Should We "Do It In The Dark" Or Just Leave The Lights On?

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Introduction

The world's population faces a global crisis today. Carbon dioxide emissions –the result of industrialization and decades of selfish consumption habits –have triggered rising world temperatures, posing a serious threat to our ecosystems. Public and political attention has begun to focus on the ways that we can combat this threat to our livelihoods before these effects become irreversible. There are two main ways to confront the tide of global warming: new technology and behavior change. New technologies such as wind, solar, biomass, and hydroelectric provide relatively emissions-free methods to harness our Earth's resources to produce the energy our current lifestyles require. Behavior change, on the other hand, is geared specifically towards conserving the resources we already have. Energy conservation is a method that can be easily implemented in small, self-contained communities such as a college or university. Unlike developing new technology, energy conservation is cheap, has quick and visible results, is relatively easy to measure and track, draws attention to the issue at hand, and promotes community engagement.

The "Do it in the Dark" competition at Williams College attempts to utilize this concept of energy conservation and is one way that the College can help reduce its carbon emissions. My goal in studying the competition was to determine whether "Do it in the Dark" has had any quantifiable effect on energy use habits at the College in the two years that it has run. Did the competition produce measureable short-term or long-term reductions in energy use? Are there certain conditions such as dorm size that motivate people to conserve more energy? One final idea I wanted to pursue was whether "Do it in

the Dark", if not quantitatively “successful”, should still be organized in the hope that it serves a qualitative purpose.

Campus Energy Use and Background on "Do it in the Dark"

When analyzing energy use on a college campus, it is important to consider the factors that determine electricity use. Energy use on campus is controlled primarily by student choice. Students choose whether they will leave their television, lights, speakers, fridges, plug-ins, and computers on while not in use. These choices are where "Do it in the Dark" aims to have an impact. External factors may also play a significant role in energy use. Weather variation, such as an unusually dark and cold November, can cause students to be inside more and use their lights more than average, while putting an increased demand on the electricity-powered hot water pumps. It is important to note that energy use usually increases from September through November due to a higher heating demand and students spending more time inside. The age and condition of a dorm may also be a determinant of the energy use of a particular building because some dorms simply have less efficient systems than others and use more energy. Finally, changes in the way a dorm is used can significantly alter its energy use. For example, in the summer of 2006, the College renovated Morgan to make it into upperclassmen housing, and moved all freshmen out of the Berkshire Quad and Morgan into either the Freshmen Quad or into Mission (which had previously been popular sophomore housing). Renovations can introduce more efficient electricity systems into a dorm and changing the average age of a dorm’s occupants may also affect energy use trends.

While the competition may have started earlier, the College only has records of weekly energy use for the "Do it in the Dark" competition for the years 2007 and 2008.

The competition is run mid-October through mid-November each year. The 2007 competition ran from October 16 to November 13 and the more recent 2008 competition ran from October 25 to November 22. Monthly electricity use data from 2003-2009 for most dorms is also available for the purposes of studying long-term trends in energy use at the College.

Thursday Night Group (TNG) and the Zilkha Center for Environmental Initiatives are jointly responsible for running the competition each year. TNG, a student group focused on environmental issues, initiates and organizes the publicity side of the competition. They are in charge of advertising, event-planning, and chalking campaigns. At the beginning of the competition, students hang banners in Paresky and write energy-saving slogans in chalk on sidewalks across campus. Two years ago, they organized a Paresky Blackout Night to raise awareness about the energy used by large buildings on campus and a Dinner in the Dark to raise awareness about the energy costs of using non-local foods into our dining halls (Brickley, 2009). TNG also passed out compact fluorescent light bulbs (CFLs) to replace students' old incandescent bulbs. During each week of the competition, college staff and members of the Zilkha Center collect and compile the electricity use data in each dorm for the five weeks of the competition. The Zilkha Center is the group that determines the winner of "Do it in the Dark", the dorm that shows the largest average decrease from its baseline energy use over the five weeks of the competition. The winning dorm of "Do it in the Dark" each year is awarded a prize such as a pizza party for all its residents.

Methods of Data Analysis

There were two main methods that I used to analyze electricity use on campus: baseline comparison and data normalization. For both of these analyses, data that seemed extremely inconsistent with either expected trends or from the 2007 competition to the 2008 competition, or had an obvious error with the electricity meter reading (such as when a monthly reading showed zero energy use) was not used in the analysis. There are a number of ways to choose a baseline but it is important to keep in mind that the baseline one eventually selects can have a significant impact on one's results and conclusions. Possible ways to calculate a baseline electricity use in kWh for each dorm include averaging the energy use in a dorm in November or October for the previous year or randomly choosing a week during the previous year's competition. Another method is to use the average for the month before the competition begins as a baseline and this was the method used to determine dorm baselines for the 2008 competition. It is unclear how the baseline for the 2007 competition was determined. The percent change from baseline energy use (the way the competition winner is decided) was calculated using the average energy use over the five weeks of "Do it in the Dark".

I used three different methods for normalizing energy use data so all dorms could be compared on the same scale. This type of data analysis can be used for comparison purposes to look at patterns and trends but not at absolute use. First, I calculated kWh/square foot by dividing the average energy use of each dorm over "Do it in the Dark" by that dorm's square footage listed on the Buildings and Grounds website. For Mission, the website only had a total square footage measurement so I divided that number by four to roughly estimate the square footage of each of the four "houses" in

Mission. This normalizing method, however, becomes an issue when we consider that Mission and Dodd both have associated dining halls that cause our square footage data to unfairly reflect the size of those dorms. These associated dining halls also increase the real energy use of Mission and Dodd because their average energy use numbers includes energy used by the kitchen and not just dorm rooms.

Second, I calculated kWh/student by dividing the average energy use in each dorm during the competition by the number of students in each dorm. Student numbers in each dorm were taken from the housing booklet distributed for the spring 2009 room draw. For freshmen dorms that were not included in this booklet, I estimated that the total number of students in Mission was 300 (roughly 75 students per "house") and that Sage and Williams Hall contained 120 students each. This method, like the first method, is also disrupted by inaccurate estimates for energy use in dorms that contain dining halls or frequently used kitchens.

My final normalizing method was intended as a way to look at energy use trends without factoring in the often inaccurate student and square foot data for each dorm. I analyzed trends in the six freshmen dorms, three small co-ops, three medium-sized dorms, and three large dorms. I selected these dorms based on there representativeness and complete and reasonable-looking data from 2007 and 2008. To normalize the data, we collected all the monthly data from the last five years for each building and summed together the data for October and November of each year. We then divided each building's yearly data by the maximum energy use in one of those five years. This converted everything into a scale of zero to one and we can now compare all buildings on the same scale which we could not do using absolute energy use. The zero to one value

tells us the difference between each year's energy use and that building's maximum energy use year.

Results

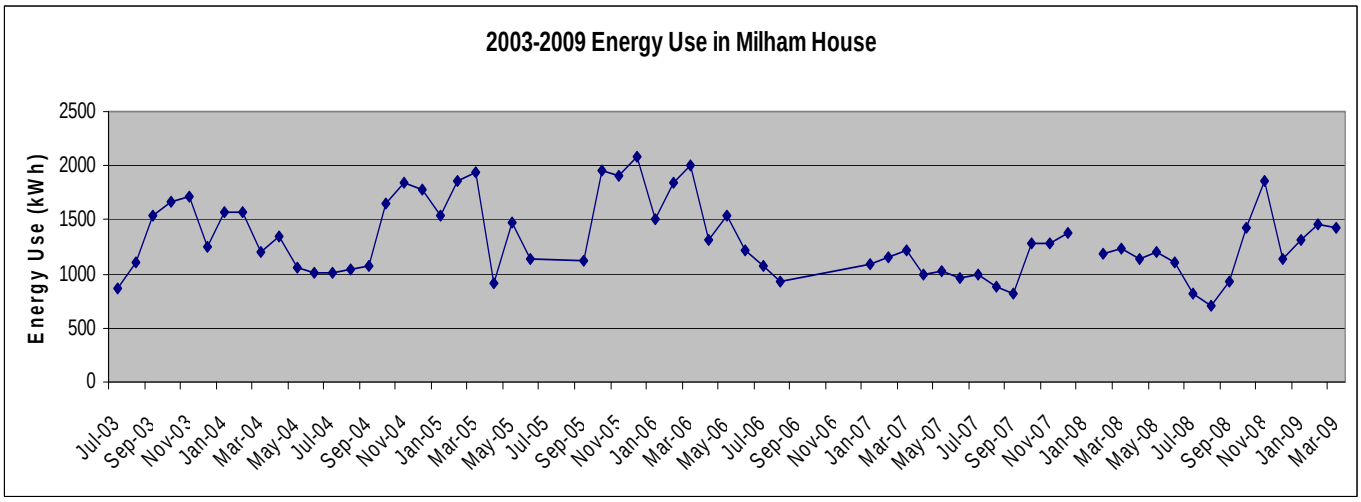

Figure 1. Energy use in Milham House between July 2003 and March 2009.

