Minnesota State University, Mankato

Carbon Footprint Update Report

May 16, 2017

Prepared for the Environmental Committee by

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Executive Summary

A baseline carbon footprint for MSU, M for FY 2012 was developed and subsequently updated through FY 2016 in a collaboration among Facilities Management, the Environmental Committee, and Sebesta and with funding from the MSU, M Administration. A carbon footprint is an accounting of all the greenhouse gases (GHG) emitted in one year. Major campus activities contributing to the footprint are electricity use; natural gas and fuel oil combustion for heating buildings and hot water; commuting of students, faculty and staff back and forth to campus; and use of the vehicle fleet.

Total campus GHG emissions in the FY 2012 baseline year were 48,630 metric tons of CO_2-equivalent. Electricity use contributed 54% to the total, followed by natural gas and fuel oil consumption at 23%, commuting at 22%, and the vehicle fleet at 1% (Fig. 1, p. 6). After adjusting for the effects of weather, it was found that the total carbon footprint <u>decreased</u> by 6.8% from FY 2012 to FY 2016 (Fig. 3, p. 8). All four major activities contributed to the decrease: electricity emissions decreased by 3.8%, natural gas and fuel oil emissions by 6.3%, commuting emissions by 13.4%, and vehicle fleet emissions by 47.7% (Table 2, p. 8).

The major cause of the reduction in electricity and natural gas and fuel oil emissions was the Public Building Enhanced Energy Efficiency Program (PBEEEP), administered by the State of Minnesota, brought to campus by Ron Fields, Assistant Vice-President for Facilities Management, and implemented at the end of Fall Semester 2012. PBEEEP reduced GHG emissions by cutting back on wasteful electricity and natural gas use; as a result, it cut electricity consumption by 2,200,000 kWh a year, natural gas consumption by 120,000 therms a year, and is saving the University more than $220,000 a year, at a net initial cost to the University of $13,000.

Most of the reduction in commuting emissions was due to changes in student commuting, as students make up approximately 90% of the campus population. Whereas *total* commuting emissions decreased by 13.4%, the decrease in *student* commuting emissions was 19.0%. Analysis of the commuter survey data showed that the major reason for the decrease in student commuting emissions was the increase in the number of students either walking or simply not commuting to campus at all on a particular day, and a corresponding decrease in the number of students driving alone.

The FY 2012 baseline carbon footprint and the carbon footprint updates benefit the University community in a number of ways:

- Tracking the carbon footprint makes possible the identification of strategies which are the most effective in reducing the University's GHG emissions.
- The GHG emission analysis used in the development of the footprint and updates also shows the energy and cost savings from electricity and natural gas use.
- The baseline footprint and updates demonstrate the University's commitment to addressing the problem of global warming and climate change, making the University more attractive to prospective students and potential donors.
- The GHG emission analysis and the data sets used in the development of the footprint and updates can suggest research projects to faculty and students.

I. Introduction

A university's carbon footprint (also known as a greenhouse gas inventory) is an accounting of all the greenhouse gases (GHG) emitted in one year, taking into account all the activities for which the university is responsible. These activities include electricity use, natural gas and fuel oil combustion for heating buildings and hot water, commuting using motorized vehicles by students, faculty and staff to and from campus, and use of the University's fleet vehicles. Other minor activities included which contribute only minimal amounts of GHGs to the footprint are solid waste disposal, waste water treatment, and fertilizer use. A carbon footprint is an indispensable tool if a university wants to reduce its greenhouse gas emissions and be a good steward of the environment. When tracked through time a carbon footprint can show quantitatively the effectiveness of various strategies employed to reduce a university's GHG emissions.

With this in mind, the MSU, M Administration, working with Facilities Management and the Environmental Committee, provided the funding for Sebesta to conduct an initial greenhouse gas (GHG) inventory during Spring Semester 2013 which resulted in a baseline carbon footprint for the 2011 – 2012 academic year (FY 2012). This baseline footprint was seen as a preliminary step in the development of a climate action plan (CAP) for MSU, M. Subsequently, the Environmental Committee received Strategic Priorities Initiative funding for a consultant (Sebesta) to aid in the development of the CAP. The CAP has been developed and approved for implementation by the Administration; the CAP Report can be viewed on the Environmental Committee website at www.mnsu.edu/greencampus .

In agreement with Sebesta, the Environmental Committee took on the task of producing annual updates to the carbon footprint, and Sebesta provided the computer tools for the Environmental Committee to do so. In the course of updating the footprint, the Environmental Committee found errors in Sebesta's analysis of the commuter survey, used to calculate commuting emissions for the footprint, and re-calculated the baseline footprint. The recalculated baseline footprint and updates through FY 2016 are presented in this report.

II Greenhouse gases

It is important for institutions such as universities, businesses, cities, states, and countries, and also for individuals to reduce their greenhouse gas emissions, as the overwhelming consensus of climate scientists is that human-caused greenhouse gases are the primary driver of global warming and climate change, the effects of which we are witnessing daily in Minnesota and around the world. The most important of the greenhouse (or heat-trapping) gases in the atmosphere is water vapor, but its concentration in the atmosphere depends on weather and climate conditions and is beyond human control. Of the remaining heat-trapping gases, the most important are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These are the gases that are tracked by the University of New Hampshire Campus Carbon Calculator, the computer tool used to calculate the baseline footprint and updates. Of these gases, most of the warming is due to CO_2.

