



GMC Greenhouse Gas Emissions Inventory FY 2015

Overview

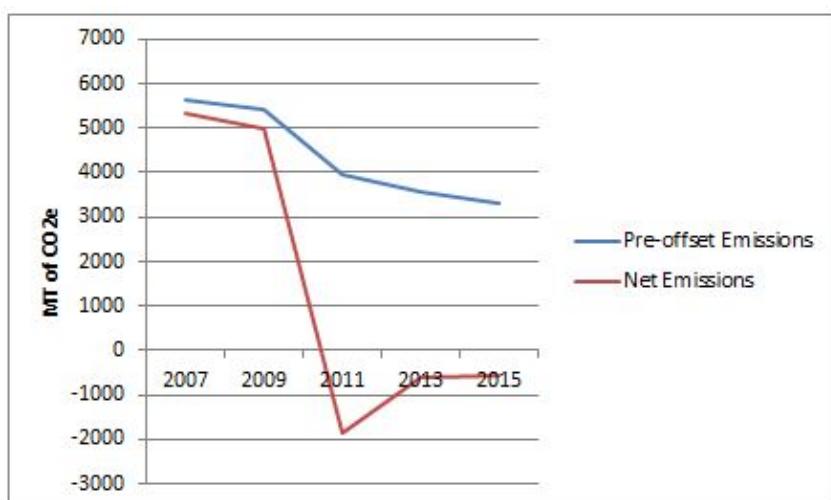
Green Mountain College's (GMC) sustainability office completed the school's fifth greenhouse gas (GHG) emissions inventory in August of 2015. This study assessed emissions from Fiscal Year 2015 (July 1st, 2014 to June 30th, 2015). Data were compared with data from prior inventories, including FY 2013, FY 2011, FY 2009, and FY 2007. This year's pre-offset emissions represent a 7.1% reduction over FY 2013, but a 41% reduction over FY 2007. The consistent downward trend in pre-offset emissions reflects GMC's continued dedication to reducing the emissions it is directly responsible for. This year's inventory would have represented a larger reduction had it not been for slightly expanding the scope of what is counted within the boundary of upstream and downstream emissions.

Fig. 1: FY 2015 Emissions Summary

Emissions Source	MT CO ₂ e
Scope 1	1281
Scope 2	799
Scope 3	1247
Total Emissions	3326
Offsets	-3911
Net Emissions	-585

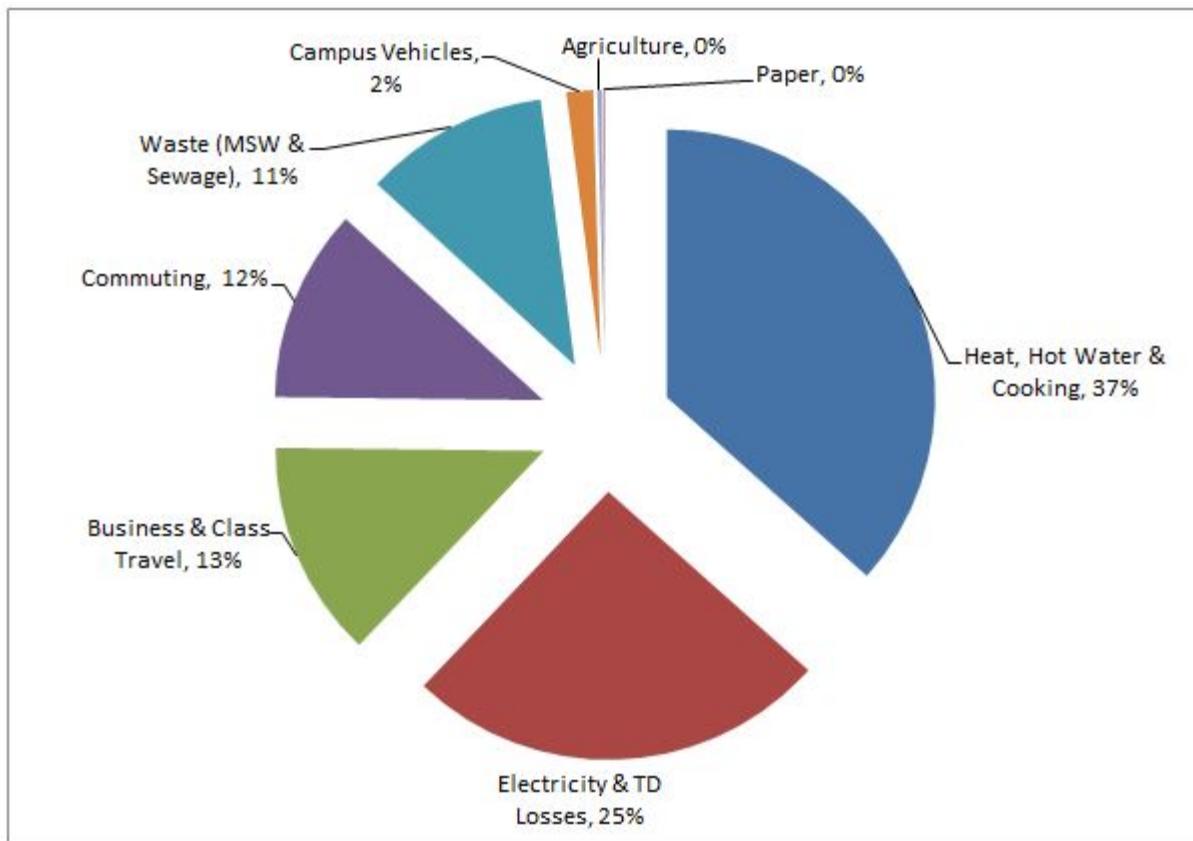
GMC continues to maintain climate neutrality by purchasing offsets to cover the school's footprint. In 2011, GMC became the second college in the country to achieve neutrality. See figure 2 below, which shows that the school has successfully maintained neutrality since 2011. The even years (non-inventory years) are also covered by offsets.