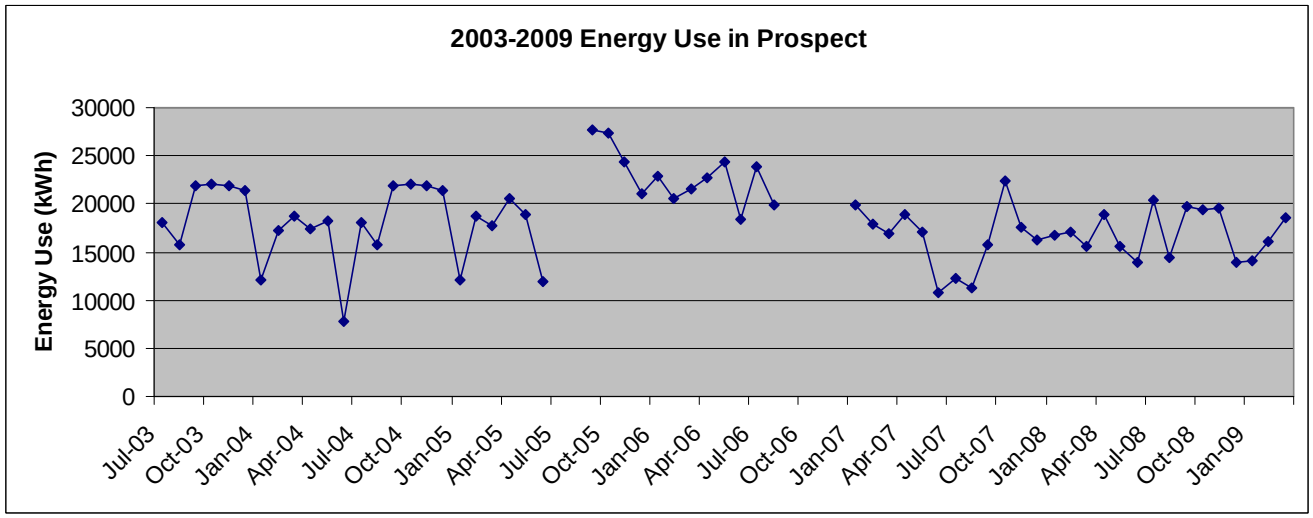

Figure 2. Energy use in Prospect House between July 2003 and March 2009.

Figures 1 and 2 demonstrate relatively predictable yearly fluctuations in energy use. Energy use generally decreases in the summer and increases again in the fall as temperatures drop and the days get shorter. It is important to note that Prospect is sometimes used in the summer for housing while Milham is not in use during that time.

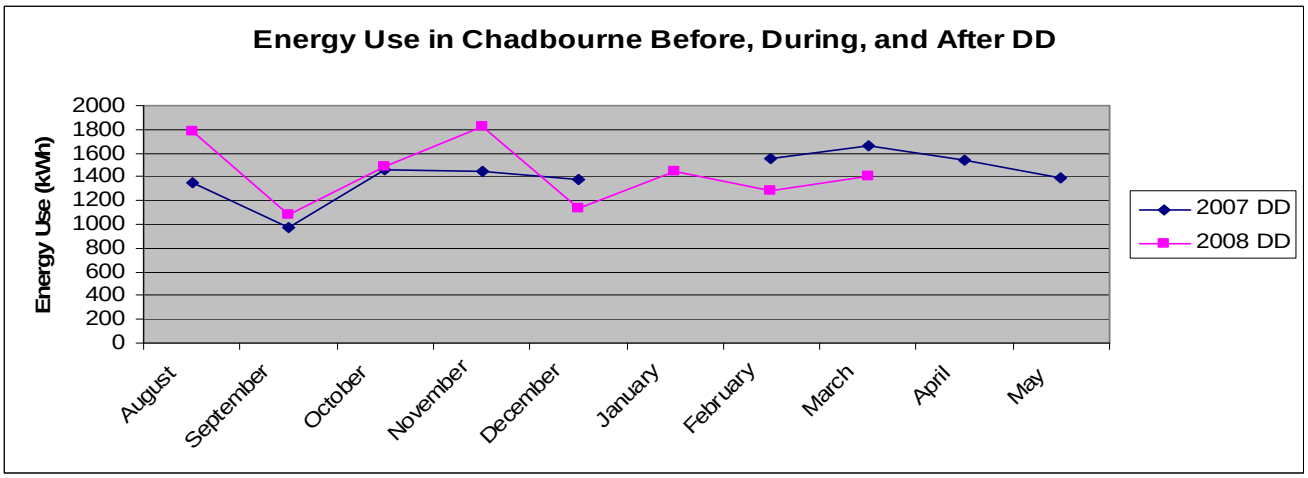

Figure 3. 2007 and 2008 energy use in Chadbourne House two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

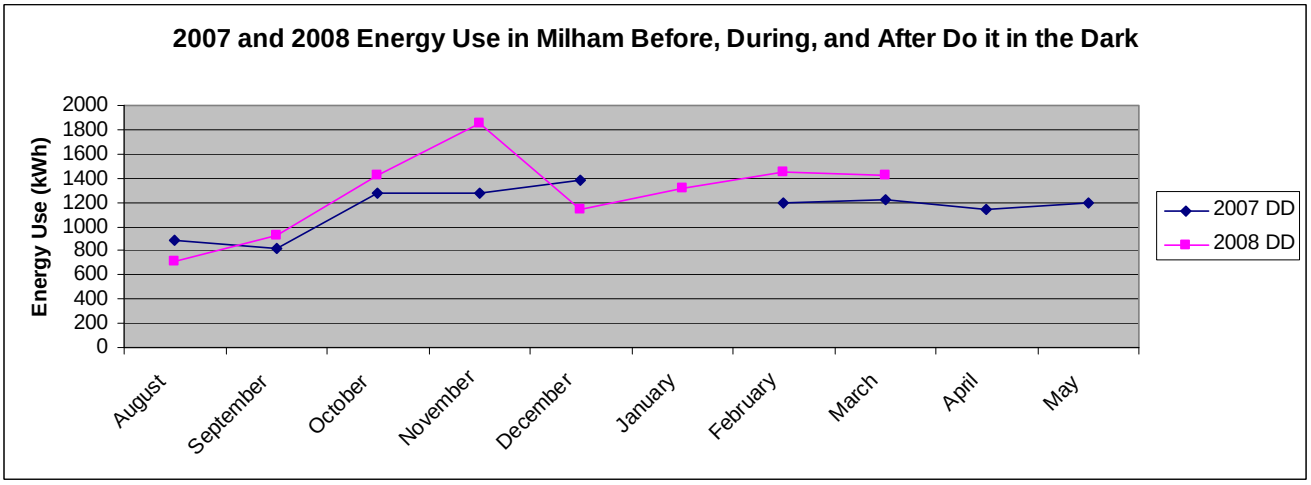

Figure 4. 2007 and 2008 energy use in Milham House two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

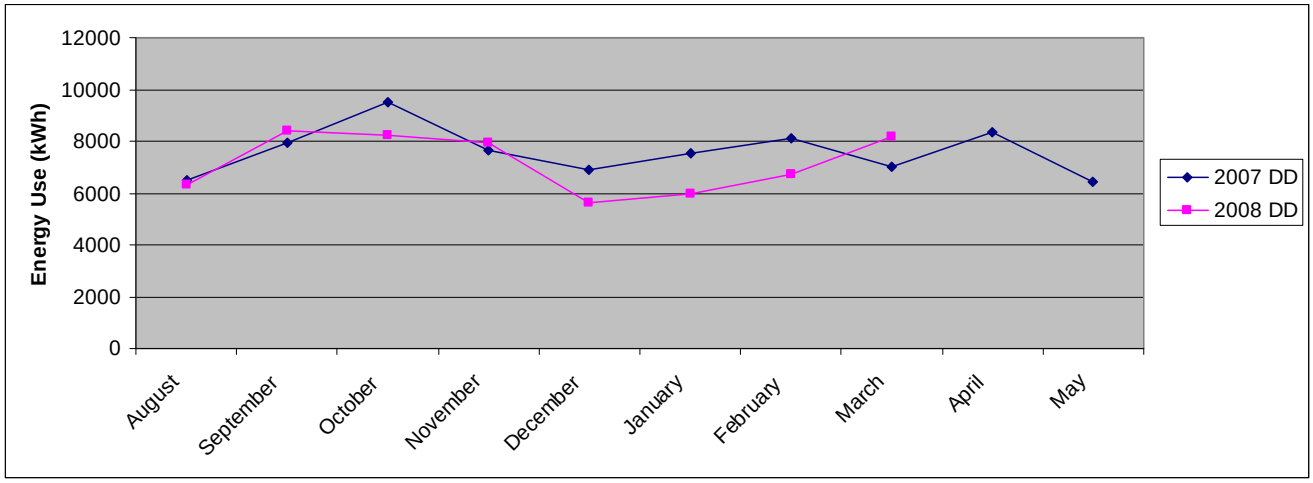

Figure 5. 2007 and 2008 energy use in Carter House two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

