Annual Greenhouse Gas Emissions Inventory Update for FY 2016 (October 7, 2016)

Background and Overview

Bowdoin College committed to become "carbon-neutral" by the year 2020 and released a detailed implementation plan to achieve that goal in the fall of 2009.[1] The plan focused primarily on an ambitious goal of reducing "own-source" emissions by at least 28% over the 12 years between 2008 and 2020, with the understanding that the College would need to purchase carbon offsets in 2020 to achieve the ultimate goal of carbon neutrality.

This document serves as the Annual Greenhouse Gas Emissions Inventory Update for Fiscal Year (FY) 2016. Bowdoin's greenhouse gas emissions (GHG) in FY 2016 were 14,461 metric tons of carbon dioxide equivalent (CO_2e), which is 24% lower than the FY 2008 baseline total of 19,153 metric tons. Own-source emissions for FY 2016 were 13,304 metric tons CO_2e, or 19%, lower than the 2008 baseline. The balance of this update provides a more detailed explanation of the College's inventory.

Summary of FY 2016 Bowdoin College Greenhouse Gas Emissions

Bowdoin categorizes emissions into three scopes. Scope 1 includes onsite combustion of fuels, College vehicle use, and fugitive refrigerants. Scope 2 encompasses purchased electricity. Scope 3 includes travel by College faculty and staff, daily employee commuting, transmission line losses from electricity usage, and waste disposal. Bowdoin's own-source emissions are comprised of both scope 1 and scope 2 emissions.

The College has the most control over scope 1 emissions and has made significant progress in this area, as fuel-switching, green building standards for new construction, and weatherization programs for existing buildings have increased campus-wide energy efficiencies. However, yearly fluctuations in winter temperatures – colder winters require higher heating fuel usage – can be another key driver either augmenting or diminishing the impacts of efficiency projects.

[1] In 2007, the College became a signatory to the American College and University Presidents' Climate Commitment—a pledge by leaders of more than 640 colleges and universities to move their campuses toward carbon neutrality and build new academic pathways for addressing sustainability issues. To achieve this goal, the College developed a Climate Neutrality Implementation Plan in 2009. As part of that plan, the College tracks and reports annually on its greenhouse gas (GHG) emissions relative to the Fiscal Year (FY) 2008 baseline year. The plan is revisited and updated every two years so that Bowdoin community members can measure the effectiveness of strategies, evaluate the financial feasibility of specific projects, and incorporate new technological advances. The 2009 plan can be reviewed at https://www.bowdoin.edu/sustainability/pdf/2009-implementation-plan.pdf and the most recent update can be reviewed at https://www.bowdoin.edu/sustainability/pdf/2014-implementation-plan.pdf.

Scope 1
Onsite fuel combustion, College vehicle use, and fugitive refrigerants

Scope 1 emissions were 4% lower in FY 2016 than in FY 2008, a decrease of 357 metric tons.

Scope 1 emissions have decreased as a result of reduced on-site fuel combustion for space heating at the central heating plant and satellite locations. This decrease was partially offset by annual increases in vehicle use and fugitive refrigerants in FY 2016.

Stationary, on-site fuel combustion was measured at 7,984 metric tons of CO2e for 2016. This is the second lowest measurement for this category since 2008, only higher than the onsite emissions recorded during the very warm winter of 2012. This decrease in on-site fuel combustion resulted from a relatively warm winter and the success of fuel conversions and efficiency projects, which have driven emissions down despite an increase in heated square footage on campus. As measured by heating degree days, FY 2016 was 10% warmer than 2008.[2] This warmth reduced natural gas consumption by 12% compared to 2015, a year which had hit an all-time high for natural gas usage. At the same time, Bowdoin used less heating oil than ever before, only 11,301 gallons, which represents a 91% decrease since 2008, resulting primarily from fuel conversion projects.

