Skidmore College
2016 Greenhouse Gas Inventory
Published July 2019

Introduction

The 2016 Greenhouse Gas (GHG) Inventory quantifies the amount of greenhouse gases released from college-related activities between June 1, 2015 and May 31, 2016. This report is Skidmore's fourth GHG inventory and serves as a point of comparison to our 2000 baseline report and the College's 2009 and 2013 GHG inventories. For consistency and comparability, the authors of this report continued to mirror the framework and language of previous reports. We acknowledge the authors of the 2009 and 2013 reports and those that completed the College's 2000 baseline inventory, including the Campus Sustainability Subcommittee (formerly the Campus Environment Committee) and the Loyalton Group. We also appreciate the support we received from Sightlines while conducting this inventory.

Goal IV of Skidmore's strategic plan, *Creating Pathways to Excellence: The Plan for Skidmore College, 2015-2025*, embraces the responsible management of our natural resources and affirms a "more comprehensive definition of sustainability that includes the interconnected spheres of the environment, the economy, and society." Our holistic understanding of sustainability reinforces the connections between sustainability and other core goals of the plan, including integrative excellence, inclusion, and health and well-being. We believe that measuring and tracking Skidmore's GHG emissions demonstrates our continued commitment to sustainability and fosters a sense of collective responsibility as we examine current actions and seek solutions to minimize emissions across college operations.

Rationale

The implications of contemporary climate change on environmental systems, economic development, and human health and well-being are widely understood. Human activities have increased atmospheric greenhouse gas concentrations to unprecedented levels compared to the last 800,000 years, which is contributing to rising earth surface temperatures and sea level, diminishing snow and ice, and intensifying storms and droughts. These impacts have significant environmental consequences including ocean acidification, habitat loss, biodiversity loss, and threaten global food production and environmental resiliency (IPCC, 2014, Porter *et al.*, 2014). The effects of climate change will also interrupt economic growth and development across the world and in countries at all levels of development (Stern, 2007). The 2018 National Climate Assessment describes in great detail the "substantial net damage to the U.S. economy throughout this century" without significant and sustained global mitigation and regional adaptation efforts (USCGRP, p. 26). And while these impacts are experienced across the world, it is imperative that we recognize the inherent injustice and inequity of climate change. The implications of climate change are contributing to widening social inequality, resource scarcity, political unrest, forced migration, cultural loss, and human rights implications (Adger *et al.*, 2014), and these impacts disproportionately burden disadvantaged people and communities across the world (IPCC, 2014).

The IPCC's 2018 special report explains that without unprecedented action, global temperatures could increase 1.5°C from pre-industrial levels by 2040, a level many now believe will trigger far more devastating impacts to human and ecological systems than previously thought (IPCC, 2018). While there is little time to act, there is a pathway for the global community to mitigate the impacts of climate change. It is imperative that Skidmore reinforce our role as responsible global citizens by continuing to take bold action to address climate change, and this GHG inventory is one example of our continued commitment to climate action. This report intends to measure the effectiveness of Skidmore's current programs and guide future decisions as we look to reduce institutional GHG emissions and model informed, responsible decision-making for our students and the greater community.

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 Intergovernmental Panel on Climate Change (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 28 times that of CO2, so it has a value of 28.

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 28) equals 29 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)

[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.

6. Sulfur Hexafluoride (SF_6).

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 CO_2 alone (The Loyalton Group, 2009).

Greenhouse Gas Emission Inventory Background

A GHG emission inventory documents the total GHG footprint, in metric tonne carbon dioxide equivalent (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. It 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, the Clean Air Cool Planet Campus Carbon Calculator, and now the University of New Hampshire's Sustainability Indicator Management and Analysis Platform (SIMAP). This GHG inventory was drafted using the Greenhouse Gas Protocol accounting standards using the University of New Hampshire's SIMAP.