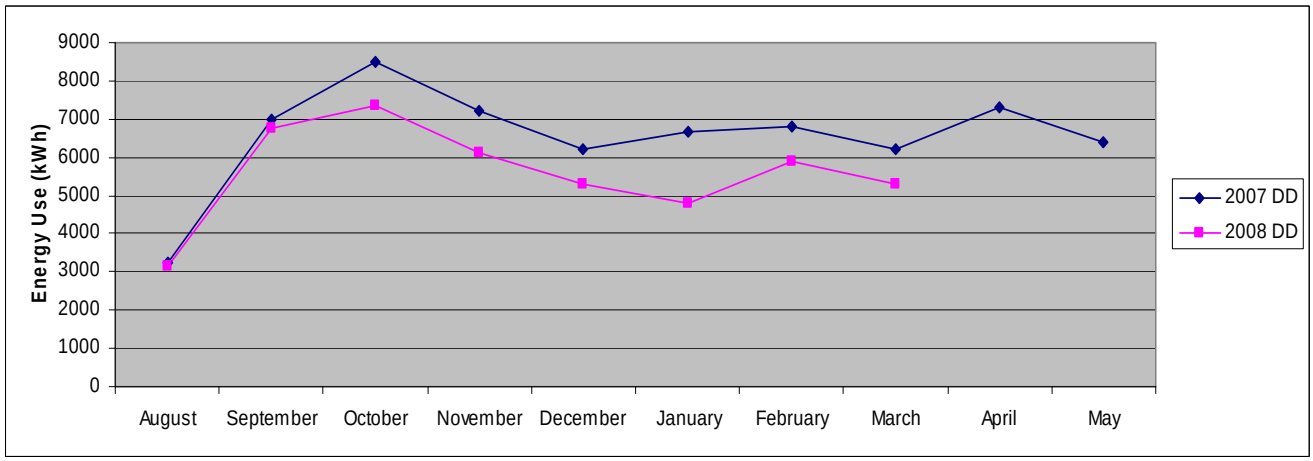

Figure 6. 2007 and 2008 energy use in West College two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

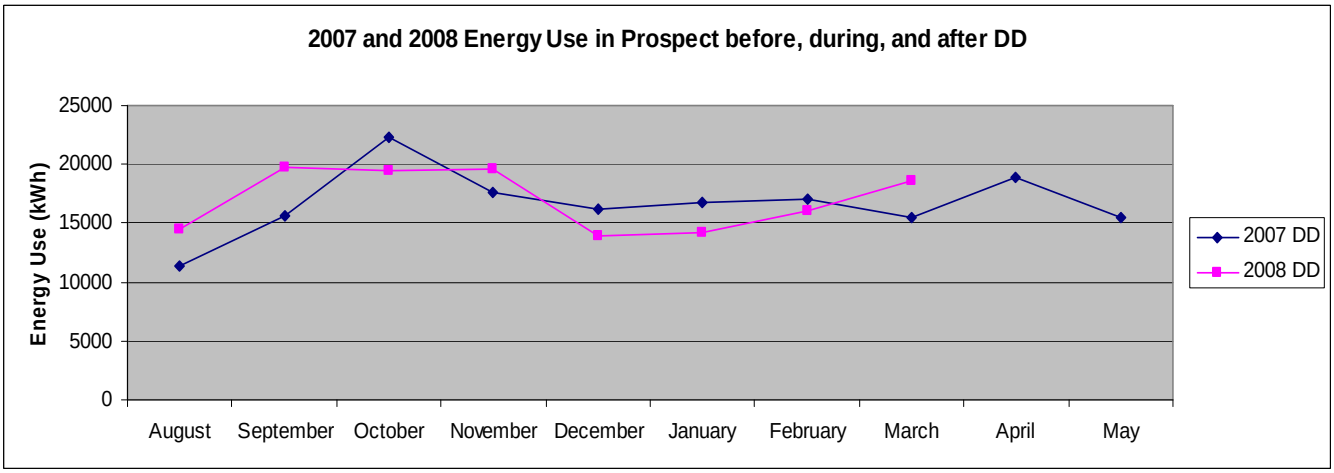

Figure 7. 2007 and 2008 energy use in Prospect House two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

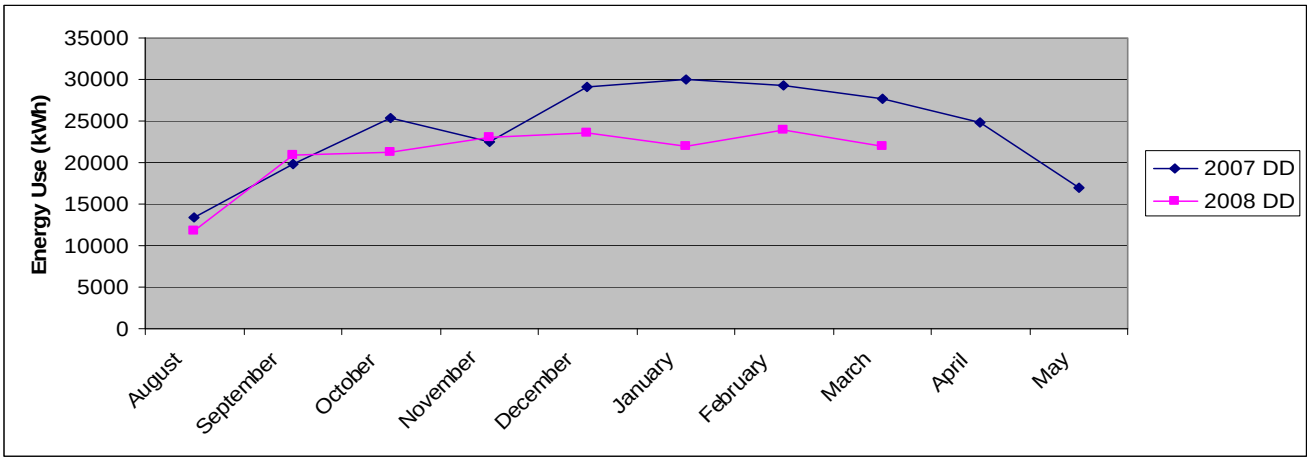

Figure 8. 2007 and 2008 energy use in Williams Hall two months before "Do it in the Dark", during the competition, and six months after the end of the competition.

The six graphs of energy use before, during, and after "Do it in the Dark" for 2007 and 2008 do not show consistent trends differentiating the small (Milham and Chadbourne), medium (West and Carter), and large dorms (Prospect and Williams) from each other. There does not seem to be a consistent trend among all six dorms except that most show the expected increase in electricity use from September through November. Some show a decrease from the November

high energy use mark after "Do it in the Dark" ends but energy use after that point may slowly increase again, stay the same, or continue to decrease.