Partially offsetting the reduced emissions from lower onsite fuel consumption were increases in College vehicle use and fugitive refrigerants. Gasoline and diesel fuel use in College vehicles rose 31% (104 metric tons) compared to FY 2008. The increase in College vehicle use has been, in large part, due to a change in the College's fleet vehicle usage policy. Instead of renting vehicles to accommodate academic field research or community service trips, departments are now encouraged to use College-owned vehicles.

Projects completed in the last year that aim to reduce Bowdoin's Scope 1 emissions include:

- Insulating steam and domestic hot water piping in mechanical rooms and steam tunnels across more than a dozen campus locations.
- Replacing a steam line near the intersection of Coffin Street and Longfellow Avenue.
- Converting four satellite locations from no. 2 oil and propane burners to natural gas.
- Weatherizing five faculty/staff rental properties, including new attic insulation, sealing air leaks, and applying spray foam to basement areas.

Scope 2
Purchased electricity

Scope 2 emissions were 37% lower in FY 2016 than in FY 2008, a 2,664 metric ton reduction.

For the first year since FY2011, Bowdoin saw a slight increase in electricity consumption, likely due to increased square footage. This slight increase was magnified by a revised EPA eGrid number that increased the carbon emissions per MWh used in Maine. Taken together, this resulted in a 17% increase in Scope 2 emissions compared to FY 2015. It is worth noting that these emissions are still far below the 2008 baseline, mainly driven by the College's investments in efficient lighting and electrical systems as well as its cogeneration system – a 630 kW backpressure turbine that was installed in February of 2012. In FY 2016 this turbine produced 1,134,405 kWhs, which is very close to the prior year's production. While the year-over-year uptick in emissions cannot be ignored, the impacts of the cogeneration turbine and numerous efficiency projects have kept kWh consumption close to historic lows despite expanding square footage. Additionally, the New England grid is likely to get

[2] Heating degree days (HDD) are a rough measure of the amount of energy needed to heat buildings in a certain location. HDDs are derived from measurements of outside air temperature. One HDD indicates that the average outside temperature for a single day was one degree below 65 degrees Fahrenheit.

cleaner in coming years as a result of renewable legislation. This year's increased eGrid number is mainly the result of the timing of biomass generation plant retirements.

Continuing to focus on energy-efficiency projects and raising awareness about conservation measures among students, faculty, and staff will be paramount in decreasing overall electricity consumption. Notable accomplishments in FY 2016 included:

- The continued replacement of higher wattage lighting fixtures with LED fixtures and the installation of occupancy controls resulted in considerable electrical savings. Several buildings dedicated to the arts received major campus lighting upgrades, including the Bowdoin College Museum of Art, Studzinski Recital Hall, and Pickard Theater in Memorial Hall. Not only will the buildings operate more efficiently, but building occupants have also been very happy with the quality of light and other benefits the LEDs provide.
- Two month-long energy conservation competitions were held, one in the fall and one in the spring. The competitions provide an opportunity to raise awareness about what individuals can do to help Bowdoin reduce greenhouse gas emissions in an engaging and fun manner. Bowdoin students conserved over 17,000 kWhs last year between the two competitions.

Bowdoin has chosen to discontinue its purchase of renewable energy credits (RECs) from Maine renewable electricity generators. From FY 2006 through FY 2013 Bowdoin purchased RECs in the voluntary market to offset 100% of its Scope 2 emissions. These credits have never been factored into the GHG emissions inventory, but it should be noted that the funds previously used to purchase renewable energy credits are being put towards expanding on-campus efficiency and renewable energy projects going forward.

