organizations have developed greenhouse gas emission inventory protocols to help entities account for their greenhouse gas emissions. The IPCC defined a methodology for countries to account for their national inventories. In 1998, a collaboration between the World Resources Institute and The World Business Council for Sustainable Development created the Greenhouse Gas Protocol, which is now the internationally accepted GHG accounting and reporting standard that has been voluntarily adopted by dozens of governments and thousands of enterprises, including the U.S. EPA Climate Leaders program, the California Climate Action Registry, the Chicago Climate Exchange, and the Clean Air Cool Planet Campus Carbon Calculator. Skidmore College's greenhouse gas emission inventory was drafted using the Greenhouse Gas Protocol accounting standards in conjunction with the Clean Air Cool Planet Campus Carbon Calculator.

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<sup>1</sup> **Metric Tonnes Carbon Dioxide Equivalent (MTCDE)** -Metric tonnes (2,205 pounds), the standard for reporting GHG emissions, shorthanded as MTCDE (metric tonnes of CDE) and MMTTCDE (million tonnes CDE) for larger entities.

<sup>2</sup> Excerpt from The Loyalton Group's Skidmore College Footprint Appendix

An organization’s carbon footprint is analogous to an “MPG sticker” that shows how efficiently/sustainably an organization is functioning in terms of natural resource consumption and the impact upon the environment<sup>3</sup>.

**Methodology:**

Based on the Greenhouse Gas Protocol, emissions are separated into three categories or “scopes” defined by the College’s level of control of the emissions. **Scope 1** includes direct emissions from sources that are owned and controlled by the College. **Scope 2** includes indirect emissions resulting from the generation of purchased energy (for example, electricity), and **Scope 3** includes indirect emissions that are a result of activities related to the College, but are not owned or controlled by the College (for example, employee commuting). A greenhouse gas inventory not only accounts for activities that generate greenhouse gas emissions, but it also gives credit to activities that reduce greenhouse gas emissions such as carbon sinks (contractually preserved forests), renewable energy credits (RECs) and offset purchases. RECs are purchased certificates that represent energy generated by renewable sources such as wind or solar. Carbon sinks and offset purchases are investments in projects that reduce carbon emissions such as a tree planting project. Below is a table showing examples of standard Scope 1, 2 and 3 emissions as well as the emissions from Skidmore that fall under each category.

**Table 1.** Greenhouse Gas Protocol and Skidmore Scope Emission Boundaries

Scope Description	GHG Protocol’s Standard Boundaries	Skidmore’s Scope Boundaries
<b>Scope 1: Direct emissions that are owned and controlled by the College.</b>	<ul style="list-style-type: none"> <li>• Consumption of fuels in vehicles and grounds equipment, boilers, furnaces, space conditioning, water heating, production heating</li> <li>• Intentional or unintentional leakage of refrigerants and other GHG’s (fugitive emissions)</li> <li>• Production of chemical emissions</li> <li>• Release of GHG’s from livestock, crop husbandry, and grounds-keeping</li> </ul>	<ul style="list-style-type: none"> <li>• Combustion of gasoline, oil, natural gas, diesel, propane and kerosene on site.</li> <li>• Fugitive refrigerants</li> </ul>
<b>Scope 2: Indirect emissions that are from the purchase of power</b>	<ul style="list-style-type: none"> <li>• Purchased electricity</li> <li>• Purchased steam, hot water, or chilled water</li> </ul>	<ul style="list-style-type: none"> <li>• Purchased electricity</li> </ul>
<b>Scope 3: Indirect emissions that are a result of activities related to the College, but are not owned or controlled by the College.</b>	<ul style="list-style-type: none"> <li>• Air and business travel</li> <li>• Employee, student, tenant, and user commuting</li> <li>• Event and lifestyle activities</li> <li>• Waste stream emissions</li> <li>• Extraction, production, and transport of purchased materials</li> <li>• Purchase and consumption of foods and food commodities</li> <li>• Transportation of purchased fuels</li> <li>• Vehicle emissions from outsourced contractors</li> <li>• Line or piping losses from electricity or plant transmission</li> </ul>	<ul style="list-style-type: none"> <li>• Faculty/Staff daily commuting (automobile, bus and carpool)</li> <li>• Faculty /Staff academic/business travel (air and train)</li> <li>• Student travel to and from campus to home (automobile, air, train and bus)</li> <li>• Student study abroad travel</li> <li>• Chartered bus travel</li> <li>• Solid waste</li> <li>• Athletic air travel</li> </ul>