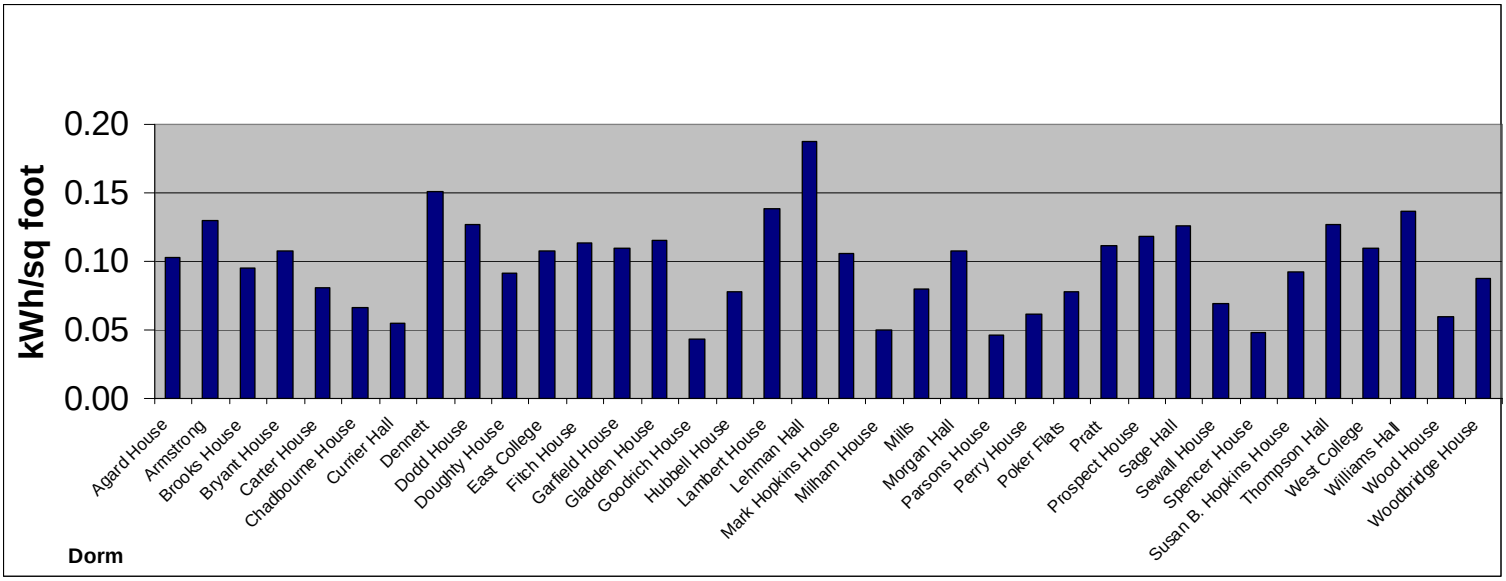

Figure 9. 2007 kWh/square foot energy use in each dorm during "Do it in the Dark".

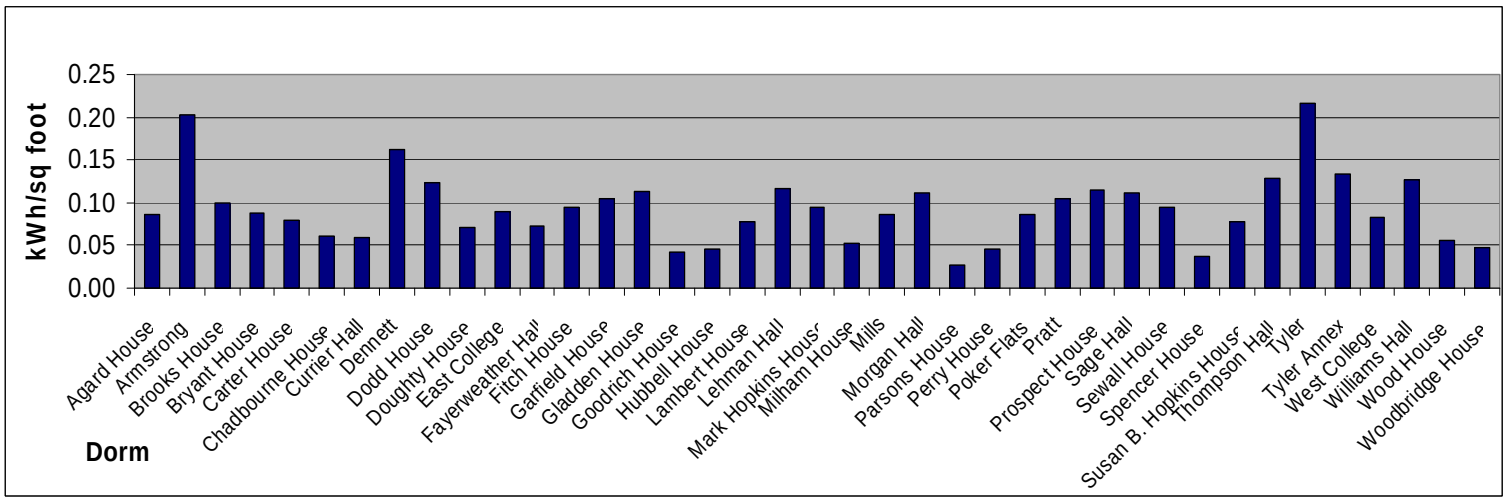

Figure 10. 2008 kWh/square foot energy use in each dorm during "Do it in the Dark".

While there is consistency from 2007 to 2008 in terms of which dorms use less or more energy in relation to the other dorms, there does not seem to be a consistent trend in energy use in small dorms versus larger dorms. The data for Mission and Dodd was likely affected by the

presence of dining halls in those buildings, causing some uncertainty in our results because energy use would be higher and there would be greater square footage.

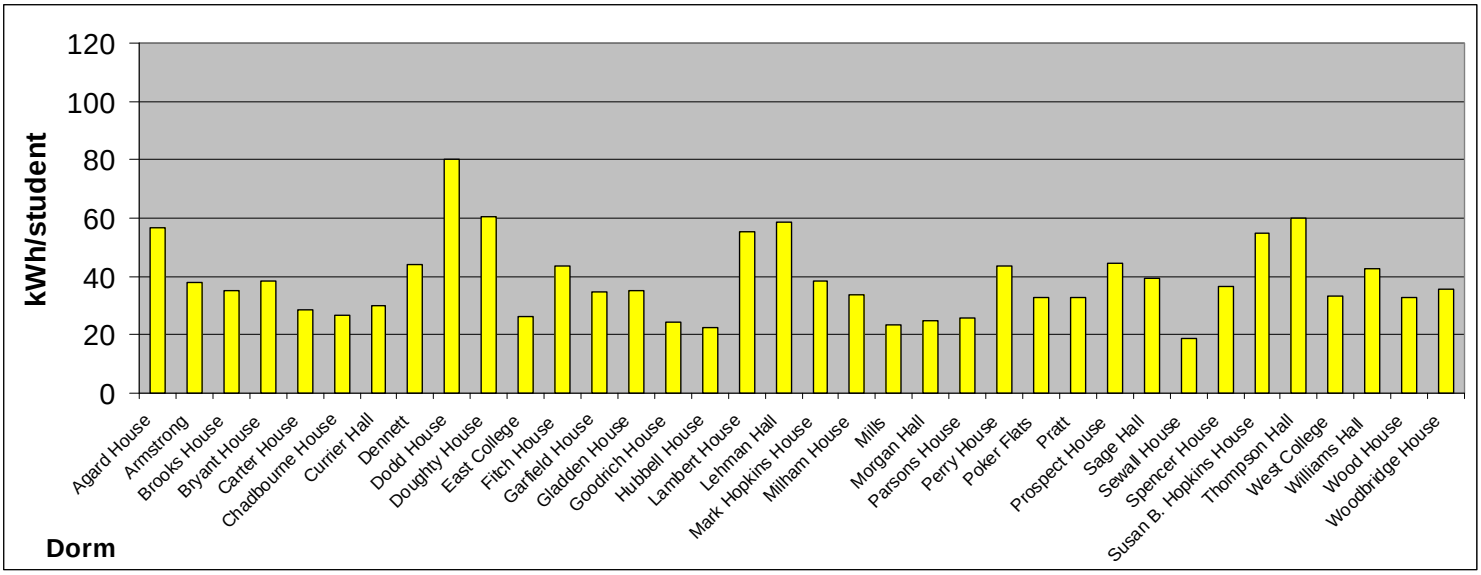

Figure 11. 2007 kWh/student energy use in each dorm during "Do it in the Dark".

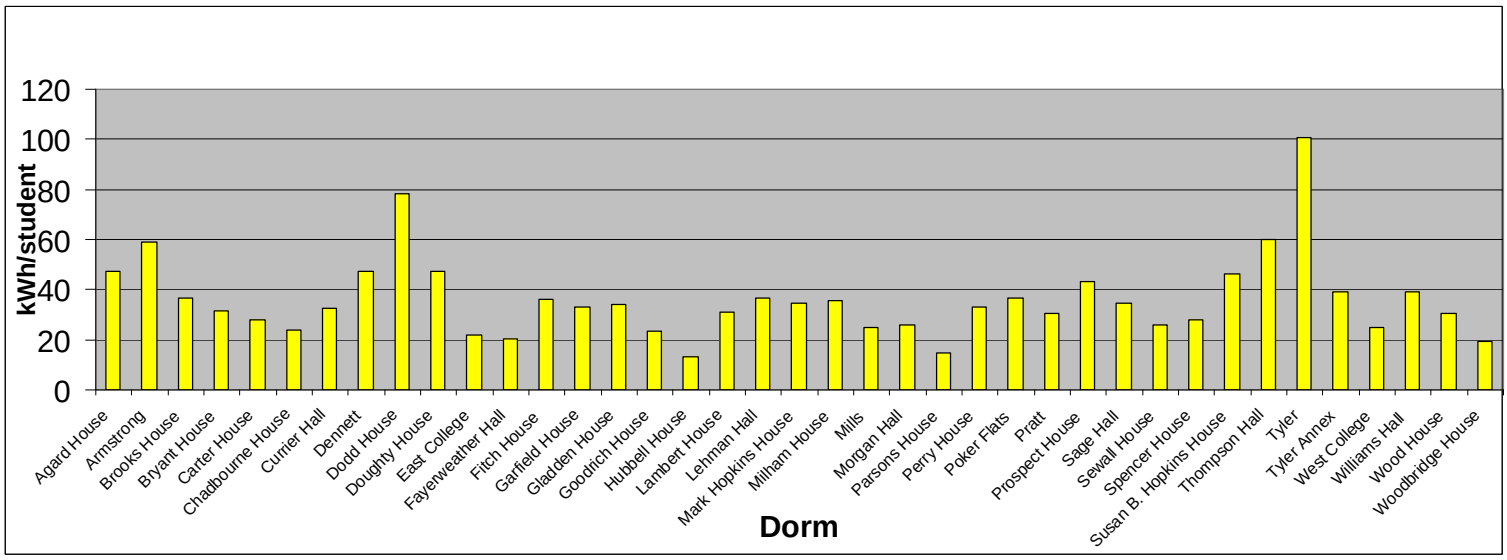

Figure 12. 2008 kWh/student energy use in each dorm during "Do it in the Dark".

