

McPherson College's Environmental Impact on Water Use, Energy Use, and Waste Generation/Disposal

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ABSTRACT

The increasing population has had a negative impact on water use, energy use, and waste generation/disposal at global and national levels. Therefore, conservation plans have been created and implemented to address these impacts. For my senior project I investigated the ways in which McPherson College has a negative impact on the environment and suggested a conservation plan that will reduce the effects it has on the environment. Through my research I have analyzed the consequences of the college's actions by collecting data and observing the campus's behavior. My results proved my hypothesis correct, showing that the college has had a relatively negative impact on the environment. The data I collected focused on utility bills, waste audits, and showerhead testing. Electric, water, and waste disposal usage and cost were the greatest during the summer months and natural gas usage and cost were the highest during the winter and fall. The entire campus population contributed to the high cost and usage per capita for electric, water, and waste. The annual electric and waste disposal costs increased in the last five years (1998-2002). The water and natural gas costs decreased, so therefore the over all utility cost decreased. These results suggest that through utility trends, low population, and increasing annual electric and waste disposal costs, McPherson College has had a negative impact on the environment. As a result of testing the showerhead flow rates in each dorm, I have concluded that Dotzour showerheads wasted more water than those in Bittinger and Morrison. Through the waste audits I conducted, I found that the college generated a large amount of non-recyclable waste and disposed food that could be composted and paper that could be recycled. These results are interesting due to the fact that the college has paper-recycling stations available, thus showing that the current recycling program is ineffective. Based on my observations of the college's actions and management polices, I have seen that institutional practices pertaining to water and energy use were wasteful. During the waste audits I observed that the college generated a large amount of waste that could be recycled and disposed of articles that be reused. Through the data I collected and the behaviors I observed I have created a conservation plan for McPherson College that addresses the institution's energy use, water use, and waste generation/disposal.

Keywords: water, energy, natural gas, waste disposal, waste generation, environmental impact, conservation plan

INTRODUCTION

The human population has increased dramatically over a relatively short period of time. Approximately 200,000 years ago a few thousand individuals inhabited the earth. In the 1800's the population surpassed 1 billion and in 1999 it reached 6 billion people (Harrison and Pearce, 2000). The projected population for 2025 is 8.5 billion people (Hjorth, 2000).

Although the specific numerical data was unavailable for global water use and waste disposal/generation per capita, the impact that an increasing population has had on the environment can be seen through the global per capita use of energy. In 2001 the global per capita rate for electricity was 65.7 million BTU per year (Energy Information Administration).

At the national level, water use, energy use, and waste disposal impacts can be seen on the environment. The average water consumption per person is 374 gallons per day (U.S Census Bureau, 2001). It is also estimated that the annual average energy consumption per person in 2001 was 342 million BTU per year (Energy Information Administration). In 1999 each person generated 229.2 lbs of trash per year and 131.9 lbs of trash per year was deposited in landfills (U.S. Census Bureau, 2001).

Due to the environmental impacts of water use, energy use, and waste generation/disposal, a need for conservation is present. The growing demands on the environment have created an urgent demand to link research with improved environmental management (Jackson, 2001). One commonly practiced method that includes research, analysis, and management is a conservation plan. Conservation plans have been implemented in cities, offices, and schools. Austin, Texas, for example, implemented a conservation plan to reduce its extensive water use (Greeg and McReynolds, 1995). As part of the Kitsap Peninsula Vocational Skills Center's conservation plan, triple glazed skylights were installed to reduce its energy use (Donald, 1997). Eastern Illinois University has created a waste disposal conservation plan and implemented a recycling program on campus. In 2001, the campus recycled 56% of its total waste (EPA Waste Wise). Through conservation plans that targeted water use, energy use, and waste generation/disposal, these organizations improved their environmental impact. For my Senior Project, I investigated McPherson College's water use, energy use, and waste generation/disposal trends and analyzed their environmental impact. To address these issues I have

created a conservation plan.

When I approached this study I expected to find that the institution's actions reflect a negative impact. While conducting my research I addressed the following questions: (1) What are the trends in water use, energy use, and waste generation for the past five years at McPherson College? and (2) What can be done to lessen this environmental impact?

MATERIALS AND METHODS

An assessment of the impact the college has had during the past five years was needed to create an accurate conservation plan. My assessment was divided into two different categories - data collection and observation. My data sources varied from utility bills to waste audits. I utilized my observations as a student and resident of McPherson College to assess the college's environmental impact. When I combined both numerical and anecdotal data, I was able to understand the college's environmental impact more broadly and accurately.