Carbon dioxide is produced by the combustion of fossil fuels: natural gas and fuel oil for heat; gasoline or diesel in motorized vehicles; and in the generation of electricity when it is produced by burning coal, fuel oil, or natural gas. Methane is produced when organic material decays anaerobically, for example, in landfills or in waste water. Nitrous oxide arises from agricultural practices such as the use of fertilizer. Methane and nitrous oxide are both more potent greenhouse gases than carbon dioxide. The global warming potential (GWP) of methane is 25 times greater than that of carbon dioxide, and the GWP of nitrous oxide is 298 times greater. Carbon dioxide, however, is much more prevalent in the atmosphere, where it is present at a concentration of about 400 parts per million, compared to about 2000 parts per billion for methane and 300 parts per billion for nitrous oxide.

In this report, the amounts of methane and nitrous oxide emissions are converted into their carbon dioxide equivalents by multiplying by their GWPs. Carbon dioxide is by far the largest contributor to the University's GHG emissions: in the baseline year FY 2012, for example, carbon dioxide accounted for >99% of the total carbon footprint of 48,630 metric tons of carbon dioxide equivalent.

III. Methodology

The major activities tracked for the Minnesota State Mankato carbon footprint and updates were electricity consumption, natural gas and fuel oil combustion for heating, daily commuting (students, faculty and staff) to and from campus, and vehicle fleet operations. These four activities produced essentially all (>99%) of campus GHG emissions. Other minor activities which were also tracked were solid waste disposal, waste water treatment, and fertilizer use. The University of New Hampshire Campus Carbon Calculator, version 8.0, a tool used by hundreds of colleges and universities across the U.S., was used to calculate the carbon footprint. Electricity, natural gas, fuel oil, and waste water treatment data were obtained from the State of Minnesota B3 Benchmarking database, after having been entered by Facilities Management staff. Commuter data were obtained from annual commuter surveys emailed in the spring to all students, faculty and staff. Response rates were about 5% for students, 15% for faculty, and 20% for staff. Vehicle fleet use, solid waste, and fertilizer data were obtained from Facilities Management staff.

IV. GHG Emissions Summary

Greenhouse gas emissions for the baseline year and updates are summarized below.

Table 1. MSU, M greenhouse gas emissions baseline (FY 2012) and annual updates through FY 2016, in metric tons of CO_2-equivalent

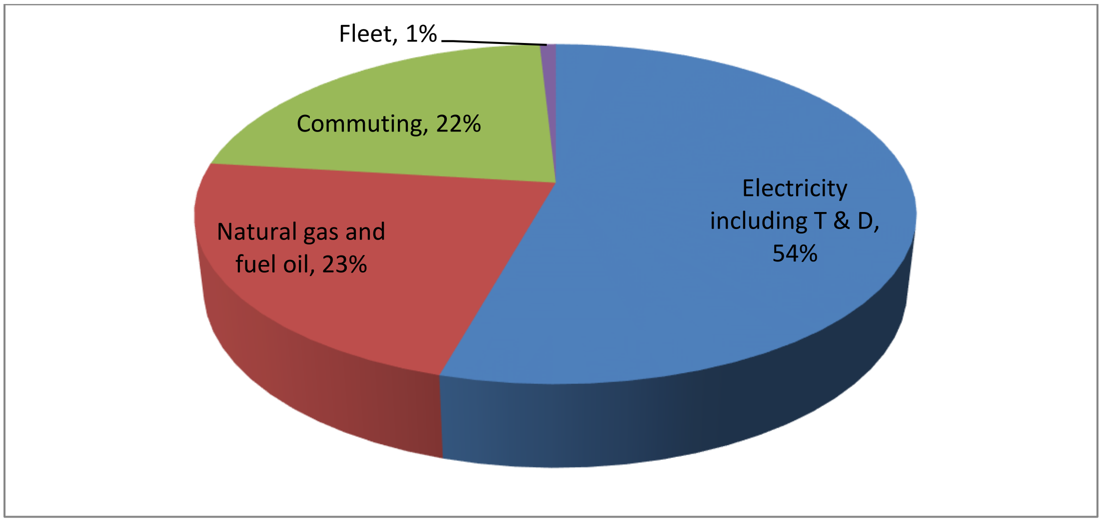
Main Emission Sources	FY2012	FY2013	FY2014	FY2015	FY2016	Percent change
Natural Gas and Fuel Oil	10,970	12,234	12,852	11,632	10,908	-0.6%
Electricity	24,864	24,728	23,213	23,093	23,931	-3.8%
T&D Losses[1]	1,537	1,528	1,435	1,427	1,479	-3.8%
Electricity Total	26,401	26,256	24,648	24,520	25,410	-3.8%
Fac/Staff Commuting	2,716	2,797	3,053	2,502	2,806	+3.3%
Student Commuting	8,086	7,943	7,420	7,901	6,548	-19.4%
Commuting Total	10,802	10,740	10,473	10,403	9,354	-13.4%
Vehicle Fleet	417	372	248	269	218	-47.7%
Total	48,590	49,602	48,221	46,824	45,890	-5.6%
Total Carbon Footprint[2]	48,630	49,656	48,285	46,981	45,941	-5.5%

[1]Transmission & Distribution losses from the power plant to MSU
[2]The total carbon footprint also includes minor contributions (<1% of the total) from fertilizer use, solid waste disposal, and waste water treatment.

V. Relative contributions of major sources of GHG emissions

The relative contribution of each of the main sources of emissions to the FY 2012 total carbon footprint are shown below.