Fig. 2: Total Emissions over Time



Thermal energy continues to be the largest source of emissions at the college, followed by electricity, and then transportation. Solid waste and agriculture are the other two noteworthy sources.

Figure 3: Emissions by Sector in FY 2015



Methods for Generating Inventory

All five of GMC's GHG inventories (2007, 2009, 2011, 2013 & 2015) account for emissions within the fiscal year (e.g. July 1st 2006 to June 30th of 2007 represents fiscal year 2007). All studies used the CA-CP calculator formerly maintained by the nonprofit Clean Air Cool Planet and now directly managed by the University of New Hampshire's Sustainability Institute. The calculator was used to convert raw units to their associated GHG emissions. The calculator estimates emissions from all six major greenhouse gases specified by the Kyoto Protocol (CO₂, CH₄, N₂O, HFC, PFC, and SF6), as well as some minor gases, and then converts them into metric tons of carbon dioxide equivalent (CO₂e). The calculator's coefficients are consistent with the GHG Protocol for GHG accounting by the World Business Council for Sustainable Development and the World Resources Institute, an established standard in the field of higher education GHG accounting. The carbon dioxide equivalent values used in the calculator are consistent with the 4th Assessment of the IPCC. The Clean Air-Cool Planet calculator serves as the norm for GHG reporting to the ACUPCC.

Previous inventories used different versions of the CA-CP calculator (v5.0 in 2007, v6.1 in 2009, v6.6 in 2011, and v6.9 in 2013). For the 2015 inventory, version 8.0 was used. For consistent comparison, all inputs from previous inventories were plugged into version 8.0, and all numbers reported here use version 8.0.

For stationary and mobile fuel sources owned by the college, data were gathered by tallying gallons of different fossil fuels and short tons of woodchips purchased. Waste data were also tallied in short tons,

while paper was estimated in pounds. Waste water data were tallied in gallons. Electricity data were comprised of kWhs purchased by Green Mountain Power. Finally, commuting, class, and business travel data were input by passenger miles or vehicle miles and were collected through a combination of financial records and a survey of students, staff, and faculty. For a complete explanation of methodology, see the file named “MASTER.INPUT.SHEET.for.2015.INVENTORY.FINAL”.

An estimate of FY 2014 was also necessary, due to the fact that the college needs to cover its emissions with offsets. Actual data were used to generate the bulk of FY 2014’s inventory, including stationary fuel, mobile fuel from sources owned by the college, electricity, solid waste, waste water, paper, composting, and RECs. Averages between FY ’15 and FY ’13 were used for commuting and business travel. FY ’13 numbers were used for agriculture, due to the fact that Cerridwen Farm’s operations in FY ’14 were more similar to FY ’13 than FY ’15.

