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McPherson College's Comprehensive Carbon Footprint and a List of Ways to Reduce Our Environmental Impact

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ABSTRACT

The topic of global warming has become a national and global issue over the past few decades. As average temperatures slowly rise, there has been a push to find the cause of these changes. Research has shown that there are six greenhouse gases that are in large part responsible for the changes in the atmosphere: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. This research was done to find the carbon footprint of McPherson College so we may begin to understand our environmental impact. The carbon footprint was calculated with the use of the Campus Carbon Calculator™ provided by Clean Air-Cool Planet®. Information about electricity and natural gas use was collected to use in these calculations. Average carbon emissions at McPherson College over the past nine years were calculated at 4234.5 metric tonnes eCO_2. This is an average of 9.63 metric tonnes of carbon dioxide per person. This number is similar to other college campuses in the United States. It is conceivable with the right sustainability plan that McPherson College could decrease its environmental impact and ultimately lower its carbon footprint.

Keywords: *carbon footprint, carbon emissions, greenhouse gases, McPherson College, renewable resources*

INTRODUCTION

In 1997 the Kyoto Protocol was adopted by many nations across the globe in an effort to curb global warming. The treaty's aim was to encourage countries to reduce emissions of the six main greenhouse gases that contribute to the effects of global warming: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. While specific targets were set for each individual country, the overall target was a five percent reduction based on levels of greenhouse gases obtained in 1990. Although the treaty has been ratified by over 130 countries since 2005, the United States has yet to join this growing faction ("Kyoto Protocol", 2008). Since then there have been numerous reforms made in various countries to try to slow the effects of global warming. In December 2009 the Copenhagen Climate Council met to establish a new manifesto in order to carry on the goals of the original Kyoto Protocol, which ends in 2012. The council provides business leaders with innovative, constructive, and meaningful ways to tackle global climate change. The Copenhagen Accord declares that average temperature increases should be kept below two degrees Celsius, and clearly states goals for maximum levels of greenhouse gases in the year 2050.

Due to the current rates of global warming, predictions forecast a rise in average temperatures to be as much as 11.5 degrees Fahrenheit, and ocean levels to rise as much as 23 inches before the end of the century (Brown, 2003). These changes have a negative impact on our world, causing large-scale health, social, economic and ecological effects (Sweet, 2006). While humans cannot control the natural cycles of the earth, we can do our best to limit our impact on the environment.

Global warming, as the name suggests, affects the entire globe. Climate changes are not limited to those countries that are the largest contributors of greenhouse gas emissions. The United States alone accounts for 22 percent of the world's carbon dioxide emissions, and yet our population is only four percent of the world's total population. That means that Americans as a whole are emitting over 5,815,000,000 tons of carbon dioxide on average into the atmosphere every year (Jackson, 2008). To be competitive with the decrease other industrialized countries have attained, the U.S. would have to achieve an immediate 25 percent reduction (Sweet, 2006). As a nation, the United States is beginning to realize that becoming environmentally friendly requires changes. Furthermore, these changes need to be applied at every level of society. To become completely carbon neutral, a community must reduce its carbon emissions to zero. This is done by using renewable resources that produce zero carbon emissions such as wind and solar energy. To compensate for any emissions that cannot be completely eliminated, communities can purchase carbon offsets, which are credits that fund environmental projects such as the construction of wind farms.

This is where McPherson College enters the scene. As an institute of higher learning, the college prepares students for the future, and in doing so, the college represents the future. The goal of this research is to help McPherson College join the growing faction of colleges and universities that have decided to aim for carbon neutrality.

The study is comprised of two components. The first portion describes the calculation of McPherson College's carbon footprint and the results. Many

colleges and universities across the nation have made large steps toward becoming carbon neutral. Because of this trend, there is now an abundance of accessible programs that are designed to direct campuses through the process of calculating their total carbon emissions. The Campus Carbon Calculator™ provided by Clean Air-Cool Planet® was used as a guide to decipher the college's environmental impact.

The second portion of the study consists of strategies to assist McPherson College in reducing carbon emissions. It includes solutions that could be put into action immediately at no cost to the college (some of which may actually save the college money), as well as some that will require a period of planning and saving before they can be implemented. Possibilities include the installation of a wind turbine and recreating the plans for the new dormitory to make it an eco-friendly building. Turning McPherson College into a "green" campus will require time, effort, and support from the community at large, but it will give the college an ecological advantage in the long run.

MATERIALS AND METHODS

To begin to understand McPherson College's environmental impact I started by calculating the college's carbon footprint. This was achieved with the use of the Campus Carbon Calculator™ made by Clean Air Cool Planet®, a non-profit organization that encourages campuses, businesses, and communities to reduce their carbon emissions. The calculator is an extensive Excel© spreadsheet that guides the user through the necessary steps of calculating a carbon footprint. This required gathering information about energy use in previous years, which is then used to produce details of emissions on campus. The calculator uses emission factors that were determined by the GHG Protocol Imitative and is based on the workbooks that were originally created by the Intergovernmental Panel on Climate change.