Similar to the data for kWh/sq foot, the kWh/student data generally showed consistency between the two years the competition ran with a few drastic changes (such as Tyler House's energy use) included in 2008. Dorms' energy use in relation to other dorms appeared to remain similar but once again, there did not seem to be consistent trends in energy use in small versus large dorms.

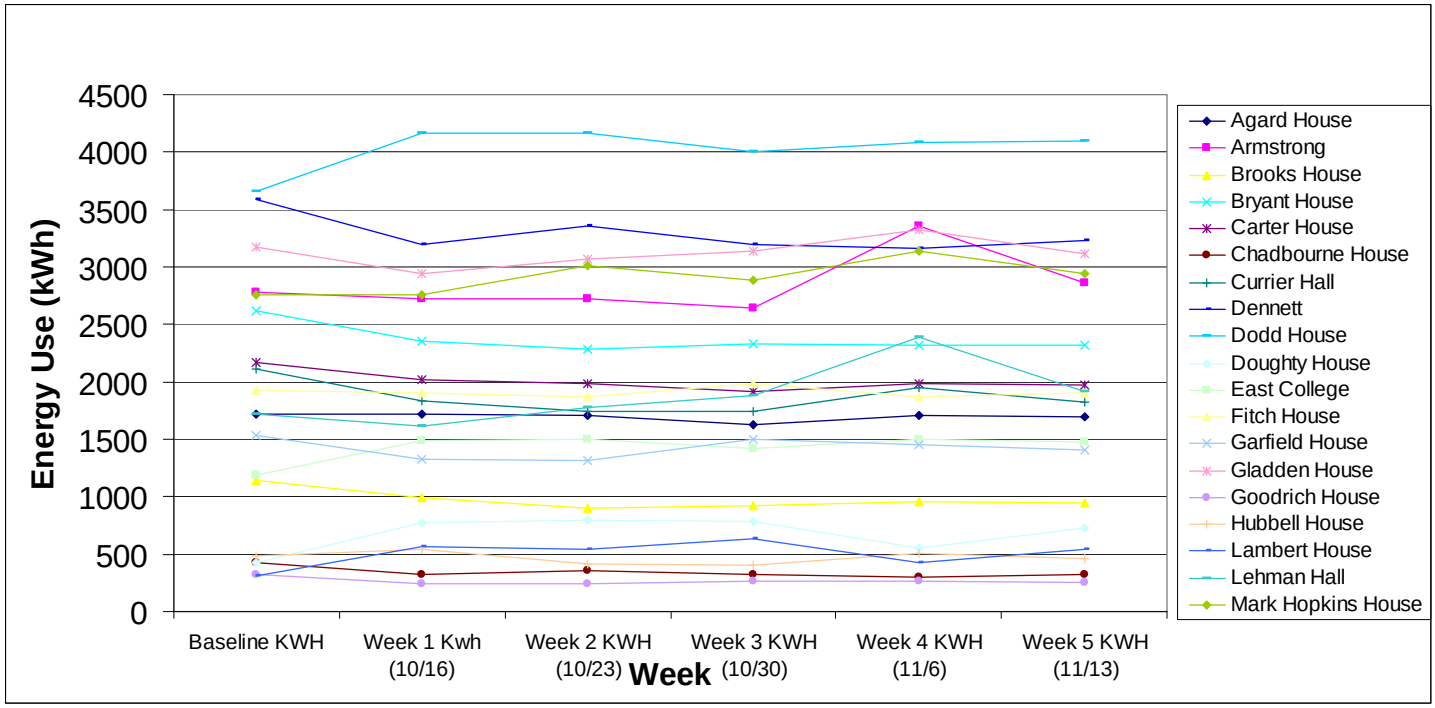

Figure 13. 2007 Agard-Mark Hopkins energy use during the five weeks of "Do it in the Dark".

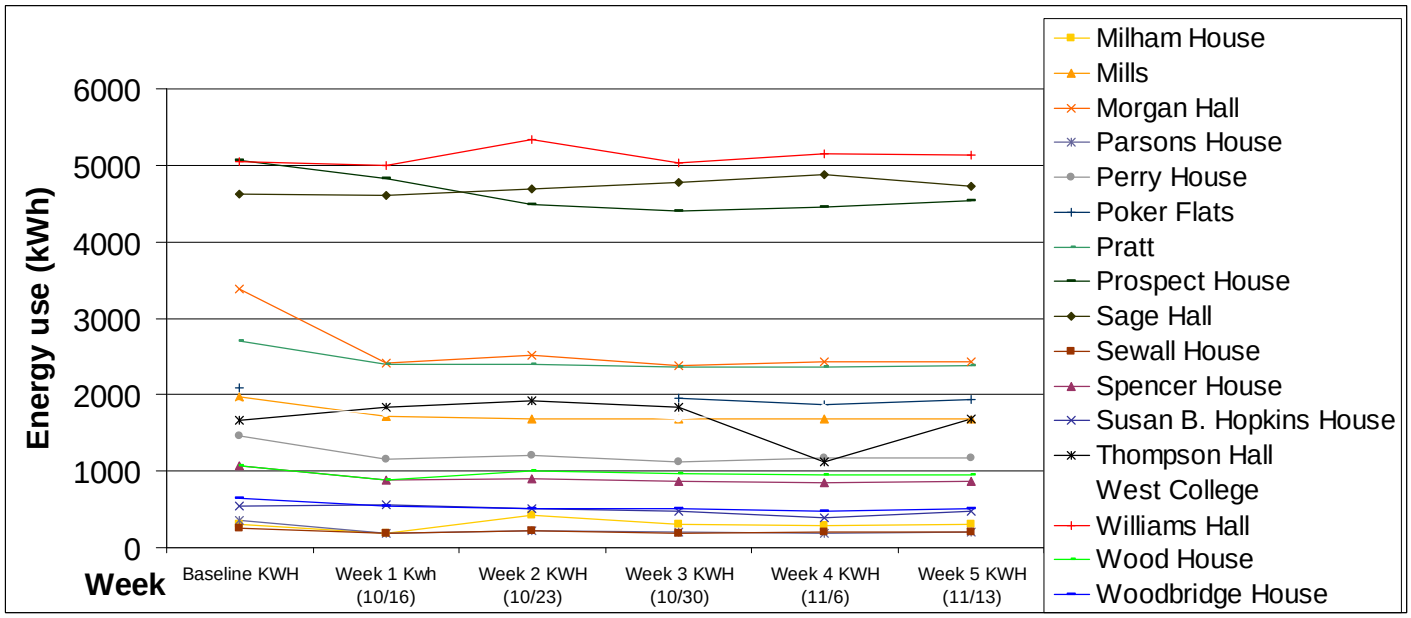

Figure 14. 2007 Milham-Woodbridge energy use during the five weeks of "Do it in the Dark".