Figure 1. FY 2012 baseline emissions by activity at MSU, M



Electricity (including that which is lost by transmission and distribution between the power plant and MSU, M) was responsible for 54% of campus emissions in FY 2012, followed by natural gas and fuel oil combustion for heating at 23%, commuting emissions at 22%, and vehicle fleet emissions at 1%. There was not much change in these percentages between FY 2012 and FY 2016: in FY 2016, the percentages were 55% for electricity including T & D, 24% for natural gas and fuel oil, 20% for commuting, and less than 1% for the University fleet.

VI. Trends in Total GHG Emissions

Looking at the total carbon footprint, Table 1 shows a decrease by 5.8% between FY 2012 and FY 2016. The general trend is shown in Figure 2 – first an increase in FY 2013 from the baseline, then a gradual decline. Some of this annual variation is due to the effects of weather on the consumption of natural gas and fuel oil for heat. The winter of 2012-2013 (FY 2013) was colder than the winter of 2011-2012 (FY 2012), so more natural gas and fuel oil were combusted for heat and there were correspondingly more GHG emissions. However, the winters of FY 2014, FY 2015, and FY 2016 were also colder than FY 2012, so the decline after FY 2013 is due to other factors.

Variations due to weather can be eliminated and weather effects normalized to the baseline year by calculating what the consumption of natural gas and fuel oil for subsequent winters would have been had they been just as mild as FY 2012. The normalization was done with a heating degree day method, described in Appendix A. Weather-normalized updates along with the baseline footprint are shown in Table 2 and plotted in Figure 3.

Figure 2. MSU, M carbon footprints, baseline and updates, FY 2012 through FY 2016

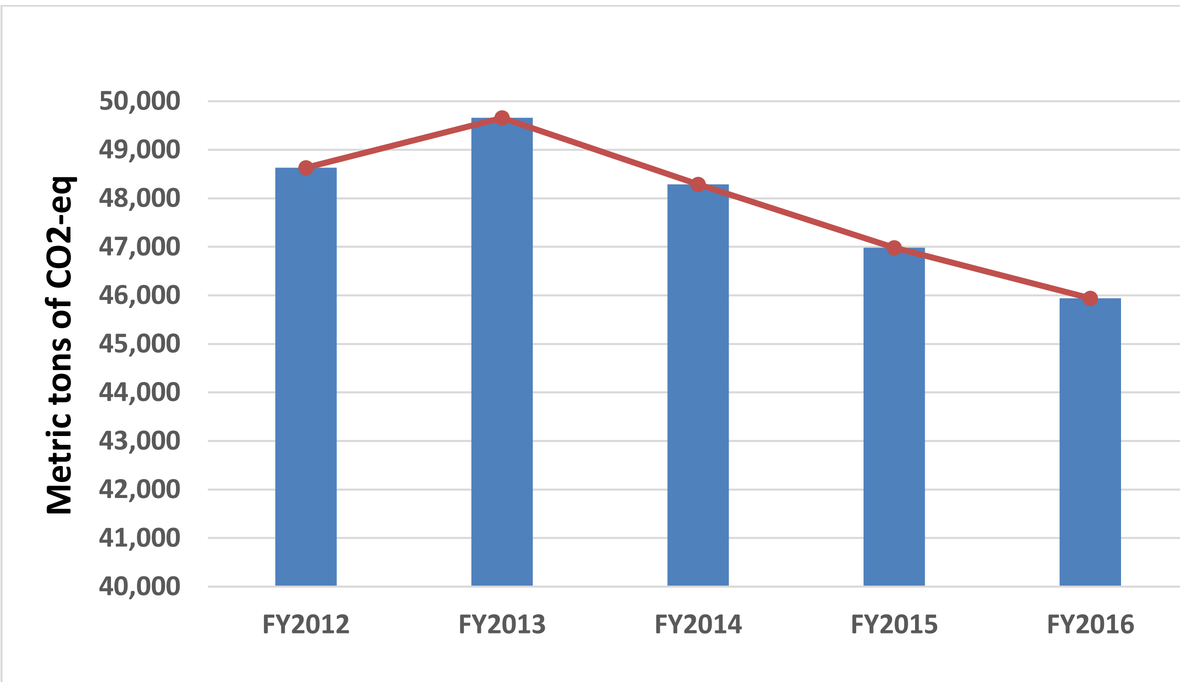
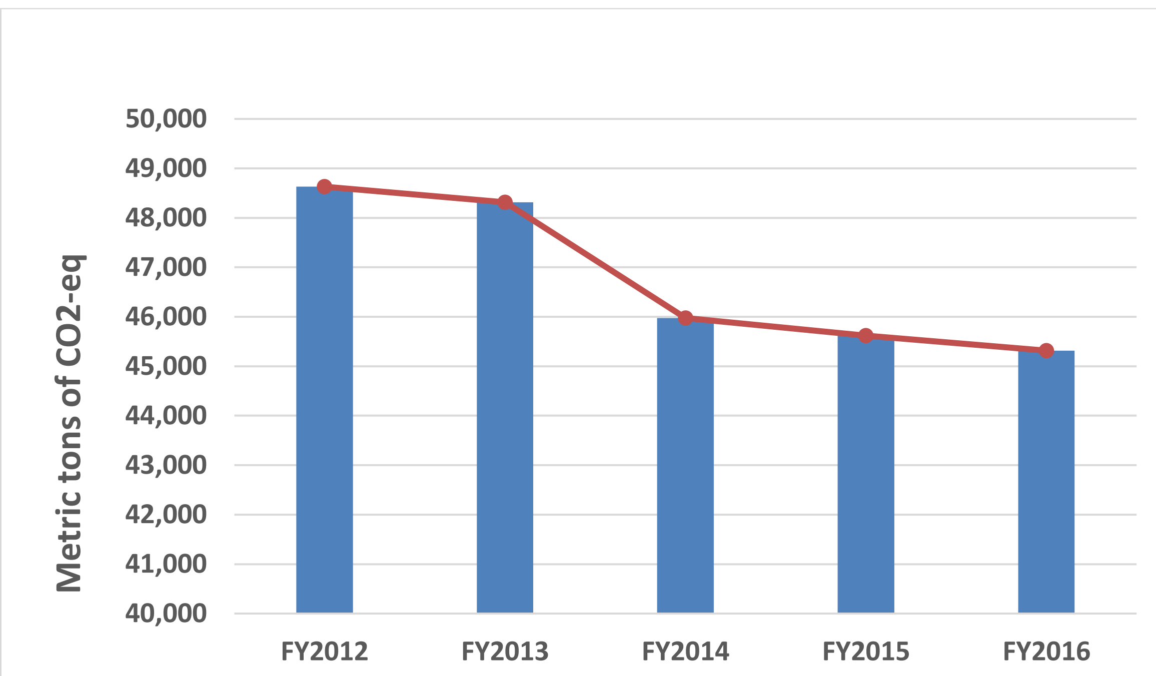