<sup>3</sup> Excerpt from The Loyaltton Group’s Skidmore College Footprint Appendix

	and distribution	
<b>Greenhouse Gas Offset and Carbon Sinks: Greenhouse gas reductions used to compensate for a greenhouse gas emission production elsewhere</b>	<ul style="list-style-type: none"> <li>Renewable energy credits (RECs) purchased certificates for electricity generated with renewable sources</li> <li>Forest Protection offset</li> </ul>	None

The greenhouse gas inventory covers Skidmore’s Fiscal Year 2009, which is from June 1<sup>st</sup>, 2008 to May 31<sup>st</sup> 2009. As mentioned above, the College utilized the energy management consulting firm to help collect, calculate and verify our emissions data. Scope 1 and 2 data were collected from fuel bills directly from the provider (Table 2 and 3). Scope 3 data were collected from a survey of the community as well as from various offices on campus (Table 4). All data were collected and sent to the energy management firm for carbon emission equivalent calculations. However, since they track most of our gas, electric and oil consumption, they already had much of our Scope 1 and 2 data.

**Table 2.** Skidmore’s Scope 1 Emission Details

<b>Emission Source</b>	<b>Use</b>	<b>Data Source</b>
Combustion of Natural gas	Heating buildings	Energy bills from Facilities Services
Combustion of Oil	Heating buildings	Energy bills from Facilities Services
Combustion of Gasoline	Fuel for campus vehicle and grounds equipment	Fuel bills from accounts payable and Facilities Services
Combustion of Diesel	Fuel for campus vehicles and generators	Fuel bills from accounts payable and Facilities Services
Combustion of Propane	Fuel for bunsen burners, forklift as well as some generators and building heat	Fuel bills from Facilities Services
Fugitive refrigerants	Includes refrigerants that escape into the atmosphere via leaks in equipment	Vendor from whom we buy refrigerants. Refrigerants bought for replacement is approximately equal to fugitive refrigerants.
Combustion of Kerosene	Van Lennep Stables heat	Fuel bills from Facilities Services

Scope 1 GHG emissions were calculated using Clean Air Cool Planet carbon emission equivalent coefficients.

**Table 3.** Skidmore’s Scope 2 Emission Details

<b>Emission Source</b>	<b>Use</b>	<b>Data Source</b>
Purchased Electricity	Electricity	Electricity bills: transmission/distribution and procurement

Scope 2 emissions were calculated using emission equivalents from a New York state emission factor, which is reflective of the New York state electricity generation mix. The Scope 2 GHG emissions were calculated using the Clean Air Cool Planet carbon emission equivalent coefficients.