Data Collection

Population

I went to the campus registrar's office to collect campus population statistics for the last five years. The population included students, faculty, and staff.

Water

To quantify the impact that the college has had on water use I used two methods and several materials. The first method was to collect water bills from the Facilities Management Office. To acquire accurate data, I collected photostatic copies of water bills from the past five years (1998-2002). They purge their files every five years, therefore, limiting my research.

The second method I used to analyze water use at the college was to measure the flow rate of the water produced by showerheads in each dorm. I went to every shower in all four dorms (Dotzour, Metzler, Bittinger, and Morrison), and ran the water for five seconds into a graduated plastic bag. These two methods gave me a way to analyze the current impact that the college had on the environment and a direction to improve the impact.

Energy

I divided the energy bills into two types – electric and natural gas. I collected photostatic copies of bills for electric use from the City of McPherson's Board of Public Utilities and for natural gas use from Oneok Energy Marketing and Kansas Gas Service.

Waste Generation/Disposal

The waste data was divided into two categories: generation (the quantity of trash created) and disposal (where the trash is taken). To measure the waste

generated at McPherson College I conducted four waste audits by going through the four dumpsters on campus.

I analyzed the disposal trends of the college by collecting photostatic copies of bills from McPherson Area Solid Waste Utility and weighed the amount of paper the college recycles on a weekly basis.

Observation

I used my personal observation of the college's actions and behaviors to gather an understanding of its environmental impact.

RESULTS

Data Gathered

Population

The campus population fluctuated in conjunction with the annual school cycle as evident in Figure 1. The college population was higher in the fall semester and decreased in the spring. Students did not live on campus during the summer months until the summer of 2002. However, this did not cause any drastic change in the population, only gradual decreases among the student population were seen.

Water

Figure 1 also shows the monthly increase in water usage and cost in the fall months over the last five years. The box plots show that in March, July, and September there was a wider range of usage, yet the cost fluctuation was not visible until October and November. The water usage and costs per capita were the largest in the summer months while the fall and spring months remained constant.

The annual water cost decreased every year in a linear fashion with the exception of 2000 (Fig. 2). The annual water cost in 2002 was almost half that of 1998.

The average flow rate for each residence hall can be seen in Figure 3. The standard deviation shows that the showerheads in Dotzour and Metzler varied more than the showerheads in Morrison and especially Bittinger.

Electrical

An increase in electric usage during the fall months is apparent in Figure 1. The range in electrical usage varied from month to month in 1998-2002. While the range remained constant, the electrical usage fluctuated in the months of August and September.

Similar to water usage and costs per capita, the summer months were incredibly high and the spring and fall months were constant. I also found it interesting that the electric costs per capita increased every year since 1998.

The annual electric cost grew in a linear manner over the past five years. Figure 2 explains how this steady increase of cost doubled over time.

