Skidmore College
Greenhouse Gas Inventory
2013

Introduction

This inventory quantifies the greenhouse gas (GHG) emissions attributed to college-related activities during Skidmore's fiscal year 2013 (June 1, 2012 to May 31, 2013). This most recent inventory provides a point of comparison to the full inventory that was conducted for fiscal year 2009 (Campus Environment Committee, 2009) and to the baseline inventory from 2000. The framework and much of the language in this report mirrors the 2009 report to make comparisons between the two reports as seamless as possible, and we'd like to acknowledge the authors of the 2009 report, including the Skidmore College Campus Environment Committee (now the Campus Sustainability Subcommittee) and The Loyalton Group, for their efforts.

Our GHG inventory 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 is to establish snapshots of Skidmore's GHG emissions to inform our carbon reduction goals and strategies and thereby contribute to our overall goals for sustainability.

Rationale

While climate systems are incredibly complex, the causes of contemporary climate change and many of the potential impacts are now well understood. The atmospheric concentrations of several greenhouse gases (e.g., carbon dioxide, methane, and nitrous oxide) have increased to unprecedented levels, in at least the last 800,000 years, and carbon dioxide levels are now hovering around 400 ppm, a concentration beyond the 350 ppm concentration now widely recognized as a target level to preserve our social systems. As a result, it is unequivocal that there is a warming of the climate system, including the atmosphere and oceans, and it is consensus that human influence has been the dominant cause of warming since the mid-20th century. We understand, with varying degrees of certainty, that this warming has and will continue to cause snow and ice melt, sea level rise, ocean acidification, loss of permafrost, increased severity of storm events, significant changes in precipitation patterns, biodiversity loss, spread of certain insect-borne diseases, and the displacement of human populations and cultural loss. And the positive and negative feedback loops inherent in the climate system could very well accelerate these impacts (IPCC, 2013). It is also worth noting that there are major inequities intrinsic in contemporary climate change. Relatively few of us have enjoyed the lifestyle associated with high greenhouse gas (GHG) emissions, and, of course, not everyone is experiencing the burdens of climate change equally. As one metric, climate change threatens to cause the largest refugee crisis in human history. By 2050 more than 200 million people, largely in Africa and Asia, will potentially be forced to seek refuge in other places. Hundreds of millions more are expected to experience hunger and other life-altering hardships due to climate change (Biermann, F & Boas, I., 2010). Societies are beginning to respond to climate change by adopting policies, programs, and projects to reduce GHG emissions, and, again, this inventory is meant to inform Skidmore's carbon reduction strategies and goals.

Greenhouse Gas Background

A GHG is a gas that is transparent to solar radiation but opaque to infrared (or heat) radiation. That is, a GHG permits the sun's rays to reach the earth, but prevents infrared radiation from escaping back into space. Excess GHG's 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 (CO2). There are naturally occurring (biogenic) sources of GHG's and human-generated (anthropogenic) sources of GHG's.

Various GHG's 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 GHG will contribute to global warming. CO2 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 CO2, 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 GHG's can be added together to obtain a total footprint. For example, 1 metric tonne of emitted CO2 (GWP of '1') plus 1 metric tonne of emitted methane (GWP of 23) equals 24 metric tonnes of CDE (MTCDE)[1].

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

1. Carbon Dioxide (CO2) - Enters the atmosphere through the burning of fossil fuels (oil, natural gas, coal, and gasoline), solid waste, trees and wood products. CO2 is also the result of various chemical reactions in manufacturing or raw resource extraction.

2. Methane (CH4) – 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 (N2O) – 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 (SF6).

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's. Various forms of fluorinated gases have GWP from 300 to as high as 3300 times greater than an equivalent measure of CO2 alone (The Loyalton Group, 2009).

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[1] **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 MMTCDE (million tonnes CDE) for larger entities.

Greenhouse Gas Emission Inventory Background

A GHG 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 GHG emission inventory protocols to help entities account for their GHG 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 GHG emission inventory was drafted using the Greenhouse Gas Protocol accounting standards in conjunction with the Clean Air Cool Planet Campus Carbon Calculator. 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 (The Loyalton Group, 2009).