**Table 4.** Skidmore’s Scope 3 Emission Details

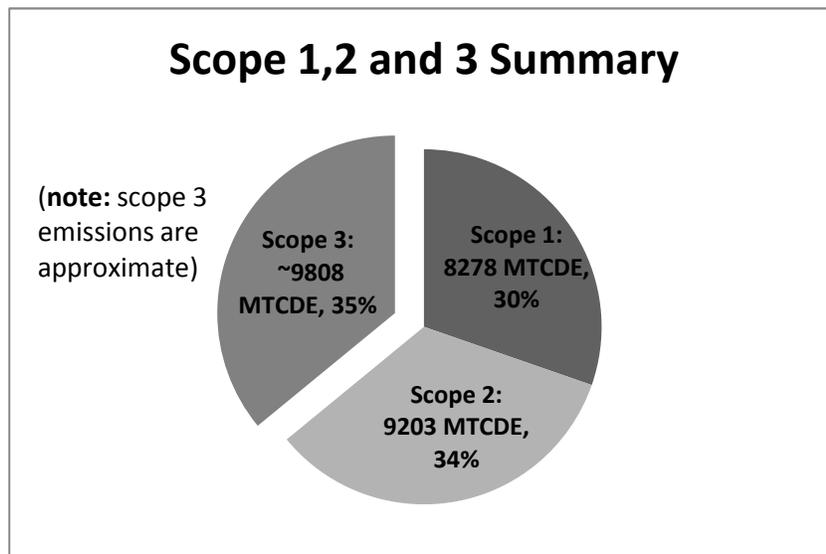
<b>Emission Source</b>	<b>Data Source</b>
Faculty/Staff daily commuting	GHG inventory survey was extrapolated to create a daily commuting emission average per person
Faculty/Staff business/academic train travel	GHG inventory survey was extrapolated to create an average train travel emission per Faculty/Staff
Faculty/Staff business/academic air travel	Travel agency as well as GHG survey. Data was <i>not</i> extrapolated to create an average per person for agency booked travel, but air travel collected from the survey was extrapolated.
Chartered bus travel	Bus company usage and mileage report
Student travel to and from home to Skidmore	GHG inventory survey was extrapolated to create an emission average for the student population
Study abroad travel	Office of Off Campus Study & Exchanges
Solid Waste	Waste hauler bills.

Scope 3 emissions are an optional reporting category; extrapolation of some data to make estimates for the community was required.

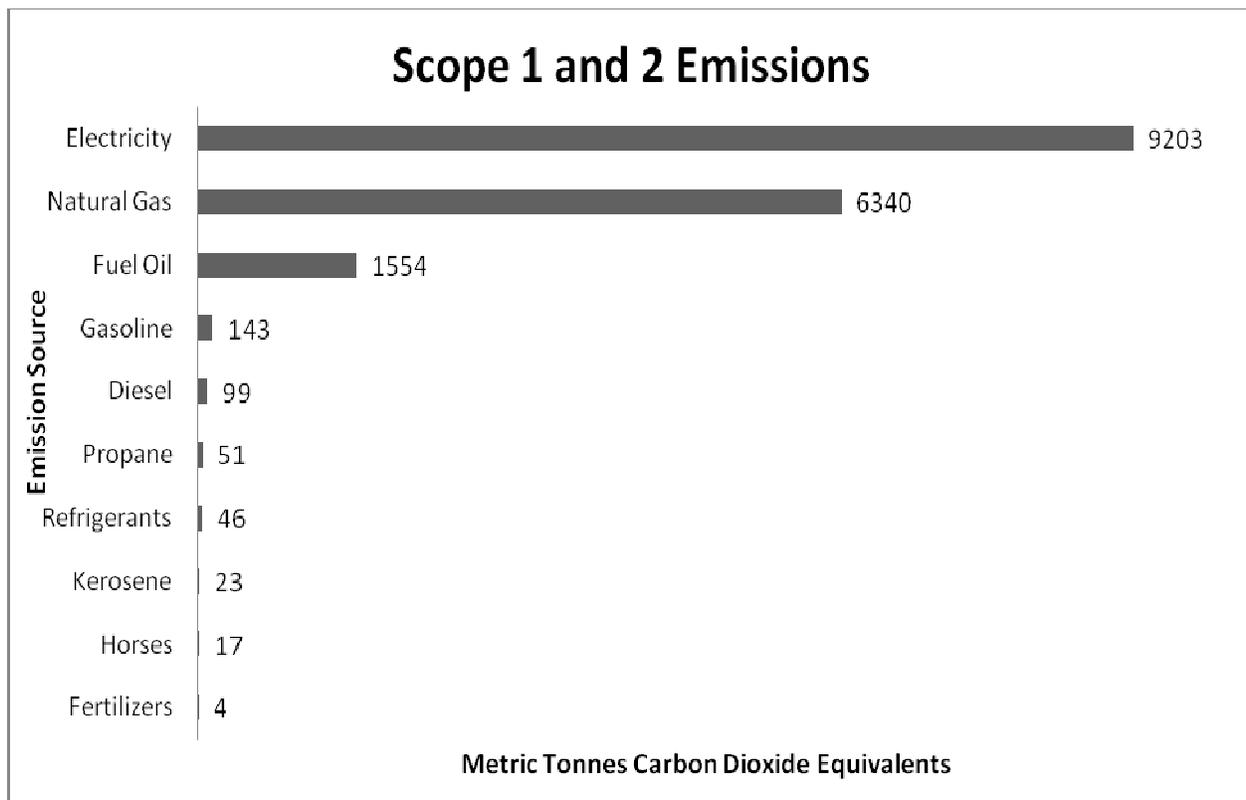
In February 2009, 30% of the Skidmore community completed the Greenhouse Gas Inventory Commuting/Travel Survey and Environmental Attitude and Awareness Survey. The Clean Air Cool Planet Campus Emissions Calculator requires a 10% participation rate in order to use the data. The survey was devised to collect not only driving distances, but also commuting and travel habits. Since we had a 30% participation rate, the carbon emission equivalent data was extrapolated to a MTCDE average for Faculty/Staff commuting, train travel, individually booked air travel, and student travel to and from home. The extrapolated data was then “back checked” using a zip code analysis for commuting; however, the extrapolated survey data was the data used for the final report. The travel data reported for travel agency-booked air, athletic air, chartered bus and study-abroad air were used directly to calculate emissions and were not extrapolated.