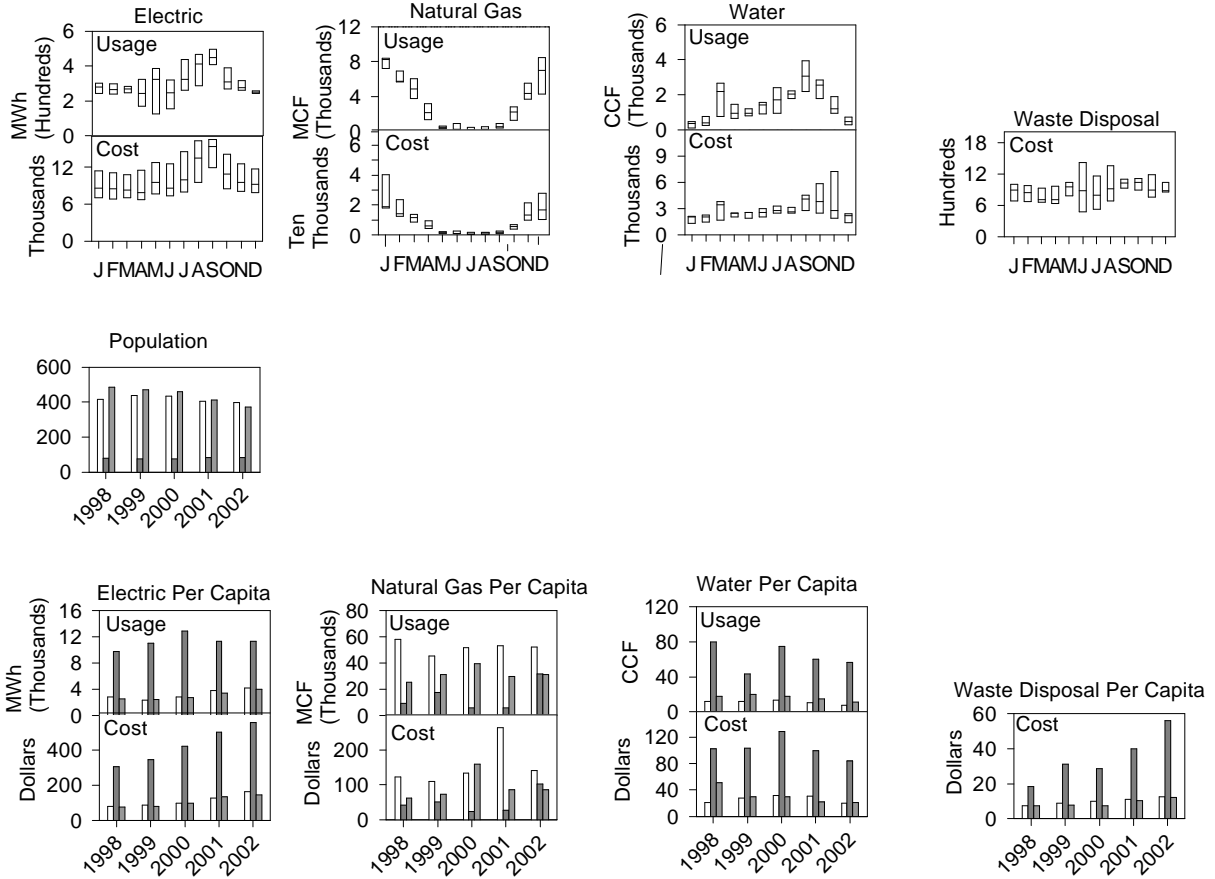


Figure 1. In the first two rows, cost and usage for each utility is depicted in box plot graphs showing the minimum, maximum, and median. In the last two rows, usage and costs per capita are depicted through bar graphs (Fall, Summer, Spring respectively). The population graph was used to calculate the per capita numbers. The unit for cost is dollars and the units for usage are MWh (mega watt hours) for electric, MCF (million cubic feet) for natural gas, and CCF (hundred cubic feet) for water.

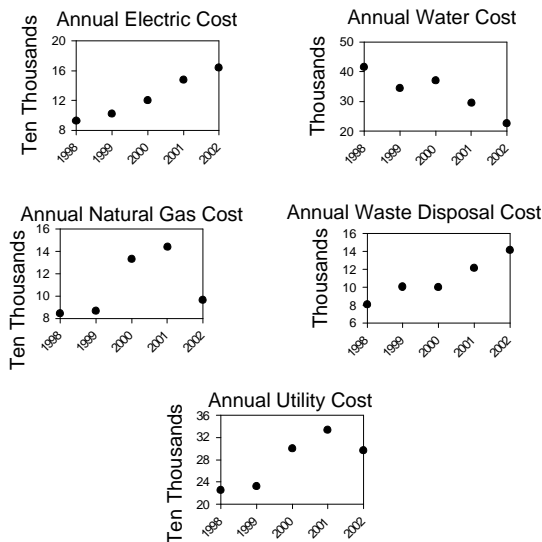


Figure 2. Shows the annual costs (in dollars) for each utility as well as a combined annual utility cost.

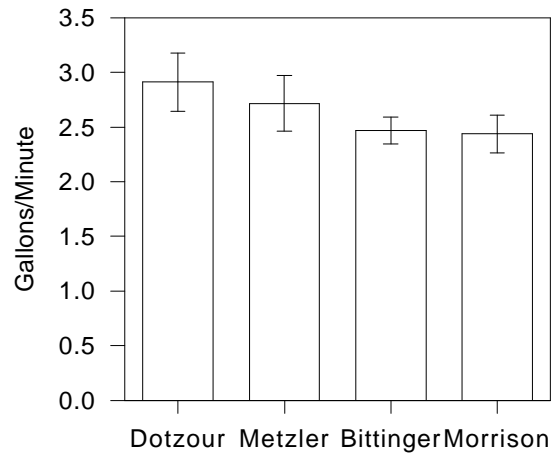


Figure 3. The average flow rate is depicted in this graph for each residence hall in gallons/minute.

Natural Gas

The natural gas cost and usage differed from water and

electric. It was higher in the winter and fall months and lower in the summer months (Fig. 1). The range of natural gas cost and usage decreased in the summer months and varied more during the winter and fall. Unlike electric and water, natural gas cost and use per capita did not peak until fall.

In Figure 2 the annual natural gas costs are depicted. In 1998, 1999, and 2002 the cost were lower than in 2000 and 2001.