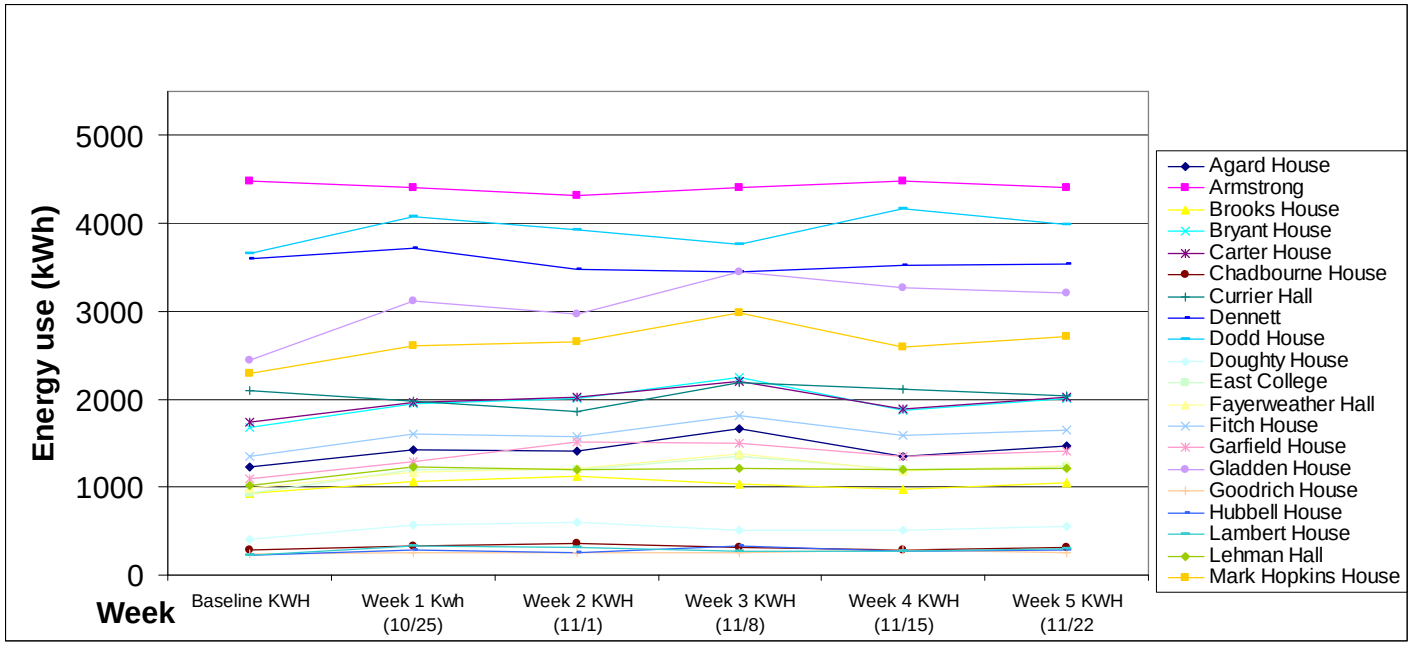

Figure 15. 2008 Agard-Mark Hopkins energy use during the five weeks of "Do it in the Dark".

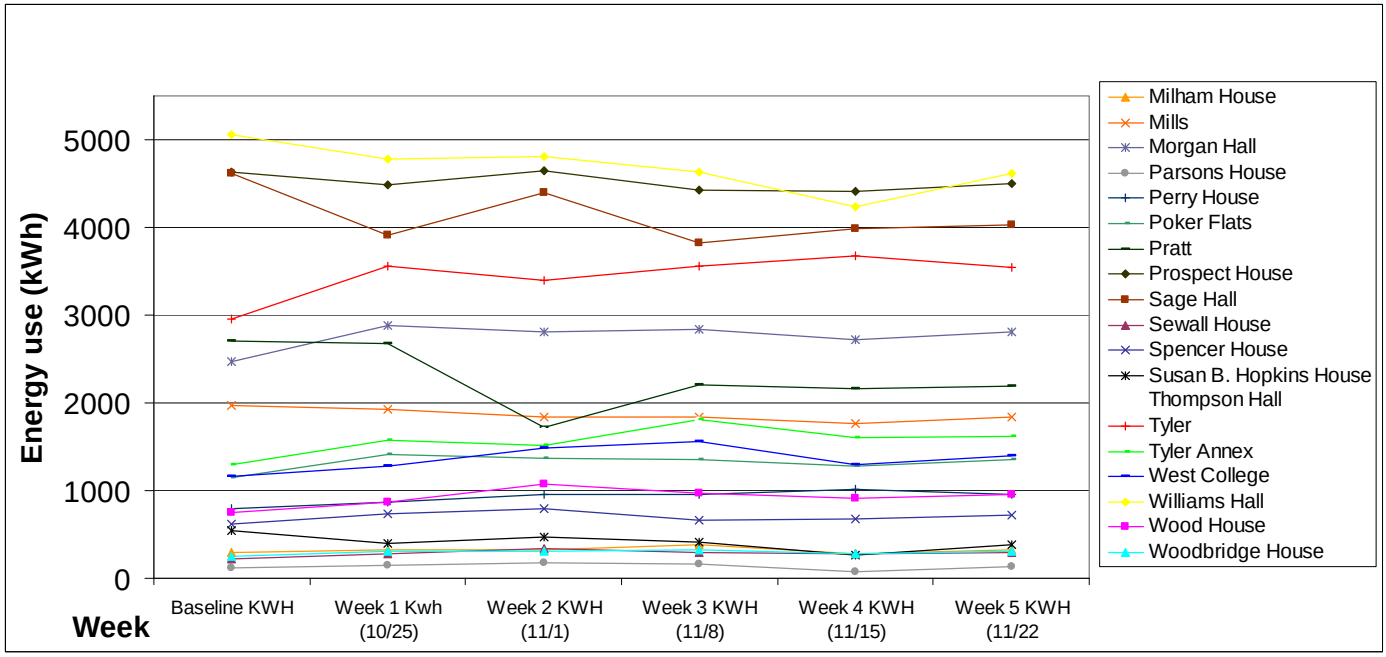

Figure 16. 2008 Milham-Woodbridge energy use during the five weeks of "Do it in the Dark".

Figures 13-16 do not show continually decreasing energy use through the five weeks of the competition. 2007 data showed mostly negative slopes on the graphs (decreasing electricity use) in the first week of the competition but then little significant change in energy use. 2008

data, however, seems to show many positive slopes on the graph (increasing energy use) for the first week of the competition and then a plateau in energy use.

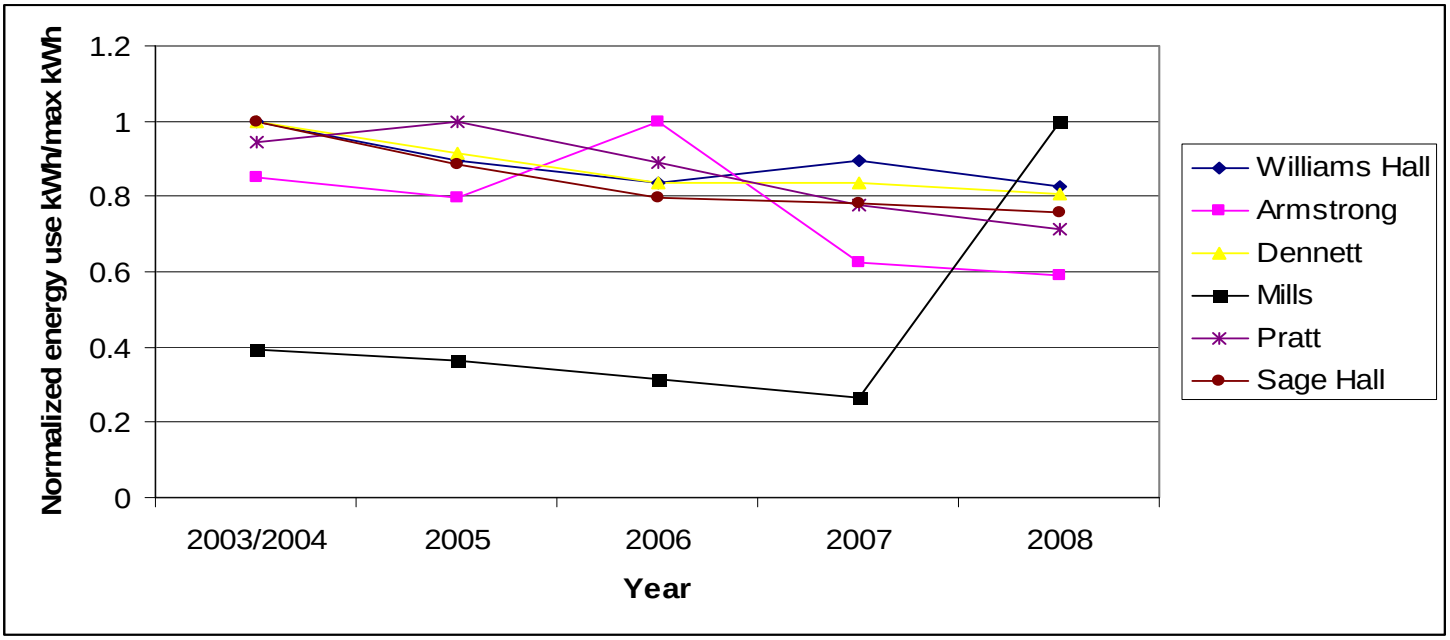

Figure 17. Normalized energy use for 2003-2009 in freshmen dorms.