Standard reporting practice classifies GHG emissions by “scopes” which are defined in the ACUPCC Implementation Guide as follows:

Scope 1: Refers to direct GHG emissions occurring from sources that are owned or controlled by the institution, including: on-campus stationary combustion of fossil fuels; mobile combustion of fossil fuels by institution owned/controlled vehicles; and “fugitive” emissions. Fugitive emissions result from intentional or unintentional releases of GHGs, including the leakage of HFCs from refrigeration and air conditioning equipment as well as the release of CH₄ from institution-owned farm animals.

Scope 2: Refers to the indirect emissions generated in the production of electricity purchased by the institution.

Scope 3: Refers to all other indirect emissions, those that are a consequence of the activities of the institution, but occur from sources not owned or controlled by the institution. Though ACUPCC signatories are only required to report on commuting and air and ground travel sponsored by the institution (e.g., study abroad programs, faculty travel to conferences, staff driving to meetings, etc.), GMC has made every effort to quantify other scope 3 emissions for this inventory. Since 2007, the college has calculated emissions related to the disposal of solid waste, application of organic fertilizers including manure generated by campus-owned livestock, and boarding of livestock. In addition, inventories from 2009, 2011, 2013, and 2015 also account for emissions lost in the transmission and distribution of electricity (indicated as “T&D”) in scope 3 instead of scope 2, where they were counted in the 2007 inventory. New this year, the inventory includes downstream waste water treatment and upstream paper purchasing. As other scope 3 emissions outlined in the calculator were determined by best estimates to contribute less than 4% of GMC’s total emissions, they have been designated as *de minimis*, or small sources, and are not included in this report (e.g. fugitive emissions from refrigeration and other chemicals on campus). Designation of these sources as *de minimis* follows standards established by the ACUPCC in its Implementation Guide.

Limitations

The GMC sustainability office has been responsible for collecting the data necessary for this report since 2009. In 2007, the report was produced through collaboration between the sustainability office and Professor Steve Letendre.

The majority of the data used for the inventory came from actual units of fuel or kWhs purchased. However, some data were estimated, most notably, those required for scope 3 transportation. In the spring of 2015, an online survey was emailed to all faculty, staff, and students to capture their commuting patterns. Additionally, sustainability office workers sat in the student center and asked passersby to fill out the survey. The response rate for the survey was over 37% of the GMC population. However, due to GMC’s small

population size, the potential for error is noteworthy. The question structure this year was less specific than it was in FY 2013 because the sustainability office planned to use the online Carbon MAP instead of the Excel CA-CP tool. The Carbon MAP requires average inputs using their existing format and does not allow for more specific data entries. But, a significant error was located with Carbon MAP's coefficients, so it was not actually used in the end. Unfortunately, the transportation data were not as specific as they were in FY 2013 because of asking Carbon MAP questions. This limitation is similar to all inventories prior to FY 2013, which also used broadly worded transportation survey questions.

Emissions from directly-financed business travel have also fluctuated over time because the methodology for estimating this has varied considerably. Inventories prior to FY 2013 relied exclusively on the commuting survey instrument to capture staff and faculty business trips. The FY 2013 and FY 2015 inventories relied on the survey instrument for most departments, with the exception of the two most significant contributors to emissions (athletics and admissions)¹. Athletics and admissions data were estimated more directly by examining financial records to find actual destinations and modes used. Given that these two departments represent more than 50% of ground transportation, the sustainability office is confident that FY 2015's inventory provides the most accurate estimation of business travel to date. Regardless, these changes in methodologies do not have a significant impact on the reliability of the total emissions estimates. The goal of GMC's GHG emissions reporting effort is to produce the best snapshot possible.

Agricultural emissions also show noticeable fluctuations over time because of two reasons. First, researchers have made different interpretations of whether or not to count college-owned livestock manure as fertilizer. Prior to FY 2013, this manure management has been considered part of the livestock head count reported elsewhere in the calculator. For FY 2013 and FY 2015, the decision was made to report applied manure in the fertilizer section after consultation with CA-CP staff. The Sustainability Office recommends that future inventories continue to report manure and livestock separately as the two represent a more robust picture of GMC's GHG emissions. For sake of comparison, all the normed emissions numbers reported from past years in this report include estimates of past manure applications based on animal head count and consultation with Cerridwen farm staff. The second reason the agricultural emissions have fluctuated is because the total number and type of livestock has changed. For example, the dip in FY 2015's emissions over FY 2013 can mostly be explained by there being half as many tons of livestock (especially cows).