Table 2. MSU, M greenhouse gas emissions baseline (FY 2012) and weather-normalized annual updates, in metric tons of CO2-equivalent

Main Emission Sources	FY2012	FY2013	FY2014	FY2015	FY2016	Percent change
Natural Gas and Fuel Oil	10,970	10,893	10,545	10,283	10,283	-6.3%
Electricity	24,864	24,728	23,213	23,093	23,931	-3.8%
T&D Losses[1]	1,537	1,528	1,435	1,427	1,479	-3.8%
Electricity Total	26,401	26,256	24,648	24,520	25,410	-3.8%
Fac/Staff Commuting	2,716	2,797	3,053	2,502	2,806	+3.3%
Student Commuting	8,086	7,943	7,420	7,901	6,548	-19.0%
Commuting Total	10,802	10,740	10,473	10,403	9,354	-13.4%
Vehicle Fleet	417	372	248	269	218	-47.7%
Weather-normalized Total	48,590	48,261	45,914	45,475	45,265	-6.8%
Total Weather-normalized Carbon Footprint[2]	48,630	48,315	45,978	45,618	45,316	-6.8%

Figure 3. Weather-normalized MSU, M carbon footprints, baseline and updates, FY 2012 through FY 2016



The only difference between Table 2 (weather-normalized footprints) and Table 1 (non-normalized footprints) is in the Natural Gas and Fuel Oil row and the Total and Total Carbon Footprint rows; to emphasize this, the shading of these rows is different in Table 2. After adjusting for the effects of weather, the changes in GHG emissions seen in Table 2 are generally under the control of the University as a whole, or departments and offices within the University, or individual students, faculty and staff[1].

VII. Trends in GHG emissions from major sources

When controlled for the weather, the weather-normalized carbon footprint of the University decreases by 6.8% between FY 2012 and FY 2016. In fact, there is a decrease in emissions for *each* of the four major sources: the decrease in natural gas and fuel oil emissions is 6.3%; for electricity, 3.8%; for commuting, 13.4%; and for the vehicle fleet, 47.7%. Emissions decreases for electricity and T & D losses in Table 2 are both 3.8% because the UNH CCC calculator simply multiplies electricity usage by a factor to take into account average T & D losses. The decrease in emissions was greatest for the vehicle fleet at 47.7% but the effect of this decrease on the total footprint was minor because the fleet contributes only 1% to total emissions.

Of more importance are the emissions decreases for the other three major sources. Both the natural gas and fuel oil emissions decrease of 6.3% and the total electricity emissions decrease of 3.8% can be attributed to the Public Buildings Enhanced Energy Efficiency Program (PBEEEP), administered by the State of Minnesota and brought to campus by former Assistant Vice President of Facilities Management Ron Fields in 2012. In this program, a team of consultants came to campus during Spring Semester 2012 and identified changes in the operation of heating, ventilation, and air-conditioning (HVAC) systems to make the HVAC systems more efficient; the modifications they identified included adjusting equipment schedules to match occupancy and adjusting set points and temperature resets, among other things.

[1] There are other, societal factors which influence GHG emissions which are not taken into account in this study. The UNH CCC tool used in this study to calculate GHG emissions uses emission factors for each activity. For example, for electricity the emission factor is 0.000699 metric tons of CO_2-equivalent for each kilowatt-hour of electricity produced in the north-central region of the U.S. As electricity providers like Xcel move toward more renewable sources of electricity such as wind and solar, the emission factor goes down. Likewise, the emission factor for motorized vehicles is trending downward as vehicles become more fuel-efficient. However, all the UNH CCC emission factors used in this study are constant over the period FY 2012 through FY 2016. This constancy is in part a reflection of the difficulty in keeping all the emission factors in the UNH CCC tool updated over the entire U.S. In other words, the UNH CCC tool overestimates somewhat the electricity emissions and commuter emissions at MSU, M.