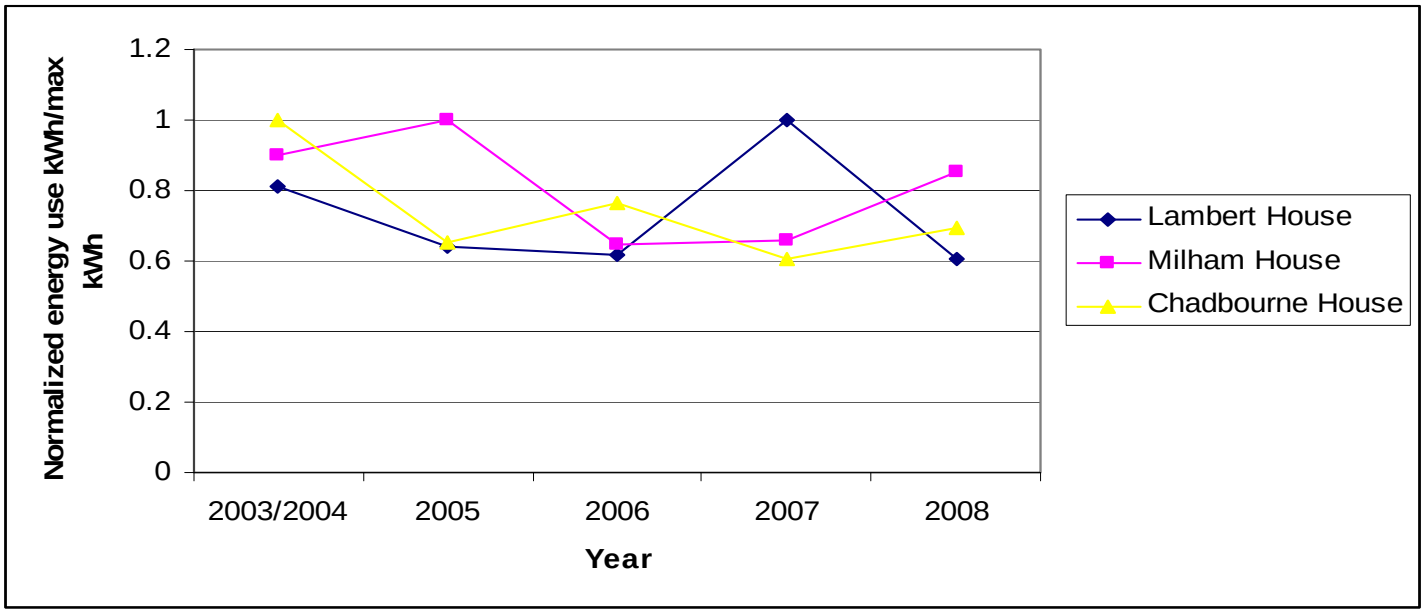

Figure 18. Normalized energy use for 2003-2009 in small houses (9-13 students).

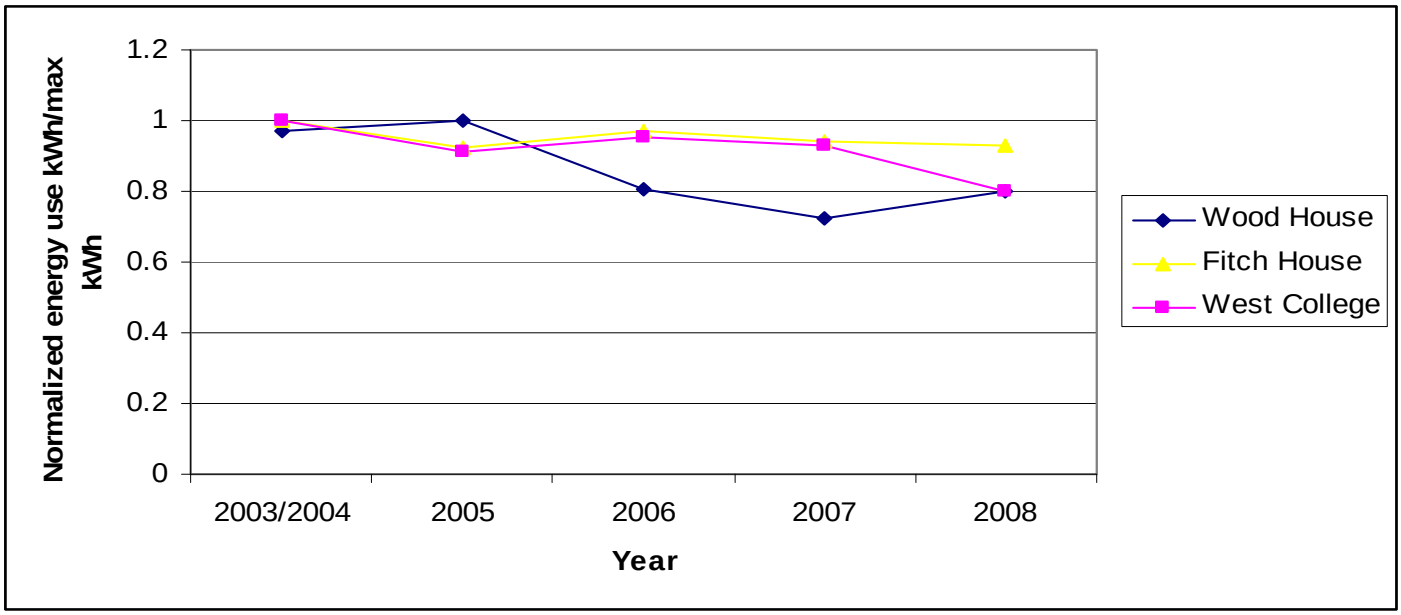

Figure 19. Normalized energy use for 2003-2009 in medium-sized dorms (30-54 students).

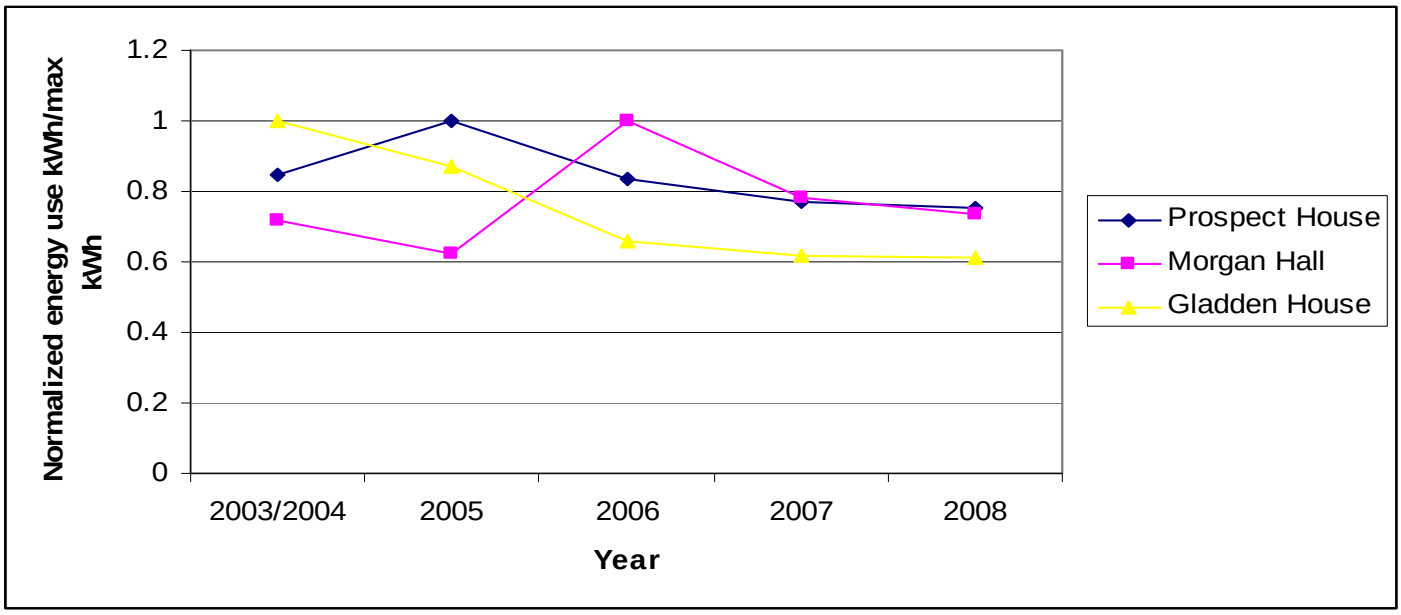

Figure 20. Normalized energy use for 2003-2009 in large dorms (89-105 students).