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 other offsets. RECs are purchased certificates that represent 1 MWh of 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) • Production of chemical emissions • Release of GHG's from livestock, crop husbandry, and grounds-keeping	• Combustion of gasoline, oil, natural gas, diesel and propane, on site • Fugitive refrigerants • Fertilizers • Livestock (horses)
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	• Academic/business air 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/student 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 • Athletic air travel • Chartered bus travel • Solid waste • Paper consumption • Wastewater
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 • Composting	• Campus composting • REC purchases

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 are approximately equal to fugitive refrigerants

Scope 1 GHG emissions were calculated using the Sustainability Indicator Management and Analysis Platform (SIMAP) 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, electricity generation at solar array and small-hydro facility

Scope 2 emissions were calculated using the "market-based" method, allowing Skidmore to factor in REC purchases and grid-tied renewable energy purchases such as our 2-megawatt solar array and small-hydro project. Scope two emissions factors are measured by the North American Electric Reliability Corporation (NERC) region.

Table 4. Skidmore's Scope 3 Emission Details

Emission Source	**Data Source**
Faculty/Staff/Student daily commuting	Transportation survey results were extrapolated to create a daily commuting emission average per person
Faculty/Staff business/academic train travel	Travel agency data and transportation survey results were 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
Chartered bus travel	Bus company usage and mileage report

Student travel to and from home to Skidmore	Commuting survey results were extrapolated to create an emission average for the student population
Study abroad travel	Office of Off-Campus Study & Exchanges reports
Solid waste	Waste hauler bills
Waste water	City water bills
Paper use	Vendor bills

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

In October 2017, 32% of Skidmore faculty and staff and about 15% of students completed the Greenhouse Gas Inventory Commuting and Travel Survey, which meets the Greenhouse Gas Protocol standards for data extrapolation. The survey was created to collect not only driving distances, but also commuting and travel habits. Since our participation rate was adequate, the carbon emission equivalent data were extrapolated to a MTCDE average for Faculty/Staff/Student commuting, train travel, and student travel to and from home. 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 the fiscal year of 2016 (June 1, 2015 to May 31, 2016), Skidmore College emitted approximately 19,023 MTCDE. Scope 1 sources contributed 5,340 MTCDE, Scope 2 contributed 4,206 MTCDE, and Scope 3 contributed about 9,477 MTCDE. Skidmore's student-run apartment composting program contributed to 1.76 MTCDE reduction in net emissions. It is important to note that the calculations for scope 3 are less accurate than the calculations for scopes 1 and 2 because scope 3 sources are not directly controlled nor regulated by the college.