The calculator can be divided into three core sections: past energy use, projected future energy use, and future reduction programs. Each of these sections requires input from the user, which is then used to calculate the results. The user can decide how broad of a scope they would like to use for their calculation of the carbon footprint. There are three scopes that were used in the calculation of this carbon footprint. This means that beyond calculating direct emissions, indirect emissions that come from outside sources, but whose products are directly linked to on-campus energy consumption (purchased electricity) were also included. Emissions from sources that are directly financed by the college or are linked to the campus due to necessity or encouragement were also included (faculty commuting). Information dating back to the year 2000 was used. Most of the information needed was obtained through records kept by the college, as well as contact with the McPherson Board of Public Utilities and Kansas Oneok. Faculty and staff commuting was included in the calculation of the carbon footprint, but student commuting was not included.

Once data was collected and entered into the calculator, it was used to create graphs and tables that demonstrate carbon emissions of McPherson College. Emissions were calculated for each of the six greenhouse gases. Total emissions were calculated as carbon dioxide equivalents (eCO_2). A carbon dioxide equivalent is a metric measurement used to compare the emissions of the six main greenhouse gases based on their global warming potential (GWP). Total emissions were then compared to the carbon footprints calculated by a number of other colleges and universities.

The second half of this project entailed creating plans to help McPherson College reduce its emissions. Many of the initial strategies are simple solutions that can be put into practice without any financial cost to the college, but do require support from the campus community. The Student Government Association at McPherson College has recently established an Environmental Committee and is looking in to starting a campaign on campus to make some of these changes in the next few years.

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RESULTS

The results of this research describe the carbon footprint of the McPherson College campus.

Table 1. Campus energy consumption and CH_4, NO_2 and CO_2 production over the last nine years.

Year	Energy	CH_4	NO_2	eCO_2
	MMBtu	kg	kg	Tonnes
2000	52,994.90	165.0	61.7	3,767.00
2001	57,212.00	167.9	69.8	4,134.30
2002	60,914.00	170.2	73.3	4,419.60
2003	60,441.40	163.1	74.3	4,421.40
2004	62,426.50	161.8	78.1	4,602.80
2005	60,167.60	156.3	75.2	4,434.90
2006	57,999.20	141.1	75.9	4,342.60
2007	59,642.70	155.1	80.2	4,439.70
2008	59,573.60	165.3	76.0	4,357.80

The table above displays the energy consumed on campus and the resulting emissions over the past nine years. The following figures show total emissions, as well as emissions per student and emissions versus building size. Total emissions are reported as carbon dioxide equivalents (eCO_2).

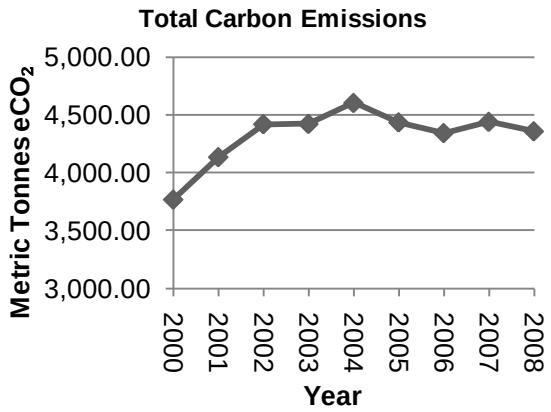

Figure 1. Total carbon dioxide emissions in metric tonnes per year.

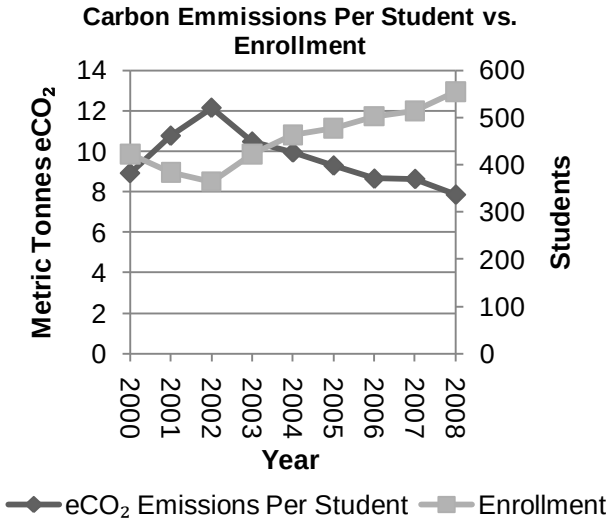

Figure 2. Carbon emissions per student versus total enrollment.