The electricity data entered into the calculator may be slightly skewed higher or lower than actuality because of a reporting error in Green Mountain Power's billing system. A handful of data points were missing both on billing statements and raw data spreadsheets provided by the company. As far as the Sustainability Office can tell, this was from a change in the billing software and a change in the template of the bill. To be conservative, if a missing month was located, that data point was extrapolated rather than left blank.

Although all past inventories were normed to v.8.0's methodology, it is important to note that FY 2015's inventory includes two additional sources of emissions: waste water and purchased paper. Although these sources only account for a total of 1.2% of the FY 2015 inventory, their existence makes direct comparability between years slightly misleading.

Past emissions estimates in all three categories have changed slightly during every new inventory due to updates for GHG coefficients within the CA-CP calculator. The most notable example in FY 2015 is the slightly reduced carbon intensity of electricity and the large reduction in the value of RECs². Other slight

¹ Both commuting and business-travel survey data were scaled up to the full population size (excluding the admissions and athletics population under business travel since they were counted directly through financial records)

² Note that the "offset" value of RECs reduces after electricity consumption is input to the calculator.

changes are due to changes in assumptions that are required to make calculations. For full transparency about assumptions see the Master Input Sheet for FY 2015 kept on file in the Sustainability Office.

Detailed Results & Analysis

GMC continues to improve the campus to reduce emissions through increased use of the biomass plant, small energy renovation projects, and a significant increase in waste diversion. The following table shows how emissions have changed over time in specific categories.

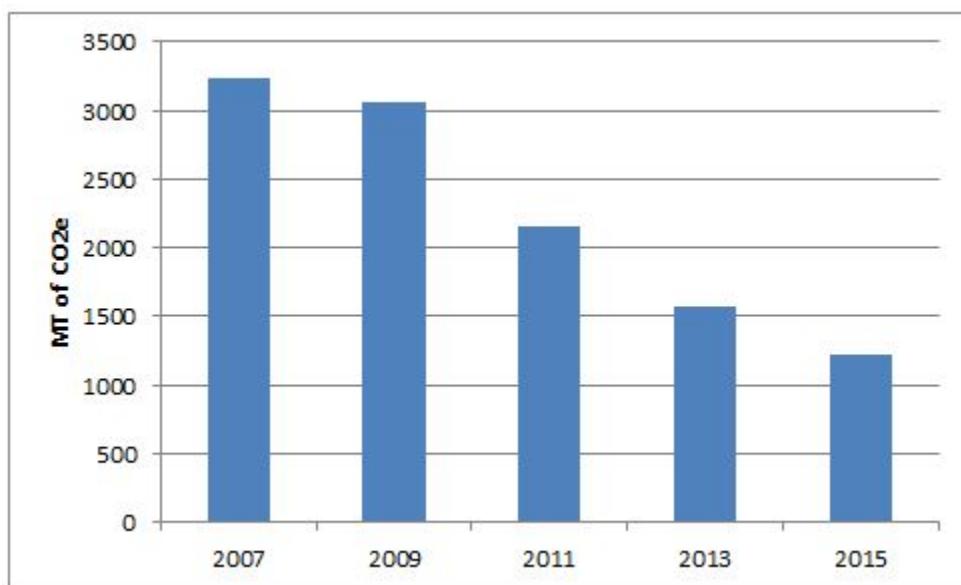
Fig. 4: Emissions by Source (All inventories normed to v.8.0 of the CA-CP calculator)

Scope 1 Emissions	2007 CO₂e (MT)	2009 CO₂e (MT)	2011 CO₂e (MT)	2013 CO₂e (MT)	2015 CO₂e (MT)
Stationary Fuel (heating & cooking)	3229	3060	2149	1564	1217
Campus Fleet Fuel	61	56	62	70	54
Agriculture	16	21	25	29	10
Scope 1 Subtotal	3305	3137	2235	1663	1281
Scope 2 Emissions					
Purchased Electricity	866	781	812	766	799
Scope 3 Emissions					
Commuting	317	369	100	352	387
Business Ground Travel	36	46	31	127	224
Business Air Travel	126	171	151	91	142
Study Abroad	327	202	40	104	69
Solid Waste	580	636	530	431	334
Wastewater					37
Paper					5
Electricity (transmission & distribution losses)	86	77	50	47	49
Scope 3 Subtotal	1472	1501	903	1152	1247
Total Emissions	5644	5419	3950	3581	3326
Offsets					
On Farm Compost		-1	-3	-6	-6
RECs (renewable energy credits)	-329	-431			-68
Certified Offsets purchased to achieve neutrality			-5800	-4200	-3837
Net Total Emissions	5314	4986	-1853	-625	-585