Scope 3

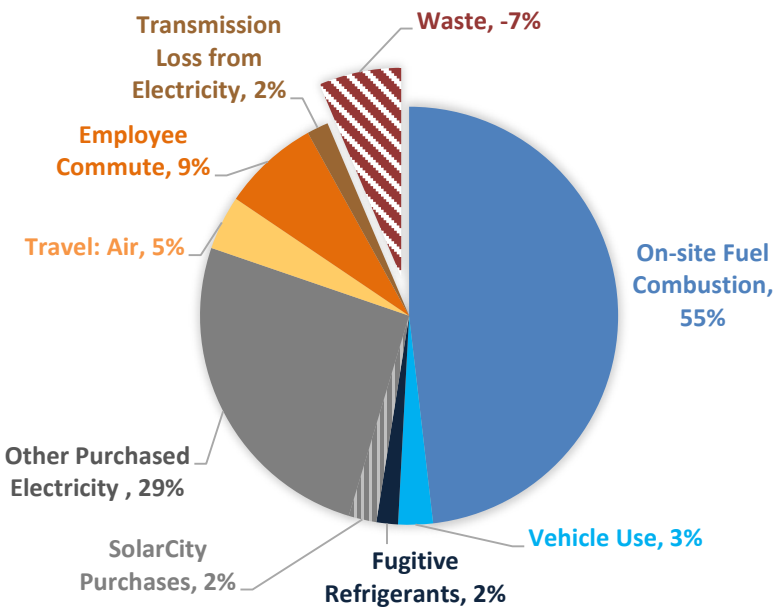
Travel by College faculty and staff, daily employee commuting, transmission line losses from electricity usage, and waste disposal

Scope 3 emissions decreased by 59% in FY 2016 compared to FY 2008, a 1,671 metric ton decrease.

Emissions associated with College travel were up 30%, an increase of 161 metric tons of CO2e from FY 2008. Emissions related to employee commuting were down 28%, or 479 metric tons, compared to FY 2008. Employee commute emissions were estimated based on the part-time and full-time job classifications of each employee, cross referenced with the employee's zip code. This total was then reduced based on a 2015 survey of faculty and staff which showed that 22% of respondents in the greater Brunswick area use carpooling, biking, or walking as their primary mode of transportation. Another employee commute initiative completed in FY 2016, which is not reflected in these numbers, was the installation of two electric vehicle charging stations available to the campus community. Electricity line loss-related emissions were 40%, or 188 metric tons, lower compared to FY 2008.

Bowdoin's waste-related emissions decreased by 1,080% in FY 2016 or 1,166 metric tons compared to FY 2008. The College sends a significant portion of its non-recycled waste to a facility that uses waste to generate electrical power. Compared to landfills with no energy recovery, waste-to-energy facilities have a much smaller GHG impact. The electricity produced by these waste-to-energy facilities displaces generation from other power plants that primarily burn natural gas – resulting in a carbon credit. A change in modeling since FY 2008 that correctly assigns waste to its final destination accounts for the majority of this decrease and the negative overall impact on Bowdoin's emissions.