Waste Generation/Disposal

Waste disposal cost and costs per capita graphs are shown in Figure 1. Even though the range varied throughout the year, there was little variation in the fall, summer, spring, and winter months. The costs per capita increased during the summer months and were higher at this time. The cost per person was the highest in 2002. The fall and spring months were constant.

Figure 2 shows how the annual waste disposal cost fluctuated over time. In 1998 and 1999 waste disposal costs were relatively constant. In 2000 and 2001 the cost almost doubled before dropping drastically in 2002.

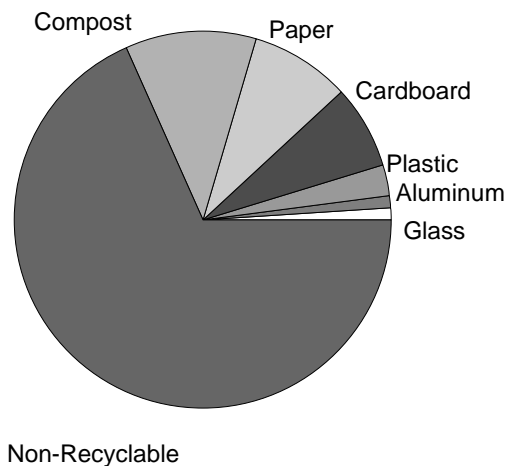


Figure 4. This pie chart breaks down the seven different items found in the dumpster over 2002. These numbers are percentages and were found by weighing each category and dividing by the total weight of the trash.

Waste generation trends can be seen in Figure 4. The waste audit proved that the majority of garbage generated was non-recyclable. Of the recyclable items, similar amounts of compost, paper, and cardboard were found.

Observations

Water

Through my observations, I saw that the college wasted the most water in residence halls and for irrigation purposes. Students turned on the showers and left them running for a certain time period in order to heat the water. Other wasteful behaviors could be seen when students took multiple showers and/or baths a day.

The fescue grass on campus requires a large amount of water. I observed that the college had a tendency to over water the grass as well as run the sprinklers during rain and/or high wind.

Energy

In the residence halls, appliances like televisions and lights were left on in the lobbies, kitchens, and dorm rooms when not in use. The lights in the bathrooms and hallway were left on 24 hours a day.

Natural Gas

I have seen that natural gas was wasted during the wintertime when students ran the heater when not in the room. Other students had windows open when running the heater.

Waste Generation/Disposal

The campus generated the majority of its non-recyclable waste at the cafeteria by using styrofoam products and unnecessary wrapping. By disposing of carpets, lamps, clothes, and other reusable items the college was contributing to the overuse of landfills. The current recycling program is ineffective due to lack of implementation.

DISCUSSION

The above results indicate the impact that the college has had on energy, water, and waste generation/disposal. From these results I have assessed the environmental impact that the college had. The first part of the discussion will analyze the data and explain its significance. The attached conservation plan (Appendix A) proposes possible solutions to the college's behavior.

Population

Population played a major role in the college's environmental impact. Even though the population decreased, usage and costs per capita increased. In this situation, addressing the college's management policies is the only solution.

Water

The college practiced water conservation by decreasing its annual water cost. It installed water saving showerheads in the new residence dorms and plans similar replacements during renovations in the summer of 2003.

Although McPherson College already addressed the

over usage and waste of water, there is still room for improvement. Through my data I found that water rates decreased in the winter while the grass was dormant and peaked in the fall during the prime-planting season. This, combined with my observations, shows that conservation techniques are needed.

Electrical

Through my research and observations I concluded that the college's excessive wastefulness of energy needs the most improvement. The high annual cost can be attributed to the overuse and waste of electricity by students, faculty, and staff.

Natural Gas

Even though the college decreased its annual natural gas usage, my results and observation show that there is room for improvement. Through leaving windows and doors open and by over heating rooms during the cooler months, natural gas was wasted. These practices can be addressed by simple individual choices.

Waste Generation/Disposal

In order to address the wasteful practices of generation and disposal at McPherson College, the college must begin to reduce, recycle, and reuse. Once these practices are implemented not only will the annual cost decrease, but also McPherson College will have a lesser impact on the environment as a whole.

Conclusion

Through my observations and research I have concluded that McPherson College has already begun to implement water and natural gas conservation plans. Improvements, however, can still be made in these two areas. There is a great demand that the college implement more aggressive electric and waste generation/disposal conservation techniques. Only through addressing these critical issues as suggested in my conservation plan can McPherson College lessen its environmental impact.

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Shower

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Waste

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