Scope 1

Every item in this category is at a historic low. Agriculture's impact went down due to less cows and pigs, despite an increase in the number of goats, sheep, and chickens. Some of the difference can also be explained by a slightly more accurate accounting of manure production. Campus fleet fuel use went down a noticeable amount due to a concerted effort to do more local trips in the adventure education program. Stationary fuel use, including heat and hot water, went down, in part, because of small projects like the Two Editors Inn renovation, stemming from a weatherization class. The majority of the reductions come from operations at the biomass plant. Every year the college increases the efficiency of the biomass plant, so that it carries a greater percentage of the heat and hot water load for central campus. Improvements since 2013 include a switch from #6 oil as a back-up to less carbon-intensive #2 oil, running the plant through the summer for hot water, and upgrades to some steam pipe components. For the first time, biomass is now covering 85% of the heat and hot water load for campus. These actions have a noticeable impact on the total scope one emissions over time. The following graph shows stationary fuel totals for the two inventories before the plant was built (FY 2007 and FY 2009) and the three inventories since the plant was built (FY 2011, FY 2013 & FY 2015).

Fig 5: Stationary Fuel over Time (heat & hot water)



Scope 2

Since achieving Efficiency Vermont's Energy Leadership Challenge in 2013, which was projected to result in a 7.5% electricity reduction, electricity mitigation has plateaued. Opportunities to reduce electricity demand still exist, but they are generally smaller, more dispersed projects. For example, Efficiency Vermont believes a comprehensive light inventory could be done to see if any old incandescent or fluorescent lights are still in use in spaces that are not frequently used, but may be left on for long periods of time. The light inventory could also assess if certain places are over lit. The Sustainability Office has tried to find a student willing to take on this project for delicate balance, but so far has not been successful. Other ideas include replacing older refrigeration/freezer units in the Withey dining hall and at the Killington Lodge, but these generally don't have paybacks less than five years. The greatest untapped source of reduction is behavioral change among campus users. The annual Do it in the Dark competition has attempted to address this issue, but generally reductions are short term and students, staff, and faculty fall back into comfortable habits after the competition is over. The potential for behavioral change is significant, as the annual Do it the Dark competition usually yields a 10% reduction on average. Some groups, such as the Vermont Summer Academy have achieved an over 50% reduction in the residence halls.

Scope 3

Trends within scope 3 are difficult to trust given the variable nature of the data. This year's commuting and business travel were higher than in most previous years, though the Sustainability Office doubts that travel patterns are significantly more carbon intensive. All commuting data, and about half of the business travel data rely on a survey instrument. Despite a relatively high percentage response rate (37%), the small population size of the College can lead to significant error in the calculations, above or below actual impact. One trend that the sustainability office is confident of is the increase in business travel within the athletics department. Recruiting efforts were ramped up considerably in 2015, and the resulting increase in emissions is noticeable.

Another reason why scope 3 appears higher this year is because waste water and paper purchasing emissions were included for the first time, as a step toward more authentic sustainability. These two categories are now available in the Clean-Air Cool Planet Calculator.

Decreases in study abroad and solid waste emissions are legitimate. In the case of waste, the sustainability office has worked hard to recycle and compost a greater portion of the college's waste stream through increasing the efficiency of the crew, installing new home-made waste stations, and carrying out educational efforts. In fact, the sustainability office increased waste diversion by over 20% over the last three years.