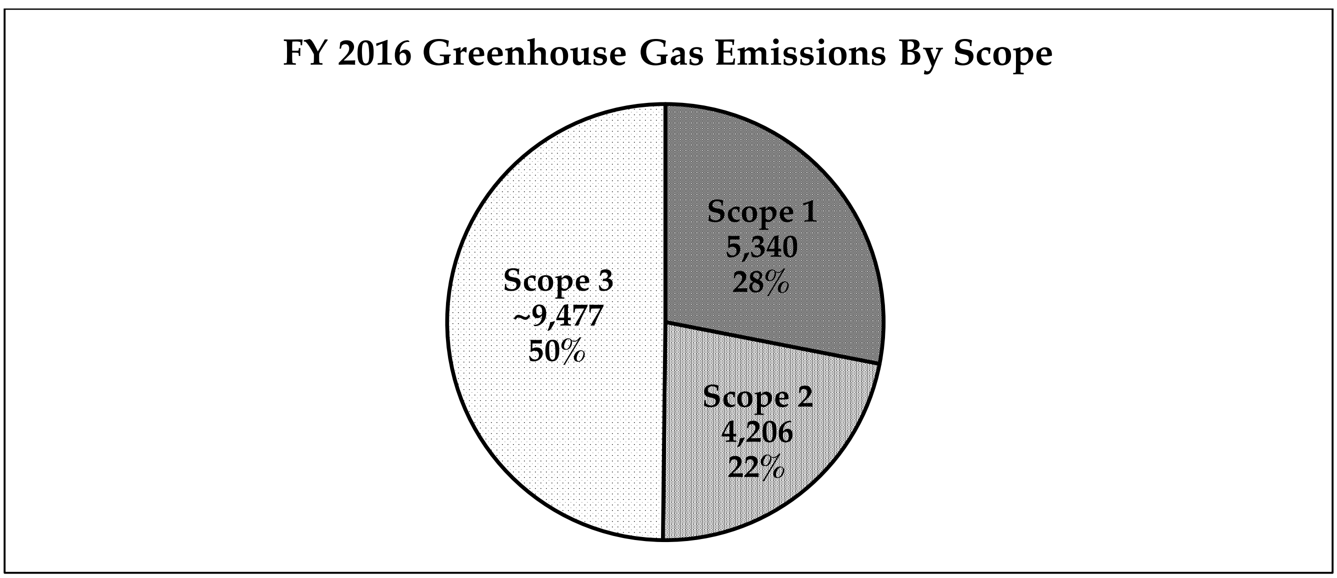

Figure I. This chart depicts a scope emission summary showing total institutional GHG emissions of approximately 19,023 MTCDE for Fiscal Year 2016.

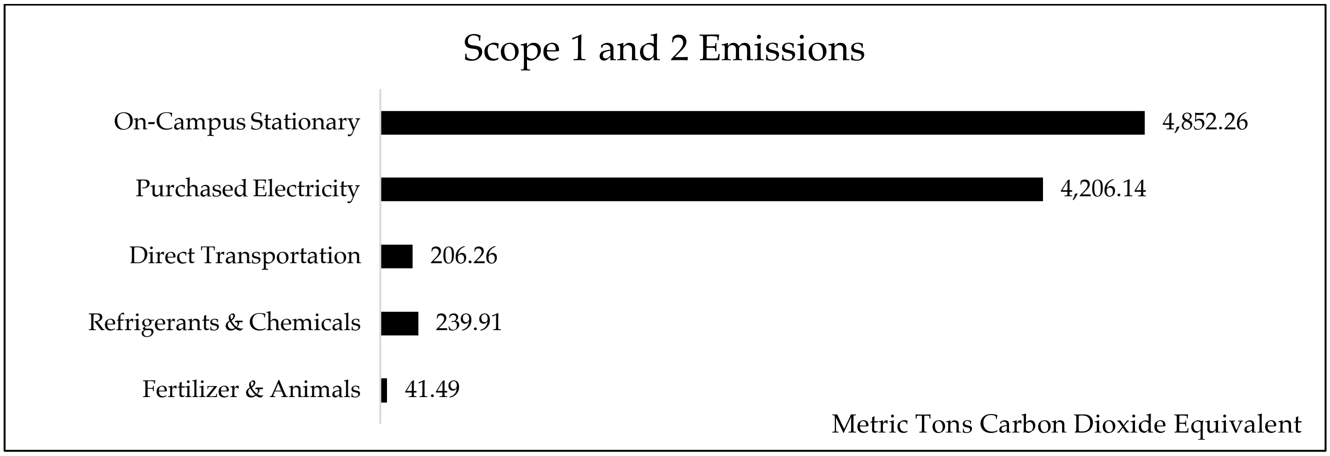

Figure II. This graph depicts scope 1 and 2 emissions by source.