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 GHG inventory not only accounts for activities that generate GHG emissions, but it also gives credit to activities that reduce GHG 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
Scope 1: Direct emissions that are owned and controlled by the College	• Consumption of fuels in vehicles and ground equipment, boilers, furnaces, space conditioning, water heating, production heating • Intentional or unintentional leakage of refrigerants and other GHG's (fugitive emissions)	• Combustion of gasoline, oil, natural gas, diesel, propane, and kerosene on site • Fugitive refrigerants • Fertilizers

	• Production of chemical emissions • Release of GHG's from livestock, crop husbandry, and grounds-keeping	
Scope 2: Indirect emissions that are from the purchase of power	• Purchased electricity • Purchased steam, hot water, or chilled water	• Purchased electricity
Scope 3: Indirect emissions that are a result of activities related to the College, but are not owned or controlled by the College	• Air and business travel • Employee, student, tenant, and user commuting • Event and lifestyle activities • Waste stream emissions • Extraction, production, and transport of purchased materials • Purchase and consumption of foods and food commodities • Transportation of purchased fuels • Vehicle emissions from outsourced contractors • Line or piping losses from electricity or plant transmission and distribution	• Faculty/staff daily commuting (automobile, bus, and carpool) • Faculty/Staff academic/business travel (air and train) • Student travel to and from campus to home (automobile, air, train and bus) • Student study abroad travel • Chartered bus travel • Solid Waste • Athletic air travel
Greenhouse Gas Offset and Carbon Sinks: Greenhouse gas reductions used to compensate for a greenhouse gas emission production elsewhere	• Renewable energy credits (RECs) purchased certificates for electricity generated with renewable sources • Forest Protection offset	• Renewable energy credits (RECs)

Table 2. Skidmore's Scope 1 Emission Details

Emission Source	Use	Data Source
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 vehicles and grounds equipment	Fuel bills from Facilities Services
Combustion of Diesel	Fuel for campus vehicles and generators	Fuel bills from 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 links 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

Emission Source	Use	Data Source
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

Emission Source	Data Source
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 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 *not* 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 April 2014, 15% of the Skidmore community completed the Greenhouse Gas Inventory Commuting and Travel 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 15% participation rate, the carbon emission equivalent data were 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 were then "back checked" using a zip code analysis for commuting; however, the extrapolated survey data were 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 2013, Skidmore emitted approximately 16,972 MTCDE with 6,167 MTCDE in Scope 1, 5,719 MTCDE in Scope 2 and approximately 5,086 in Scope 3 (Figure 1).

