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REDUCING BUILDING HOURS:

AN ANALYSIS OF DALTON, GATEWAY, AND CAMBRIAN ROW

I. INTRODUCTION

Given the option to explore sustainability issues on campus, we were initially interested in how we could reduce the amount of light pollution the College emits through its exterior lighting. Upon our first meeting to discuss our interest with Jerry Berenson, chief administrative officer, and Jim McGaffin, assistant director for energy and project managements of Bryn Mawr College, however, Jim explained that due to public safety regulations, the type of lighting throughout campus as well as power control cannot be easily changed in efforts to be more "green". Understanding this rationale, we moved on to consider the suggestion of analyzing the energy efficiency of individual buildings on campus, something facilities has not done extensive research on. And so, we made our focus to see how we can reduce certain building hours in partial efforts to reduce the College's carbon footprint.

II. BACKGROUND

Before getting into our project, it is important to provide information that gave us a better understanding as to what buildings we should analyze. First, more than a handful of buildings are kept open every hour of the day. These buildings are "kept open" such that their indoor temperatures are maintained within a mandated range and that more than just emergency power is on for any member of the College to enter and make use of the building. Some of these 24-

hour buildings include Gateway, Park Science, Dalton, Cambrian Row and Bettws-y-Coed. Second, the reason why buildings like Dalton are kept opened every hour is due to faculty's request to have 24-hour access. Further, Conferences and Events has the authority to hold events at Gateway as pleased, thus has Gateway opened at all times for their use.

So, based on the requested 24-hour access to Dalton and Gateway, we decided to narrow down our analysis down to these two buildings. We additionally thought it would be interesting to compare these buildings' per hour consumption to that of Cambrian Row, a building that is kept opened 24 hours a day, but used significantly less by the Bryn Mawr community.

III. PROCEDURE

After receiving consumption data from 2009 for Dalton, Gateway and Cambrian Row, we first dissected the raw data to put a meaning to the numbers. When trying to identify trends in the data, but there were significant peaks in consumption of gas and electricity when there is least expected to be use or need for gas and electricity. For example, Dalton used much less gas in January than in other winter months. In response to these odd spikes, we met with Jim to learn about how and for what gas and electricity are used in the selected buildings of research. Jim answered all of our questions clearly and thoroughly; there were different explanations for each building and each spike, so we won't go into detail. He also gave us information on how much of a building's electric use goes to office equipment, lighting, and other items.

Taking this new information, we compared gas consumption data to temperature data, including average and range for each month. After these basic computations, we met with Jim once more to see what results we could provide for him moving forward. We agreed that it would be best to first estimate consumption per hour in each building and then calculate cost and carbon savings if building hours were reduced.

IV. ASSUMPTIONS

In order to calculate the monetary and environmental cost savings of closing buildings at night, we made the following assumptions. First, we had to assume that 2009 was a typical consumption year since the consumption data we had was only from 2009. Additionally, we began by assuming that each building (Dalton, Gateway, and Cambrian Row) is currently open 24 hours a day, every day of the year (except for Dalton, which is closed for 3 weeks in January). To estimate consumption per hour, we assumed that dividing a building's consumption per hour by the hours it was open that month would give us a reasonable estimate of the building's hourly consumption. Finally, we assumed that we could implement policies to close Dalton, Cambrian Row, and/or Gateway for 3 or 6 hours per night. We also assumed it would be possible to close Gateway for 8 hours a night.

In calculating the monetary and environmental cost savings, we assumed that electricity in Pennsylvania costs $0.09 per kWh and that natural gas costs $1.20 per hundred cubic feet (CCF). We also assumed that each kWh was responsible for 1.216 lbs of carbon emissions and that each CCF of natural gas was responsible for 12.0593 lbs of carbon emissions.

V. CALCULATIONS

Given these assumptions, we calculated the hours per month that each building is normally open and the hours per month each building could be open given the possible policy changes. To find the consumption per hour in a given month, we divided the gas and electricity consumption data per month by the hours per month the building is usually open. We decided not to find an annual average consumption per hour because there was such a difference from month to month. This variance is mainly a result of outdoor temperature variance and how gas and electricity are used in the buildings.

Next, we multiplied consumption per hour by the number of hours per month each building could potentially be open. We then had an estimate for the reduced consumption per month for each building. To calculate how much we would save each month in consumption, we subtracted the estimated new consumption from the given consumption per month in 2009. We aggregated these savings for the whole year and multiplied the consumption savings by price and carbon emission values to show the annual savings in terms of cost, both monetary and environmental.

During our presentation in class, Jim McGaffin pointed out that when buildings are closed, they still use some gas and electricity, specifically that the building still uses two-thirds what it consumes when open. Given this new information, we went back and revised our calculations. This time, we calculated the number of hours each building could be closed per month instead of how many hours it would open per month. With these values, we could multiply the possible number of hours closed by consumption per hour and then multiply by one-third to see how much we would save per month. Again, we aggregated monthly savings to see the annual savings and then converted our data to show the monetary and environmental savings that we could realize as a result of the policy changes we considered.

VI. RESULTS

Solution	**Annual Cost Savings ($)**	**Annual Carbon Footprint Reduction (lbs)**
Close Dalton for 3 hours	$20,216.60	43,380.17
Close Dalton and Gateway for 3 hours	$30,118.12	62,733.84
Close Gateway & Cambrian Row for 6 hours	$25,836.62	49,441.95
Close Gateway for 8 hours	$26,404.05	51,609.79

The table above shows our results. Clearly, closing both Dalton and Gateway for three hours every night saves the College the most money. Considering the politics, however, it is much more likely that we would be able to close Gateway for 8 hours every night, which is our second best option in terms of cost and carbon emissions savings.

VII. LESSONS LEARNED

While our results yielded values that show the great potential the various policies have to help reduce the College's carbon footprint, this project also helped us gained a better understanding of several things outside of the topic of sustainability. On a more quantitative level, having to work with raw data really pushed us to make our best judgment as to how we needed to adjust certain numbers to most effectively use the given data and relate values to each other. Working closely with Jim McGaffin also afforded us the opportunity to recognize the importance of the logical thought process in working towards a conclusion, more or less, than the number crunching itself. We appreciated the time Jim took to work with us and are glad to have been part of this class.