Their recommendations were then implemented by Facilities Management at the end of Fall Semester 2012. The effect of these adjustments was first seen in FY 2014, as is evident in Figure 3.

Because of the tweaking of the HVAC systems on campus, natural gas consumption was reduced by 120,000 therms a year and electricity consumption by 2,200,000 kWh a year, resulting in a reduction of GHG emissions of 2,200 metric tons of CO_2-equivalent a year and an energy cost savings to the University of more than $220,000 a year. By comparison, the net cost of the program to MSU, M after federal stimulus funds and utility rebates was $13,000, yielding a payback time of less than a month.

Total commuting emissions decreased by 13.4% from FY 2012 to FY 2016. Because there are many more student commuters than faculty or staff (students comprise 90% of the total campus population) students are the primary driver of commuting emissions. Student commuting emissions decreased by 19.0%, whereas faculty and staff commuting emissions actually increased by 3.3% over this period. Analysis of the commuter survey data reveals that the main reason for the student commuting emissions decline is the increase in the number of students either walking to and from campus or not commuting at all, rather than driving alone; see Appendix B, Commuter Surveys, for details.

VIII. Benefits to MSU, M of the baseline carbon footprint and the updates

The most obvious benefit of the baseline carbon footprint and the updates to MSU, M is that, looking at the trends, we can measure progress (or lack thereof) in reducing the University's GHG emissions, and identify the strategies that are most effective in reducing emissions. But there are other benefits as well. The analysis of the natural gas, fuel oil and electricity data to calculate GHG emissions also shows trends in energy and electricity usage and cost, and allowed the calculation of the energy and cost savings of the PBEEEP program. For these sources, GHG emission analysis goes hand in hand with energy and electricity usage and cost analysis, which allows the University to keep tabs on its energy and electricity usage and cost.

Other benefits are not as direct but just as real. For one, availability of the data on the B3 website and the data from the commuter surveys as well as other data sources for the footprint and updates can suggest a wealth of research questions to be pursued by faculty and students. For example:

- Electricity usage is weather-related, just as natural gas and fuel oil usage is. In the summer, more electricity is required for air-conditioning on hot and humid days than on cooler and less humid days. Is it possible to determine how much electricity is used for air conditioning and study the weather-related and non-weather-related uses of electricity separately?
- With the addition of new buildings such as the Clinical Sciences Building and the new Dining Hall, it is likely that a better metric for year-to-year comparisons is metric tons of CO_2-equivalent / square foot rather than just metric tons of CO_2-equivalent. What happens to previous comparisons if made in terms of CO_2-equivalent / square foot?
- The Green Transportation Fee has resulted in more and more bus rides by students, faculty and staff on bus routes that serve the campus. Can the effect of the Green Transportation Fee be seen from an analysis of commuter survey data?
- There is some uncertainty in the commuting emissions calculated from the commuter surveys because only a sample of the campus population participates in the surveys. Can the uncertainties in the survey results be calculated?

These are only a small sample of research questions about the baseline carbon footprint and updates that can be addressed with the available databases. Other questions are limited only by the imaginations of students and faculty.

Finally, the support of the University for the baseline carbon footprint and updates as well as for other sustainability initiatives, including the climate action plan, is a testament to its commitment to work toward sustainability, one of the foremost challenges faced by the world community in the 21st century. Studies show that prospective students give preference in their choice of college or university to schools that have made a demonstrable commitment to sustainability. Many prospective donors as well will look favorably on a modern university that has made such a commitment.

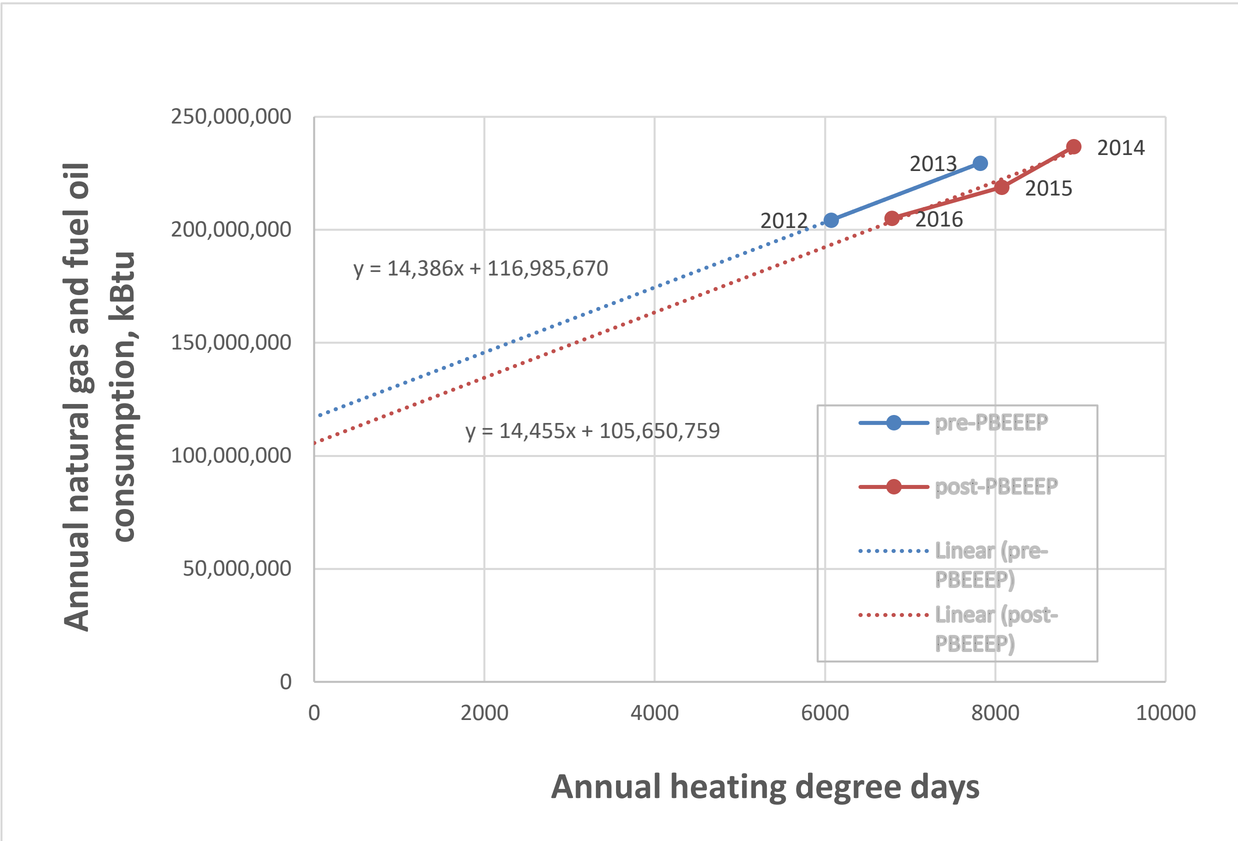
Appendix A. Weather normalization of heating data