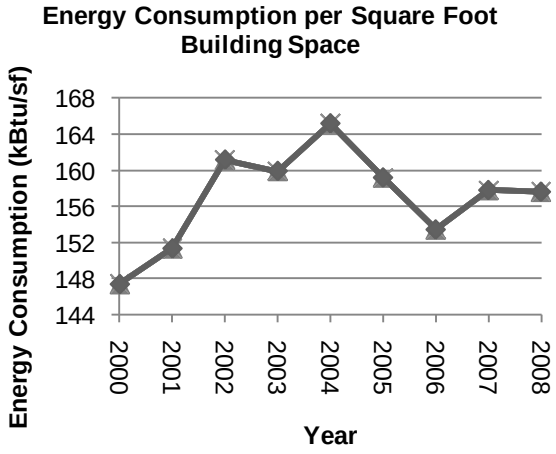

Figure 3. Energy consumption per square foot of building space.

A vast majority of the emissions produced by McPherson College come from the use of purchased electricity. In 2008, for example, 66.1 percent of carbon emissions were associated with the production and consumption of purchased electricity. Only 22.6 percent were the result of gas use, and the remaining 11.3 percent were related to off-campus activity such as employee commuting.

McPherson College's carbon footprint is similar to other college campuses across the United States. Average emissions per student at McPherson College in 2008 were calculated at 7.87 metric tonnes of carbon dioxide per year.

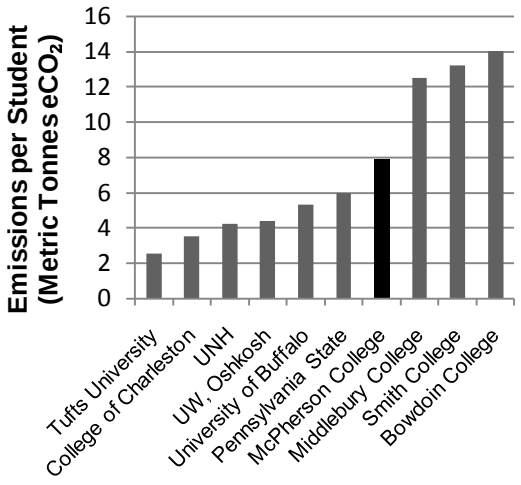

Figure 4. Average carbon emissions per student per year. Data was gathered at each institution using the Campus Carbon Calculator™. Individual figures were taken from research articles cited below.

DISCUSSION

The results of this project shed light on the environmental impact of McPherson College. While the results were very similar to other colleges and universities across the country, they also show that there is very little that is currently being done on this campus to reduce energy use. Certain trends in the data can be correlated to events taking place in those years. The replacement of Harnley Science Hall with the current Melhorn Science Hall in 2001 partially accounts for the increase in carbon emissions in that year. The extensive renovations made to the athletic facilities in 2003, which included the construction of new locker rooms, concession stand, training room, and the installation of a new track and Astroturf field, and the renovations done to Templeton Hall in 2005 are also represented by a peak in carbon emissions (2003-2005).

There is a noticeable relationship between the total enrollment of students at McPherson College and the total carbon emissions per student. This

indirect correlation seems to suggest that although the campus enrollment is steadily increasing, carbon emissions have not been growing at the same rate, therefore leading to fewer carbon emissions per person. This trend is likely due to the increase of students living off campus as enrollment grows.

Energy use per square foot of building space at McPherson College is nearly double the national average of 79.8 kBtu per square foot per year. Commercial buildings that are considered to be energy efficient use as little as 25 to 30 kBtu per square foot per year (EIA Commercial Building Energy Consumption Survey, 2003). At its peak in 2004, McPherson College was using 165.14 kBtu per square foot per year.

While much of the excess energy used on campus is due to individual carelessness, there are several projects that the college could undertake that have the potential to make a large difference. Below are suggested projects to eliminate waste and move towards sustainability.

- Installation of motion sensitive lights in restrooms
    - Benefit-Cost Analysis: These can be purchased for as little as twenty dollars per unit, but would eliminate excess electricity waste in most buildings on campus.
- Thermostat adjustment
    - Benefit-Cost Analysis: By lowering the temperature on the thermostat by even one or two degrees, energy demands would be greatly reduced while saving the college money.
- Turning off computers at night
    - Benefit-Cost Analysis: Most computers on campus are left in sleep mode at night. Instead, computers should be shut off when not in use to save electricity as well as the lifespan of the computer.
- RA's monitor lights and televisions in dorms
    - Benefit-Cost Analysis: If all of the lights and televisions were shut off in the dorms at night it would eliminate waste without costing the college anything.
- Printer Charge
    - Benefit-Cost Analysis: The software for a campus of this size costs ninehundred dollars. Eventually, this project would create revenue for the college and eliminate excess paper waste.
- "Green" Dormitory
    - Benefit-Cost Analysis: The plans for the new dorm should be revamped in order to make the dorm as energy efficient as possible. This will increase the cost of the dorm, but will save money on energy costs in the long run.
- Wind Turbine
    - Benefit-Cost Analysis: A 1.65 Megawatt wind turbine would be sufficient to meet the entire electricity demand of the college. The estimated kilowatt-hour per annum of a 1.65 Megawatt turbine is approximately 5,000,000 KWH and is reported to cost between 1.5 and 2 million dollars (Vestas).

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