**Results:**

During fiscal year 2009 Skidmore emitted approximately 27,288 MTCDE with 8,277 MTCDE in Scope 1, 9,203 MTCDE in Scope 2 and approximately 9,808 in Scope 3 (Figure 1).



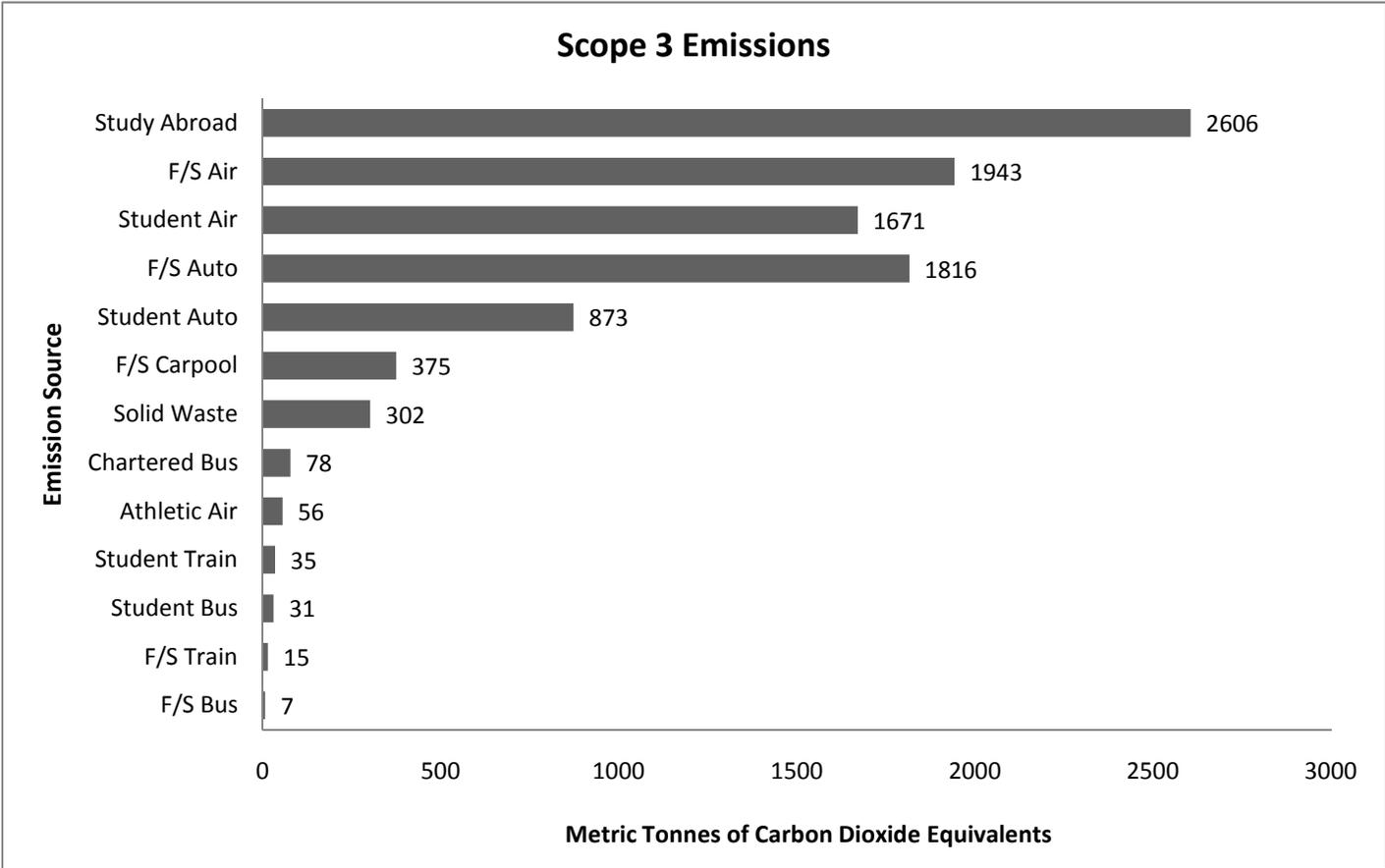
**Figure 1.** This graph depicts a Scope emission summary showing approximately 27,288 as the total of MTCDE for fiscal year 2009 and the Scope summary divided by percent of total. Actual total Scope 1,2 and 3 percents will vary slightly from 100 percent because of rounding.