Natural gas and fuel oil usage for a particular heating season (July 1, 2012 through June 30, 2013, for the first update year, for example) are normalized to the baseline year by using a heating degree day method. The idea of a heating degree day is based on the observation that the colder it is outside, the more heat is required to keep the inside of a building at a baseline temperature, taken to be 65 ^{o}F. Furthermore, the heat required increases in proportion to the difference between 65 ^{o}F and the outside temperature. A heating degree day (HDD) is defined as the difference between the average temperature on a particular day during the heating season and 65 ^{o}F. An example will illustrate the idea: if the average outdoor temperature is 35 ^{o}F on January 15, 2017, then the number of HDD for this day is 30; if the average temperature on January 16, 2017, is 5 ^{o}F, then the number of heating degree days for this day is 60. The expectation is that it will take twice as much heat to heat a building on January 16 as it does on January 15.

When the number of HDD for all the days in the heating season (defined as July 1 through June 30 but primarily November 1 through March 31) are added together, one gets the number of HDD for the entire heating season. The amount of energy required to heat a building for the entire heating season is proportional to the total number of HDD in the heating season. For southern Minnesota, the number of HDD in FY 2012 was 6071; in FY 2013, which had a colder winter, the number of HDD was 7824. The number of HDD in FY 2014, FY 2015, and FY 2016 (all colder than FY 2012) were 8923, 8075, and 6786, respectively.

Figure A1 shows the total annual MSU, M fuel consumption for heat plotted versus the annual heating degree days from FY 2012 through FY 2016. From the figure it can be seen that the FY 2013 heating season was colder than FY 2012 (there were more HDD in FY 2013 than in FY 2012), and more heat was required to heat the campus buildings in FY 2013 than in FY 2012. Likewise for FY 2014, FY 2015 and FY 2016: FY 2014 was the coldest and required the most heat. The straight line through the data points for FY 2014, FY 2015 and FY 2016 shows the heat required to heat the buildings increased proportionately with the severity of the heating season as measured by HDDs. The data points for FY 2012 and FY 2013 are on a different, higher line because of the effect of PBEEEP, implemented during Spring Semester 2013.

Figure A1. Weather dependence of MSU, M fuel consumption for heat, FY 2012 through FY 2016



A more energy-efficient operation at MSU, M means fewer kBtus of heat energy required for the same number of degree days. The energy saved by PBEEEP, found from the graph by determining the vertical distance in kBtu from the FY 2012 data point to the red line below, is 12,500,000 kBtu a year.

To normalize the heat consumption for FY 2013 to the baseline year of FY 2012, the FY 2013 heat consumption was calculated assuming that the FY 2013 winter was just as severe as the FY 2012 winter; in other words, that the number of HDD was the same. Graphically, this means sliding the point for FY 2013 down the blue line until it coincides with the point for FY 2012 at 6071 HDD, and reading the normalized heat consumption off the y-axis (Annual natural gas and fuel oil consumption, kBtu) of the plot. Likewise, normalizing the heat consumption for fiscal years 2014, 2015, and 2016 means sliding the points for these fiscal years down the red line to 6071 HDD (the point on the red line just below the FY 2012 point), and, as before, reading the normalized heat consumption off the y-axis.

Appendix B. Commuter surveys

GHG emissions from commuting were estimated by emailing a commuter survey to all members of the University community every spring. Respondents identified themselves as students, faculty or staff, and were asked the distance of their typical one-way commute to campus and the mode of transportation they typically used to get to campus on each day of the work week, Monday through Friday. Modes of transportation included in the survey were: drive alone, carpool, bus, bike and walk. There were also three responses to choose from if the respondent didn't commute on a particular day: telecommute; compressed work week, day off; and don't commute this day. From the responses and the GHG emissions factors for motorized vehicular travel, the GHG emissions for the respondents were calculated, then scaled up to estimate the commuting emissions for the University community as a whole. Two other questions were also asked to elicit strategies for reducing commuting emissions: If you drive alone, indicate the reason for doing so; and, Which commuting programs/incentives would be most effective in switching your primary commuting mode away from driving alone? The commuter survey questions are shown at the end of this section. Results of the commuter surveys are shown in Table B1 below.