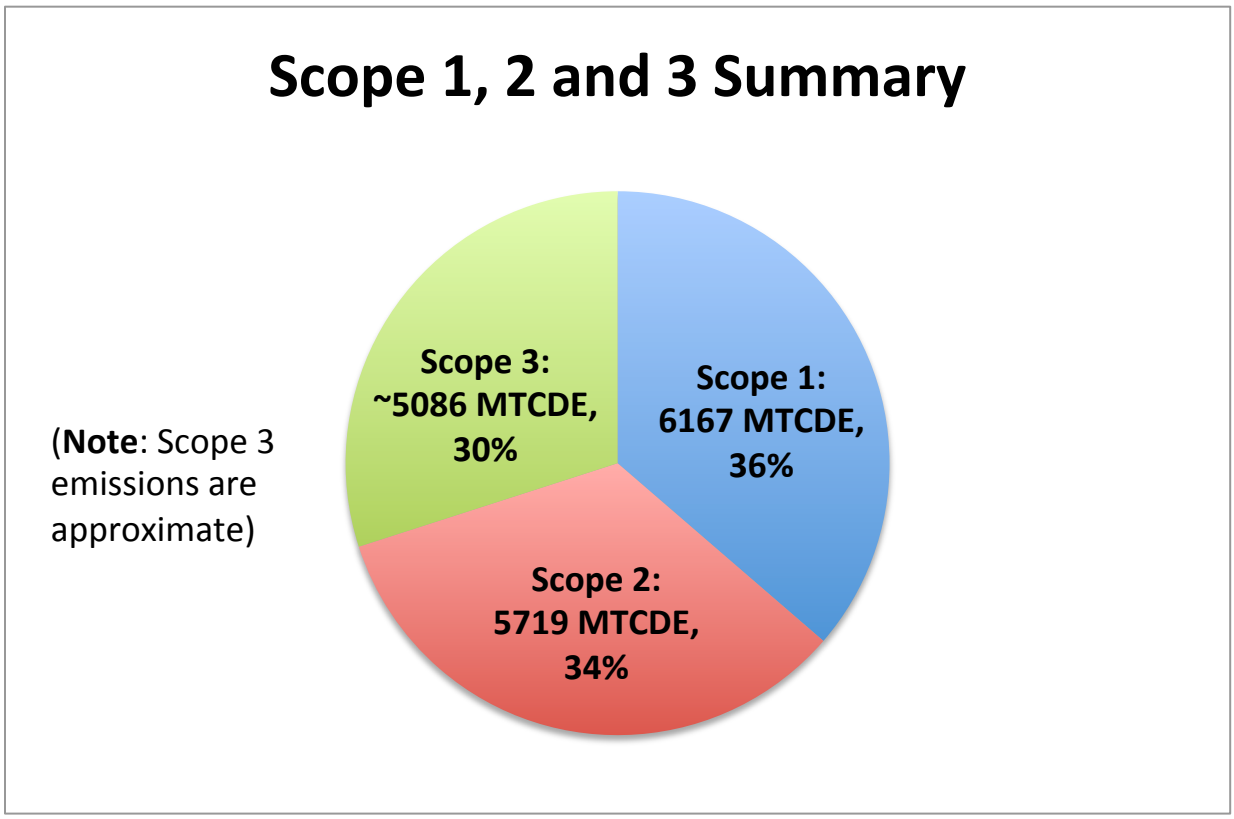

Figure 1. This graph depicts a Scope emission summary showing approximately 16,972 as the total of MTCDE for fiscal year 2013 and the Scope summary divided by percent of total. Actual total Scope 1, 2 and 3 percentages will vary slightly from 100 percent because of rounding.

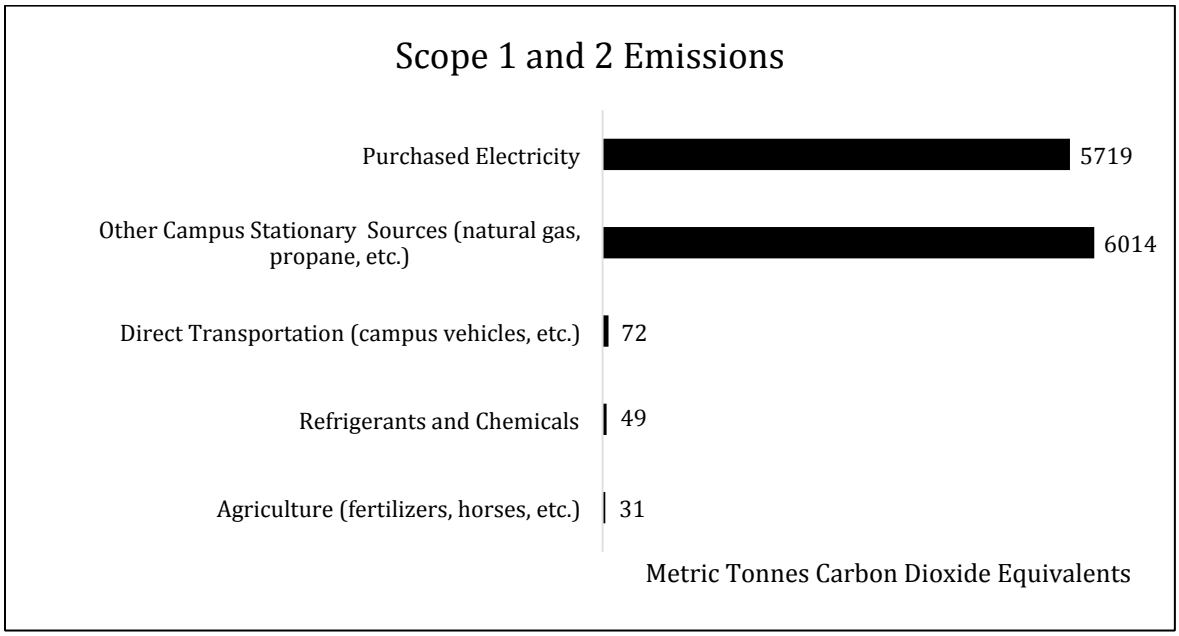

Figure 2. This graph depicts the Scope 1 and 2 emissions by source. It is clear that Skidmore's use of electricity and other campus stationary sources produce the largest quantities of greenhouse gas emissions of the Scope 1 and 2 sources.

Discussion

This GHG inventory reveals a relatively even spilt between the College's Scope 1, 2 and 3 emissions: 36, 34, and 30 percent, 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.

As the College looks forward at carbon reduction strategies, it is important to honor the good work the College has already done, and, indeed, we have seen a 48% reduction in GHG emissions (Scope 1 and 2) between our baseline year of 2000 and this inventory. A few examples of GHG reduction projects include the College's geothermal heating and cooling systems, the residence hall electricity metering project, occupancy sensor installations, light efficiency projects, re-insulation projects, motor upgrades, increased fuel efficiency in our fleet, the reduction of fertilizer use, the installation of independent boilers, etc. Please note that in 2014 Skidmore installed a large solar field, several solar thermal projects, and entered an agreement for small-hydro electricity production. These initiatives are not captured in this round of data, so we will inevitably see another significant drop in our GHG emissions in the next inventory.

To learn more about Skidmore's sustainability initiatives, please visit http://www.skidmore.edu/sustainability/.

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 MMTCDE (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

References:

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