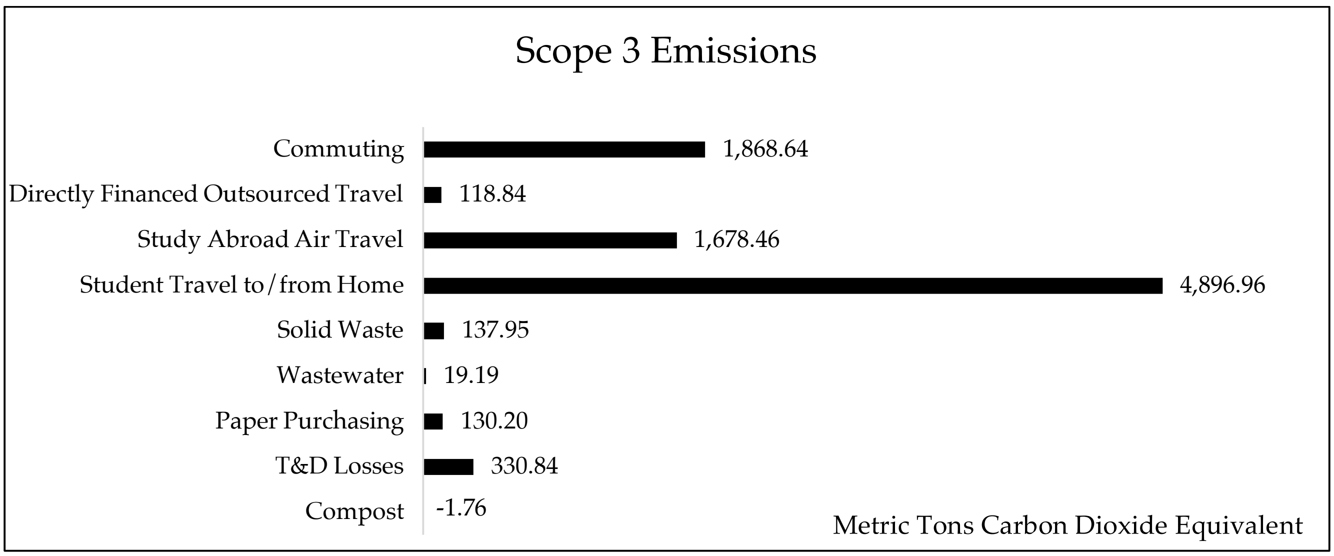

Figure III. This graph depicts scope 3 emissions by source.

Discussion

There is an uneven distribution between scope one, two, and three emissions for the first time since Skidmore began reporting its GHG emissions: 28, 22, and 50 percent, respectively. This was caused by changes in the College's electricity generation mix, new scope two reporting methodology, and a more comprehensive analysis of scope three emission sources. This is also the first GHG inventory to include the College's two-megawatt solar array and Chittenden Falls hydroelectric project. These renewable energy projects have contributed to a significant reduction in scope two GHG emissions.

Scope two reporting protocols have changed since Skidmore conducted its last GHG inventory. After careful consideration, Skidmore chose to use the market-based methodology to measure scope two emissions rather than the location-based method that we have used in the past. There are two significant differences between the methodologies. First, the market-based methodology uses different residual GHG factors when calculating emissions from grid-purchased electricity. Rather than using eGrid residual factors from the EPA's eGrid program, the market-based reporting method calculates residual factors at the North American Energy

Reliability Corporation (NERC) regional level. NERC regions are more aggregated than eGrid regions, and this change resulted in a higher residual GHG factor for Skidmore's purchased electricity. Second, the market-based approach allows institutions to include REC purchases and grid-tied renewable energy purchases (e.g., our 2-MW solar array and small-hydro projects) when measuring scope two emissions. This is unlike the location-based methodology, which prohibits organizations from including institutional renewable energy projects and REC purchases. Skidmore plans to increase the amount of renewable energy in our electricity portfolio, and therefore it is reasonable to use the market-based approach which will allow us to include any future renewable energy projects catalyzed by the institution.

Our scope three analysis includes a broader set of emission sources than previous reports. It is important to recognize the distinct difference between scope one and two emissions compared to scope three. Our scope one and two data came from highly accurate utility bills, whereas scope three data came from a variety of sources with varying degrees of accuracy. Nevertheless, we have stronger confidence in the accuracy of certain scope three emissions including air travel from Off-Campus Studies and Exchanges, faculty/staff air travel from our travel agency, chartered bus travel and athletic air travel, waste generation, paper consumption, and water consumption. The scope three emissions calculated for faculty/staff/student commuting, non-travel agency-booked air travel, faculty/staff train travel, and student travel to and from home were collected from our Community and Transportation Survey and then extrapolated. Although this methodology is well within the boundary of compliance with the Greenhouse Gas Protocol, the results should be treated as a grosser approximation than those from Scope one and two. Additionally, the College has less control over scope three emissions, and in some cases, there are fewer mitigation strategies (for example, air travel). Lastly, more entities are beginning to account for their carbon emissions, which leads to potentially "double counting" Scope three emissions. For example, if a college staff member takes the train to New York City for a meeting, the emissions of the trip could potentially be counted within Skidmore's GHG inventory as well as the train company's inventory. As a result of the decrease in data confidence and the possibility of "double counting," Scope three emissions are treated differently than Scope one and two.