Table B1. Commuting trips at MSU, M by percent of each mode

Students	Drive Alone	Carpool	Bus	Bike	Walk	Tele commute	Compressed Week	Don't Commute	Total Not Commuting
2016	24.9%	4.0%	13.0%	1.3%	41.2%	0.9%	0.1%	14.7%	15.7%
2015	28.2%	3.7%	14.3%	2.2%	36.4%	1.6%	0.2%	13.4%	15.2%
2014	27.8%	3.9%	12.6%	3.4%	38.7%	0.5%	0.3%	12.7%	13.5%
2013	30.2%	4.2%	13.3%	3.9%	34.2%	1.7%	0.3%	12.2%	14.2%
Faculty	**Drive Alone**	**Carpool**	**Bus**	**Bike**	**Walk**	**Tele commute**	**Compressed Week**	**Don't Commute**	**Total Not Commuting**
2016	62.5%	6.1%	4.3%	0.2%	13.7%	4.3%	0.7%	8.3%	13.3%
2015	67.6%	5.4%	0.7%	2.0%	12.3%	4.0%	1.6%	6.5%	12.1%
2014	74.1%	2.4%	1.8%	2.7%	10.0%	3.3%	0.8%	4.9%	9.0%
2013	68.8%	6.7%	1.6%	3.8%	6.6%	4.1%	0.3%	8.1%	12.5%
Staff	**Drive Alone**	**Carpool**	**Bus**	**Bike**	**Walk**	**Tele commute**	**Compressed Week**	**Don't Commute**	**Total Not Commuting**
2016	82.5%	7.8%	1.4%	2.9%	3.6%	0.8%	0.1%	0.9%	1.8%
2015	76.8%	11.6%	1.1%	1.9%	6.6%	0.6%	0.6%	0.6%	1.9%
2014	82.0%	6.2%	0.8%	3.0%	5.3%	0.9%	0.3%	1.5%	2.7%
2013	83.7%	7.8%	1.0%	2.9%	3.0%	0.4%	0.2%	1.0%	1.7%

The first commuter survey was conducted in the spring of 2013. Since no survey was done in 2011 – 2012, the results of the spring 2013 survey were used to determine the commuter emissions for the previous FY 2012 baseline year as well as for the first update of the footprint in FY 2013.

Commuter emissions depend on the percentage of each mode employing motorized vehicles (drive alone, carpool, and bus) and also on the average commuting distance for each mode. Average commuting distances are shown in Table B2 below.

Table B2. Average commuting distances for different modes of commuting

Students	Drive Alone	Average Round trip Drive distance, mi	Carpool	Average Round trip Carpool distance, mi	Bus	Average Round trip Bus distance, mi
2016	24.9%	28.6	4.0%	28.6	13.0%	3.4
2015	28.2%	30.7	3.7%	30.7	14.3%	3.5
2014	27.8%	28.9	3.9%	28.9	12.6%	3.4
2013	30.2%	28.3	4.2%	28.3	13.3%	3.9
Faculty	**Drive Alone**	**Average Round trip Drive distance, mi**	**Carpool**	**Average Round trip Carpool distance, mi**	**Bus**	**Average Round trip Bus distance, mi**
2016	62.5%	24.1	6.1%	24.1	4.3%	4.8
2015	67.6%	24.7	5.4%	24.7	0.7%	8.0
2014	74.1%	26.7	2.4%	26.7	1.8%	8.0
2013	68.8%	22.6	6.7%	22.6	1.6%	10.9
Staff	**Drive Alone**	**Average Round trip Drive distance, mi**	**Carpool**	**Average Round trip Carpool distance, mi**	**Bus**	**Average Round trip Bus distance, mi**
2016	82.5%	23.4	7.8%	23.4	1.4%	3.7
2015	76.8%	17.7	11.6%	17.7	1.1%	3.1
2014	82.0%	21.1	6.2%	21.1	0.8%	8.0
2013	83.7%	21.5	7.8%	21.5	1.0%	6.3

In Table B3 below is shown the number of student, faculty and staff respondents for each of the surveys. As can be expected in any survey, not all respondents answered the questions as anticipated. If, when asked, Select the mode of transportation you typically use to get to campus each day, the respondent selected more than one answer for one or more days of the work week (Monday through Friday), or no answer at all, or did not answer the question, What is the distance of your typical commute?, then the response was disregarded and not used in the analysis. Both the total response rate and the correct response rate are given in Table B3.