**Figure 2.** This graph depicts the Scope 1 and 2 emissions by source. It is clear that Skidmore’s use of electricity, natural gas and fuel oil produce the largest quantities of greenhouse gas emissions of the Scope 1 and 2 sources.

**Table 5.** Skidmore’s Scope 1 and 2 MTCDE

Emission Source	MTCDE	Percent of Scope 1 & 2	Percent of Scope 1, 2 and 3
Electricity	9,203	53	34
Combustion of Natural gas	6,340	36	23
Combustion of Oil	1,554	9	6
Combustion of Gasoline	143	1	1
Combustion of Diesel	99	1	0
Combustion of Propane	51	0	0
Fugitive Refrigerants	46	0	0
Combustion of Kerosene	23	0	0
Horse Manure	17	0	0
Fertilizers	4	0	0
Total	17,480	100	64



**Figure 3.** This graph depicts Scope 3 emissions by source.

**Table 6.** Skidmore’s Scope 3 MTCDE

Emission Source	MTCDE	Percent of Scope 1,2 and 3
Study Abroad Air Travel	2606	10
Faculty/Staff Air Travel (business/academic)	1943	7
Faculty/Staff Commuting--Automobile <sup>4</sup>	1816	7
Student Air Travel to and from Home to Skidmore	1671	6
Student Automobile Travel to and from Home to Skidmore	873	3
Faculty Staff/Carpool	375	1
Solid Waste	302	1
Chartered Bus Travel (athletic & academic)	78	0
Athletic Air Travel	56	0
Student Bus Travel	35	0
Student Train Travel	31	0
Faculty/Staff Train Travel	15	0
Faculty/ Staff Bus Commuting	7	0
Total	9808	35

(note: actual total Scope 1,2 and 3 percents will vary slightly from 100 percent because of rounding)

<sup>4</sup> This calculation assumes 240 drive days for all faculty and staff per year. Adjustments to reflect different number of drive days for various employees were tested and resulted in a minimal difference (~0.05%).

## Discussion:

This greenhouse gas inventory reveals a relatively even split between the College's Scope 1, 2 and 3 emissions: 30, 34, 35 percents respectively. However, it is important to note the distinct difference in data confidence and data types among the three Scopes. Scope 1 and 2 data came primarily from utility bills, so we can be relatively confident about their accuracy.