Offsets

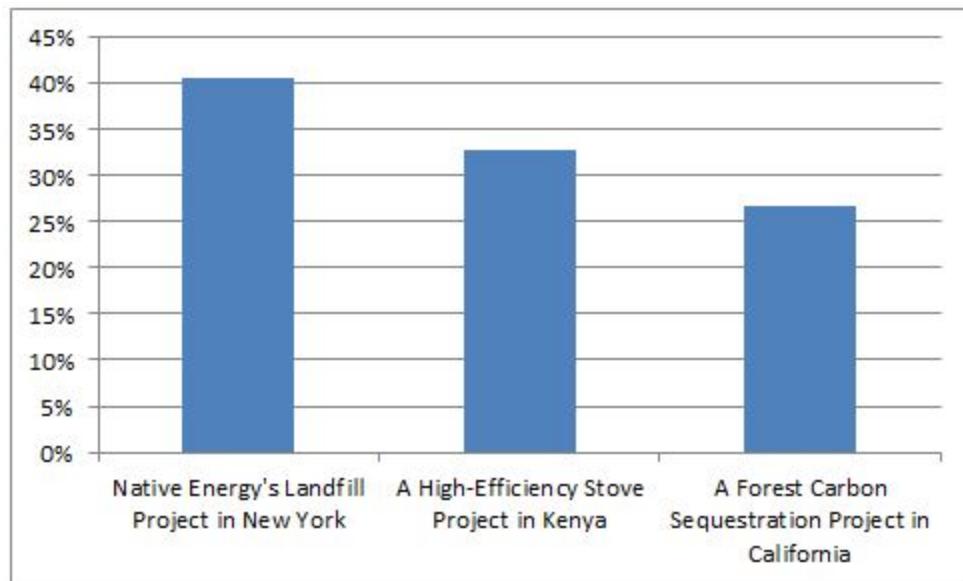
The College has maintained climate neutrality since 2011. Through FY 2013, GMC's offset provider was Green Mountain Power's Cow Power Program, which offered high-end offsets for methane destruction affiliated with the College's purchase of premium electricity. In FY 2015, the Sustainability Office launched a college-wide effort to select another offset provider given Green Mountain Power's focus on the renewable energy credit market and the expensive nature of verifying and retiring offsets from small projects.

The effort to find a new offset provider involved five classes and over 50 students. The Sustainability Office worked with key faculty members to develop an RfP (Request for Proposals) that was then provided to several classes, so that students could gain experience working as environmental consultants. The RfP called for students to research potential providers and ultimately select three finalists, which would then be voted on through a campus-wide input process, also designed by students. Various classes took up distinct parts of the request. For example, a forestry class researched six potential forest offset projects and vendors and ultimately suggested one, which became a finalist. A senior seminar in environmental studies researched numerous potential projects and recommended one finalist. Finally, a student in a delicate balance class and another student in an economics class recommended the same provider, who also became a finalist. These three finalists were vetted by the Campus Sustainability Council and then recommended to a first-year voices class that was charged with explaining what climate neutrality was to the whole campus, and getting the campus to rank the providers through a survey. The survey was implemented by the class, along with corresponding educational material including a speech in the Withey dining hall, a video production, posters, and a face-to-face tabling effort in the student center. The survey was given both online through email and in person via hard-copy.

The winner of the campus-wide vetting process was Native Energy's Seneca Meadows Landfill Gas project. The project, located in Waterloo, NY, captures methane from a landfill and either flares the methane or uses it to turn turbines to create electricity. Whether it flares or creates energy at any given time is dependent on how pure the gas is. Less pure gas is flared. The project was third-party verified by First Environment, and the offsets were retired on the American Carbon Registry with a vintage date of 2014, the most recent vintage date available at the time the offsets were purchased in September of 2015. The project was thoroughly researched to ensure it meets ACUPCC criteria outlined in V.1.0 of the Voluntary Carbon