Table B3. Commuter Survey Response Rates and Correct Response Rates

Students	**Total**	**Responses**	**Response Rate**	**Correct Responses**	**Correct Response Rate**	**Correct Responses/Responses**
2016	13,477	877	6.5%	658	4.9%	75.0%
2015	13,630	940	6.9%	703	5.2%	74.8%
2014	13,745	889	6.5%	633	4.6%	71.2%
2013	13,765	698	5.1%	566	4.1%	81.1%
2012	14,014					
Faculty	**Total**	**Responses**	**Response Rate**	**Correct Responses**	**Correct Response Rate**	**Correct Responses/Responses**
2016	760	107	14.1%	89	11.7%	83.2%
2015	759	132	17.4%	111	14.6%	84.1%
2014	761	126	16.6%	102	13.4%	81.0%
2013	754	159	21.1%	146	19.4%	91.8%
2012	746					
Staff	**Total**	**Responses**	**Response Rate**	**Correct Responses**	**Correct Response Rate**	**Correct Responses/Responses**
2016	819	180	22.0%	174	21.2%	96.7%
2015	848	182	21.5%	158	18.6%	86.8%
2014	881	199	22.6%	132	15.0%	66.3%
2013	861	240	27.9%	231	26.8%	96.3%
2012	824					

In Table B1, for the first year of the commuter survey (FY 2013) some comparisons among students, faculty and staff stand out:

- Students lead in four modes of commuting: Walk, Total not commuting, Bus, and Bike.
- Faculty lead in two modes: Telecommute and Compressed Week
- Staff lead in two modes: Drive and Carpool

There are also some notable trends from FY 2013 through FY 2016:

- For students, there is a 5.3% decrease in Drive Alone, which is roughly matched by a 6.8% increase in Walk.
- Also for students, there is a 2.7% increase in Don't Commute and a 1.5% increase in Total not Commuting.
- For faculty, there is a 6.3% decrease in Drive Alone, which is roughly matched by a 7.1% increase in Walk.

Since students make up approximately 90% of the campus population, most of the 13.4% decrease in overall commuting emissions from FY 2013 through FY 2016 is a result of changing patterns in student commuting. Fewer students are driving alone, and more are walking or simply not coming to campus at all on a particular day. Increasing numbers of faculty walking rather than driving alone also contributes somewhat to the overall decline.

Appendix C. Commuter Survey Questions

As part of our effort to calculate Minnesota State Mankato's environmental impact, we are seeking your input to assess the current commuting habits of students, staff, and faculty to campus. The following survey asks about your typical commuting practices. The survey should take approximately 3 minutes – please fill out the information below by April 22, 2016.Students: Enter your email address at the end of the survey for a chance to win a $25 gift card to the campus Barnes and Noble bookstore. Thank you in advance for your cooperation and assistance with this program!

1. How do you classify your role at MSU, Mankato?

- ❍ Student
- ❍ Staff
- ❍ Faculty

2. Do you live on Campus?

- ❍ Yes
- ❍ No

3. What is the distance of your typical commute in miles (one way only)?

- ❍
- ❍ 1-2.9 miles
- ❍ 3-4.9 miles
- ❍ 5-9.9 miles
- ❍ 10-14.9 miles
- ❍ 15-19.0 miles
- ❍ 20-24.9 miles
- ❍ 25-29.9 miles
- ❍ 30-39.9 miles
- ❍ > 40 miles

4. Select the mode of transportation you typically use to get to campus each day of the Monday through Friday work week. If you use multiple modes of transportation, choose the one you use for the greatest distance. If you do not travel to campus on a typical day, select one of the options indicating why (Telecommute, Compressed Work Week, Don't Commute This Day). You should only have 5 (five) check marks, one for each day of the work week.

	Mon	Tue	Wed	Thur	Fri
Drive Alone	❑	❑	❑	❑	❑
Carpool (more than one person in vehicle)	❑	❑	❑	❑	❑
Bus	❑	❑	❑	❑	❑
Bike	❑	❑	❑	❑	❑
Skateboard	❑	❑	❑	❑	❑
Walk	❑	❑	❑	❑	❑
Telecommute	❑	❑	❑	❑	❑
Compressed work week day off (4/40, 3/36, 9/80)*	❑	❑	❑	❑	❑
Don't Commute This Day	❑	❑	❑	❑	❑

*Compressed work week is an option for staff; it is defined as working a standard number of hours in fewer than five days by working longer hours (i.e., four 10hour days).

5. If there is another mode of transportation that you occasionally (but not typically) use that you did not select in Question 4, choose the mode from the list below. Indicate the percent of time you use the secondary mode over the course of a year in Question 6.

❍ Drive Alone
❍ Carpool
❍ Bus
❍ Bike
❍ Skateboard
❍ Walk
❍ Telecommute
❍ Compressed Work Week
❍ Other (please specify) ____________________

6. What percent of time do you use this secondary source?

______

7. If you Drive Alone, indicate the reason for doing so (select all that apply)

- ❑ Need car for errands
- ❑ Saves time
- ❑ Classes in different location on campus
- ❑ Want car for emergencies
- ❑ No one to carpool with
- ❑ Save money
- ❑ Need car for work
- ❑ Need car because of children
- ❑ No public transit stops near where I live
- ❑ Other ____________________

8. Which commuting programs/incentives would be most effective in switching your primary commuting mode away from Drive Alone (select all that apply).

- ❑ Guaranteed ride home for emergencies
- ❑ Higher Drive Alone parking costs
- ❑ Carpool incentives (reduced parking costs or reserved parking for carpoolers)
- ❑ Assistance finding carpool partners
- ❑ Secure bike racks/lockers
- ❑ Assistance finding bike routes to campus
- ❑ Bike repair options on campus
- ❑ Subsidized transit passes
- ❑ Increased public transit service
- ❑ More options related to class scheduling
- ❑ More classes offered through distance learning
- ❑ Shower facilities on campus
- ❑ Other ____________________

9. Students: Enter your email address for a chance to win a gift certificate to the campus Barnes and Noble bookstore (optional)