For Scope 3 emissions, some of the data came directly from sources: study abroad air travel, travel agency-booked faculty/staff academic/business air travel, chartered bus travel and athletic air travel so, as with scope 1 and 2, we can have confidence in the accuracy of these data. The scope 3 emissions calculated for faculty/staff commuting, non-travel agency-booked air travel, faculty/staff train travel and student travel to and from home were collected from the survey and then extrapolated to the community. Although this methodology is well within the boundary of compliance with the Greenhouse Gas Protocol and Clean Air Cool Planet Campus Carbon Calculator, the results should be treated as a grosser approximation than those from Scope 1 and 2. Additionally, the College has less control over scope 3 emissions and in some cases there are fewer mitigation strategies (for example, for air travel). Lastly, as more and more entities begin to account for their carbon emissions, Scope 3 emissions have the potential of being "double counted". For example, if an administrator takes the train to New York City for a business meeting the emissions of the trip could potentially be counted within Skidmore's GHG inventory as well as the train company's. As a result of the decrease in data confidence and the possibility of "double counting", Scope 3 emissions are treated differently than Scope 1 and 2.

The completion of the GHG inventory begs the question, "how does Skidmore's GHG inventory compare to other Colleges'?" One of the added complexities of GHG accounting in higher education is the lack of consistency in the methods institutions employ to arrive at their GHG baseline such as the gathering and presenting of the data, the various different dates of the reports, particularly for Scope 3 emissions. These differences in methodologies (such as estimating faculty and staff commuting, student travel to and from home) does not allow for productive institutional comparisons at this time. It is our hope that over time GHG accounting methodology will become more rigorous and standardized to allow for productive comparisons.

This report will serve as a baseline for the College's greenhouse gas emissions and will inform future carbon mitigation strategies as well as carbon reduction targets. Our hope is to have a College climate commitment and action plan in the next year. The goal will be to focus on Scope 1 and 2 emissions with continuing educational programs and initiatives to focus on Scope 3 emissions. We will use this GHG inventory, fiscal year 2009, as a baseline and create a climate commitment with a percent reduction in MTCDE by a target date; such as a 15%-20% reduction in MCDTE from GHG inventory fiscal year 2009 by 2015.

As the College looks forward at carbon reduction strategies, it is important to honor the good work the College has already done and recognize that the College's baseline would be much higher without these previous efforts. A few examples of this work include the College's three geothermal heating and cooling systems, the residence hall electricity metering project, occupancy sensor installation, the point-of-use boiler project, light efficiency projects, re-insulation projects, motor upgrades and the Campus Building Temperature Initiative. Additionally, there are investigations underway for wind turbine feasibility, a small cogeneration plant installation project and future geothermal projects.

All of the above efforts have lowered the Scope 1 and 2 emissions; however, the College has also made progress in reducing its Scope 3 emissions. These include the CDTA bus stop on campus, the free bus pass for all Skidmore community members, the "Leave Your Car at Home Week" initiative, carpooling, which is enhanced by the carpool zone map, a campus design that is friendly to both bikers and walkers as well as the

end of the year waste reduction program, “Give and Go”. To learn more about Skidmore’s sustainability initiatives, please visit <http://cms.skidmore.edu/sustainability/>.

This greenhouse gas emission inventory will be updated in two years.

**Definitions:**

**Greenhouse Gas / Gases (GHG)** –Atmospheric gases, such as carbon dioxide and methane, that affect the Earth’s average temperature by trapping infrared radiation (heat) in the atmosphere.

**Carbon Dioxide Equivalent (CDE)** -All greenhouse gases (six including carbon dioxide) have a scientific equivalency to carbon dioxide; this unit is also expressed as equivalent carbon dioxide (ECO2)

**Tonnes** -Metric tons (2,205 pounds), the standard for reporting GHG emissions, shorthanded as MTCDE (metric tonnes of CDE) and MMTTCDE (million tonnes CDE) for larger entities.

**Tons** –A US standard of weight (2,000 pounds), sometimes called a “short ton” to note the difference with a metric tonne (2,205lbs)

**Kg** -Kilograms (2.2 Lbs per Kg), the standard for reporting small quantities of emissions, there are 1,000 Kg per metric tonne

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Respectfully Submitted,

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