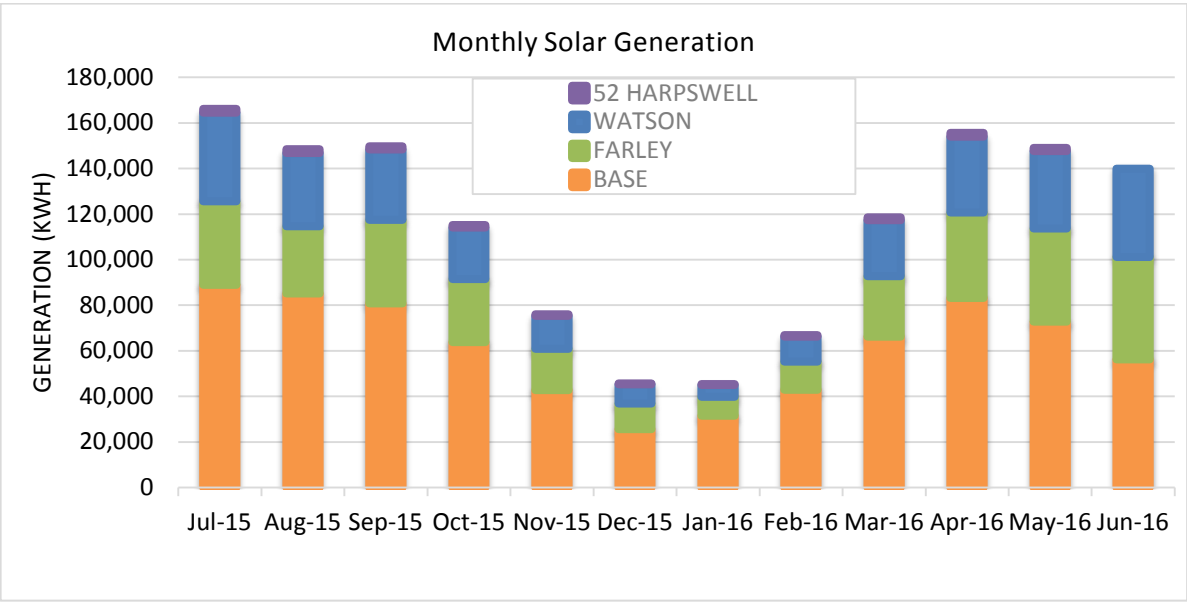
A breakdown of the estimated 14,461 metric tons of CO2e emissions for FY 2016 is shown by major category in the following chart.



Solar Update

In collaboration with SolarCity Corp., Bowdoin installed 1.2MW of Solar PV capacity at Farley Field House, Greason Pool, Watson Arena, 52 Harpswell Road, and the former Naval Air Station property. These panels collectively provided about 8% of the College's electricity in FY16, generating about 1,376,000 kWhs. **Combined with the electricity produced by the cogeneration turbine at the heating plant, approximately 14% of the College's electricity is now generated on site from renewable or efficient sources.**

While Bowdoin is responsible for creating the solar project, the College is not currently able to claim carbon reduction benefits from the solar generation. This is due to the fact that SolarCity retains the RECs associated with the generation during the term of its power purchase agreement with the College. Solar generation at Bowdoin since the project's completion is shown in the following chart.



Conclusion
Bowdoin's GHG emissions were 24% lower in FY 2016 compared to the base year of Bowdoin's carbon reduction plan. Moreover, Bowdoin's own-source emissions saw a 19% decrease in FY 2016 with respect to the 2008 baseline and the College remains on track to meet its goal of a 28% reduction by 2020.

However, achieving carbon neutrality is not an easy task. While we can celebrate progress and evaluate setbacks each year, reducing campus greenhouse gas emissions will require ongoing action by everyone on campus.

In FY 2016 Bowdoin completed several previously mentioned major lighting projects and furthered its efforts to switch from No. 2 heating oil to lower carbon natural gas. Projects that are slated for FY 2017 include:

- Implementation of energy efficiency projects at Farley Field House, Burton-Little House, and Pickard Field House that focus on reducing fuel consumption and electricity usage at all three locations. The projects will include installing two new heat recovery ventilation systems, twenty destratification fans, and a CO2 monitoring system, as well as adding variable frequency drives (VFDs) to outside air handlers, and connecting building sensors to Bowdoin's central Energy Management System that will enable the College to increase setback periods. We anticipate a combined reduction of 388,259 pounds of CO2 per year from the three projects.
- Expansion of the College's Web-based Building Dashboard® to provide individualized steam metering to over a dozen more buildings connected to the central heating plant. This data makes Bowdoin's energy use visible, engaging, and easily understood by students, faculty, staff, and guests.
- Replacement of metal halide light fixtures at the Farley and Watson parking lot with LED bulbs, which we estimate will result in a 38,000 kWh reduction.

As we have seen since the early years of implementation, the collective efforts of Bowdoin's students, faculty, and staff will be critically important to achieving carbon neutrality by 2020.

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