Normalizing Skidmore's GHG Baseline

GHG emissions calculations have become more accurate since Skidmore first began measuring and tracking institutional emissions in 2000. We have always used the most up-to-date emissions factors and followed new methodologies and protocols when conducting GHG inventories, but we have not updated our baseline emissions using present-day factors. With the understanding that our previous GHG inventories were calculated using historical and potentially outdated factors, we chose to update our calculations using present-day emissions factors and methodologies. We believe this offers a more accurate representation of historical emissions and provides a more comparative analysis between current and baseline emissions. Figure 4 illustrates the difference between historical and present-day scope 1 and 2 GHG emissions. Table 5 describes the changes in scope 1 and 2 emissions in more detail.

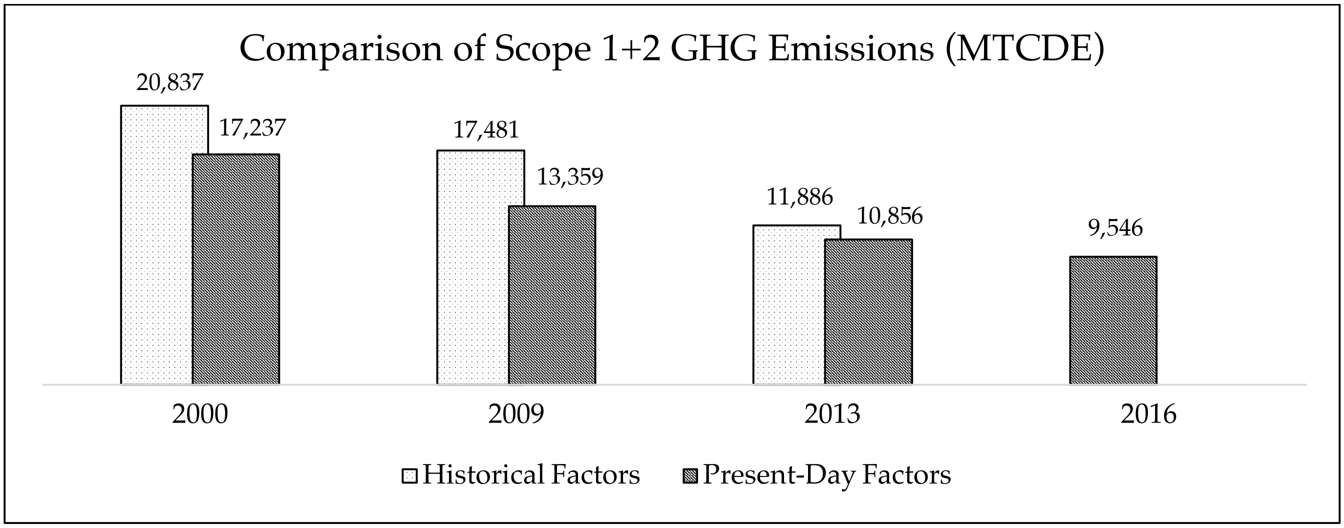

Figure IV. This chart illustrates the difference between Skidmore's scope 1 and 2 greenhouse gas emissions when re-calculated using present-day emissions factors and methodologies.

Table 5. Comparison of scope 1 and 2 emissions.

		Scope 1	Scope 2	Scope 1 + 2
2000	Historical	13861	6976	20,837
	Updated (SIMAP)	***9098.86***	***8138.11***	***17,237***
2009	Historical	8278	9203	17,481
	Updated (SIMAP)	***8339.77***	***5018.9***	***13,359***
2013	Historical	6167	5719	11,886
	Updated (SIMAP)	***6164.4***	***4691.37***	***10,856***
2016	***SIMAP***	***5339.91***	***4206.14***	***9,546***

Emissions reported in MTCDE

(Note: Figures in rows labeled "historical" were calculated with the Campus Carbon Calculator using the emissions factors released in the same year of the inventory. Figures in the "Updated" row were calculated using the emissions factors released in 2017.)

Skidmore's progress toward a 75% reduction in GHG emissions from 2000 baseline

While there are platforms that provide a standardized methodology to compare GHG emissions between institutions, we believe it is more useful to compare this report to our previous GHG inventories. As this report shows, Skidmore has realized significant reductions in scope 1 and 2 GHG emissions since 2000. These reductions can be attributed to over 15 years of projects and investments that have increased energy efficiency, supported renewable energy development, and engaged the campus community in sustainability education and action.