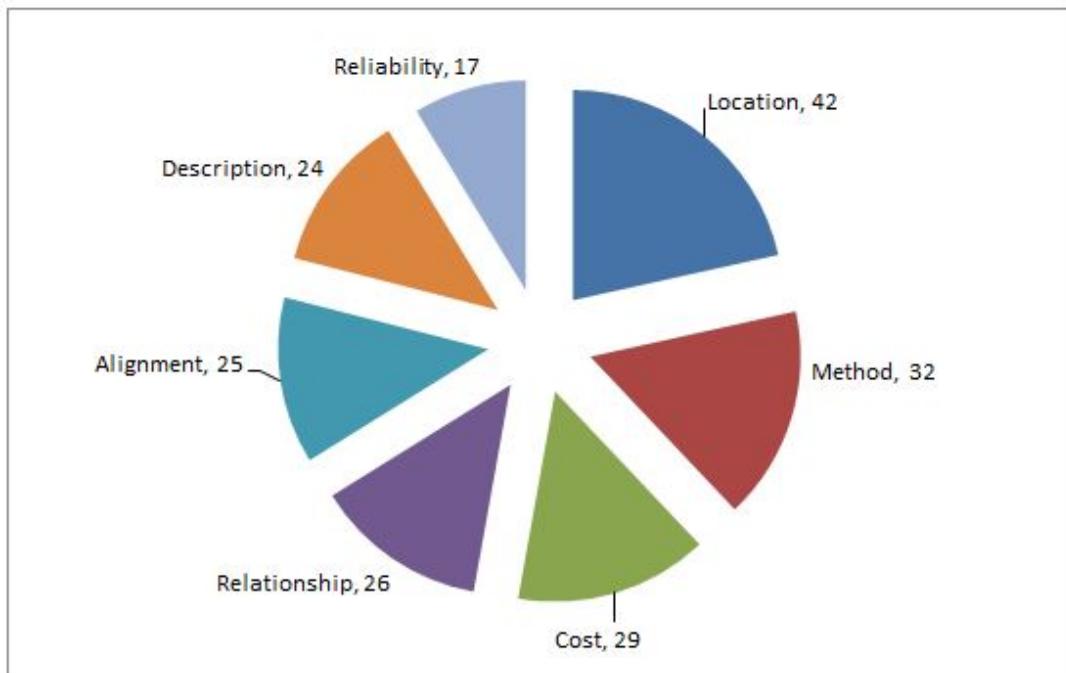
Offset Protocol. A total of 3,837 MT CO₂e were purchased to cover FY 2015 and 3,655 were purchased to cover FY 2014.

Fig 6: Percentage of Votes for #1 Ranking³



Respondents cited the local nature of the Seneca Meadows project and its straightforward way of mitigating emissions as the primary reasons for ranking it first. Figure 7 below shows the number of respondents who cited each reason for choosing Native Energy. “Relationship” refers to relationship to the local community the project is located in. “Alignment” refers to alignment between the project’s mission and GMC’s mission.

Fig 7: Reasons Respondents Chose Native Energy Landfill Project



³ Out of respect for the second and third place finishers, the company names are not displayed

The college purchased enough offsets to cover all emissions reported in this inventory as well as the emissions estimated for FY 2014, in addition to a 10% buffer for each year⁴. Estimating the sufficiency of a 10% buffer took several steps. First, the sustainability office used historic highs for all categories to estimate the potential for under-estimation. Second, researchers estimated emissions for leased classroom space on the Killington campus, as well as the former wellness center using numbers from comparable buildings. These buildings should probably be excluded under the ACUPCC's financial control model, but they are incorporated in the buffer in order to be conservative. Potential under-estimation and inclusion of the two extra buildings amounted to about 6% of the total footprint for each year (FY '15 & FY '14). An extra 4% was deemed sufficient for any de minimis emissions. GMC is confident that it has maintained climate neutrality consistent with ACUPCC standards.

Looking Forward

GMC's new strategic plan, *Sustainability 2020*, aims to achieve authentic sustainability by the year 2020, and many of the associated metrics for authentic sustainability relate to greenhouse gas emissions. For example, the plan challenges the college to produce all of its energy on campus by renewable sources, something the college has taken strides toward by sourcing 10% of its electricity from solar and another 3% from Cow Power. Another metric sets two related goals: an overall waste diversion rate of over 50% and a goal of 99% of recyclables and compostables being removed from the landfill stream. This year, the College reached its 50% waste diversion goal and will now focus more strategically on removing recyclables and compostables from the waste stream through more frequent waste audits and educational programs directly affiliated with those audits. Finally, one of metrics measures upstream emissions from the supply chain and the baseline data for that project was collected in 2013, with a plan to collect it again every two to three years. These data will prove useful for giving weight to the sustainable purchasing policy and highlighting new sources of emissions that the College may not have been aware of. Through all of these practices, the College is committed to increasing transparency around greenhouse gas accounting and continuing the trend of reducing actual emissions on campus in order to further minimize the need to purchase offsets.

⁴The buffer was calculated from the pre-offset emissions numbers (excluding on-campus compost and RECs). The calculation and purchase was made before the sustainability office noticed an error in the CA-CP tool that inflated CO₂e emissions from organic fertilizer. The result of the error is a larger buffer than 10% for FY 2015.