Our decision to normalize our 2000 baseline impacted Skidmore's trajectory toward our long-term GHG reduction goal, as illustrated in figure 5 below. "Historical Baseline" represents the percent reduction in scope 1+2 GHG emissions using current emissions factors and methodologies when compared to our historical 2000 baseline emissions figure. "Normalized Baseline" represents Skidmore's percent reduction in scope 1+2 GHG emissions using updated emissions factors and methodologies from our new, normalized baseline figure. While the normalization has lowered our percent reduction at this time, we believe this is a more honest representation of Skidmore's commendable progress in institutional GHG emissions reductions.

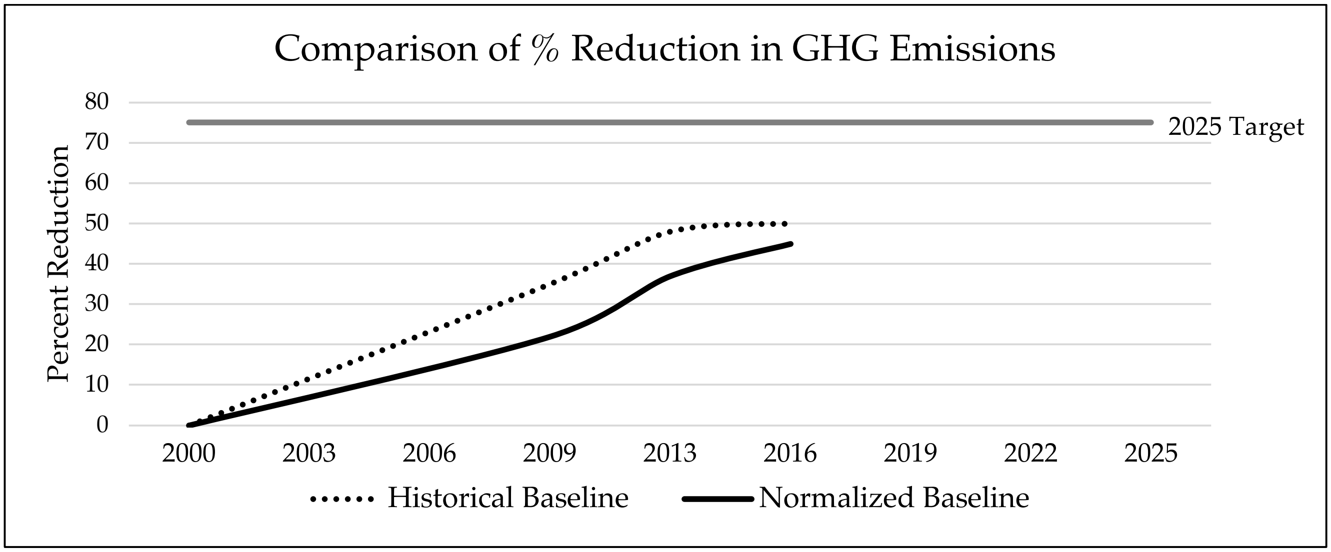

Figure V. Comparison of Skidmore's trajectory toward our GHG emissions reduction goal.

Conclusion

As the College looks forward at carbon reduction strategies, it is important to acknowledge all that Skidmore has already accomplished. We have realized a 45% reduction in scope one and two GHG emissions from normalized 2000 baseline levels by implementing projects that have transformed our campus into a living and learning sustainability laboratory. A few examples of GHG reduction projects include the College's geothermal heating and cooling systems, our 2-megawatt solar array, a power purchase agreement at a historical, low-impact hydro-electric dam, six solar thermal installations, as well as behavior change efforts that have encouraged sustainable habits and decision-making across the College. However, we should keep in mind that campus development and expanded facilities could increase energy consumption and GHG emissions, thus impacting our ability to meet the goals outlined in the *2015-2025 Campus Sustainability Plan*. We will continue to monitor institutional emissions and work across campus on mitigation efforts wherever possible.

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

This report was coordinated by the Skidmore Sustainability Office, with help from many College offices and our partner, Sightlines LLC. We would also like to acknowledge Alana Pogostin '20, GHG intern, for her dedication to this project.

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

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