Our final method of normalizing energy use data shows a number of possible trends between different sized dorms. Small houses such as co-ops show great variation between years. In Fig. 15, West and Fitch generally maintained their level of energy use but Wood decreased in energy use between 2005 and 2007. Both Gladden and Prospect in Fig. 16 showed continuously decreasing energy use over the time period but the renovations to Morgan in summer 2006 show

up in the jump in energy use for 2006. The freshmen dorms in Fig. 13 show that despite the change in housing for freshmen in fall 2006, Williams, Dennett, Pratt, and Sage all decreased their energy use during the entire time period. Armstrong's data shows the largest drop in energy use in 2006-2007 (but only after seeing a significant increase in energy use the year before) while Mills had a large jump in energy use in 2007.

One last type of data analysis I did was to compare the percentage decrease in energy use averaged over the five weeks of the competition to the provided baseline and a proxy baseline, the third week of the competition. The third week is a reasonable way to study energy use during the competition because it occurs at the point in the competition when publicity for the event is likely at its lowest. The hype surrounding the beginning of the competition has faded but the final publicity push at the end of the competition has not been started yet. When the provided baseline was used, 24/36 dorms decreased their energy use in 2007 and only 8/39 dorms decreased energy use in 2008. When week three of each year's competition was used as the baseline, 11/36 dorms decreased their energy in 2007 and 25/39 dorms decreased energy usage in 2008.

Discussion and Recommendations

My results for the quantitative effectiveness of the "Do it in the Dark" competition paint a complex picture of energy use at Williams College. As demonstrated in my graphs, there are many angles at which we can examine this issue and some of them are more useful and enlightening than others. To me, however, there do not seem to be clear answers to the questions I posed at the beginning of this paper. Besides the large amount of data to wade through and condense into useful figures, there are many external factors which affect energy use on campus that I could not account for in my data analysis. My analysis is useful for getting an overall sense

of the energy use trends on campus but reliable conclusions cannot be drawn from this data without further testing and analysis.

In principle, it is easier to make big changes in energy use in a small house versus in a large dorm. In a co-op, for example, one student who was motivated by the "Do it in the Dark" competition could significantly influence their fellow housemates to conserve energy. In a large dorm, people can easily feel like their individual actions cannot make a difference and therefore may make less effort to conserve energy. With this in mind, we would expect to see in Figures 3-8 a significant decrease in energy use starting in November when "Do it in the Dark" is running and perhaps a continuing decrease through the year. The graphs for Milham and Chadbourne Houses in 2008 show this dip in energy use in November but then show a shallow increase in energy use through the spring, signifying that perhaps "Do it in the Dark" only had a short-term impact on the residents' energy use habits that year. The 2007 data suggests that "Do it in the Dark" had no direct impact on energy use in these co-ops. Since these conclusions are based on only data from two dorms, more analysis with a broader selection of dorms would be necessary to get a fuller picture. For the medium-sized dorms, West College shows the ideal impact of the competition: decreasing energy in 2007 and a further decrease in energy in 2008. The data for Carter and Prospect is almost identical and shows the decrease in energy use after "Do it in the Dark" but in 2008, there was only a short-term change in energy use habits because the energy demand increased towards the spring months. For the Williams Hall graph, I cannot draw conclusions from it except that it does not show the expected impact of "Do it in the Dark" of decreasing energy use.

In Figures 13-16, I expected to see an initial decrease in energy for perhaps the first week (the result of publicity and initial excitement about the competition), a plateau or increase in

energy use during the middle weeks (people forget about the competition), and a final decrease in energy use (when publicity for the "last push" reminds people that the competition is almost over). My figures do not give us clear conclusions about the linear trends in energy use during the competition. The specific week of the competition does not seem to have bearing on how much energy people are using but further studies would have to be done to get a solid result to this question.

For my normalized data, there do not seem too many conclusions that can be drawn from the graphs of kWh per square foot and per student. There are too many external factors like associated dining halls and year to year variations in energy use due to individual energy use habits of dorm residents to put a lot of faith in the results from these graphs. The normalized data from 2003-2009, however, does let us examine some long-term trends in dorm energy use at Williams. We know from Figures 1 and 2 that there are yearly fluctuations in energy use in college dorms but the normalized data in Figures 17-20 lets us get a better picture of the overall decrease in energy use over the years. There does not seem to be a correlation between the class year of dorm residents and energy use patterns. The University of Connecticut found that they generally had better participation in energy saving competitions in dorms of predominantly underclassmen rather than juniors or seniors but this does not seem to be the case at Williams (Boyd, 2009). Further research would have to be done to confirm this trend.

It is interesting that medium and large dorms show a general decrease in energy use since 2003 according to Figures 19 and 20 but that co-ops do not follow any particular pattern. The co-op unpredictability is likely due to the reality that energy use in a small house is dependent on the energy use habits of its residents and this varies year to year. One year a co-op could house students that value energy conservation and the next year it could house students who could care

less. In small houses, individual habits make a big difference in total energy use. I am not sure why there is a general downward trend in electricity demand from 2003-2008. Possible reasons include the decrease in PC use in dorm rooms as laptops became widespread because PCs use more energy than laptops. Another possible reason for the decrease in energy use could be use of CFLs and retrofits that improve efficiency in dorms. To study this in more detail, one would need to talk to Buildings and Grounds about maintenance done on dorms in the past five years.

The final section of my results section illustrates how important the choice of a baseline is when comparing changes in dorm energy use for competition purposes. We can achieve a totally different result with different types of baselines and so that choice needs to be made carefully. For further research, it would be interesting to consider using different types of baselines to determine the winner of the competition such as using a week zero right before the competition or averaging the two months before the competition starts. We could also choose the winning dorm by looking at the average energy used per student for each dorm. Another spin on this idea would be to compare dorm energy use during "Do it in the Dark" to the winter break shutdown data (Boyd, 2009). The winning dorm would be the one that came closest to its shutdown energy levels, Other possible ways to change the competition would be to reward the dorm that has the lowest relative college break energy use but this may not be as effective at raising energy use awareness because students invariably forget to unplug appliances, etc. in the rush to leave for a vacation.

When considering how and if we should change the "Do it in the Dark" competition, we need to decide what kind of result we are looking for. This decision depends on what kind of “impact” we want the competition to have on our residential community. If we are looking for a quantitative impact, analyzing percent decreases in energy use and energy use per student may

be the way to go. If, on the other hand, we doubt the ability of the competition to have a significant quantifiable impact, then perhaps we should start to study the qualitative impacts "Do it in the Dark" has on campus. One of 2007 competition organizers, Elizabeth Brickley, states that

> As a former “Do it in the Dark” organizer, I recognize that the quantitative impact of encouraging students to take individual responsibility for reducing campus energy consumption is indeed small; however, the real value of Do it in the Dark lies in its ability to raise student consciousness about all of the ways we waste energy on this campus. The goal of Do it in the Dark is truly to send the message home that individual energy actions can create large-scale effects-- both for the better and worse of our environment (Brickley, 2009).

Brickley’s statement strongly supports the seeming ineffectiveness of "Do it in the Dark" in terms of impacting energy use habits on campus in a quantifiable way. My results did not show strong quantitative evidence for the success of the competition. With this in mind, it would be highly beneficial to do a survey of the students to see if the competition has raised campus awareness about energy use, something that we cannot test for with data crunching. Surveying students before and after the competition would be a great way to see if the competition is fulfilling Brickley’s claim of its “real value” of raising awareness.

In the same vein of qualitative impacts of energy saving competitions, there are a number of other techniques that other colleges have used to raise awareness about campus energy use. At Oberlin College, they installed “orbs” in the entrances of a few buildings that glow different colors depending on the real-time energy demand. Organizers of the installation say that the orbs are an effective “way of alleviating ‘information overload’ by moving data off a computer screen and into our present environment” and they “make electricity visible by translating basic consumption information into a spectrum of colors” (Adam Hull and John Peterson, 2009). These orbs are an attention-grabbing and tangible way to reminding students of their energy use

habits and I think it would be a useful experiment to install a number of these gadgets around campus. Another way to raise awareness of energy use is installing Building Dashboards ® made by the Lucid Design Group which stream real-time data about a building's energy use onto a public computer screen. One of these informative screens was installed at Williamstown Elementary as well as at many of our fellow institutions. While it's possible that students may grow bored and forget to look at the Dashboards if the screens always display energy use information, a way to combat this would be to display other interesting information such as dining menus, world news, and sports scores in addition to the energy use data.

My results do not give us a clear picture of the effectiveness of the "Do it in the Dark" competition at Williams College. Further research with longer-term energy use studies would greatly improve our knowledge of energy use trends at the College. I believe that although the competition doesn't seem to have a measureable impact of energy demand on campus, it is still a worthwhile campaign to run because it serves to raise awareness of energy consumption in our community. This result is hard to measure because it doesn't lend itself to quick quantitative analysis. Increased awareness of energy use issues will eventually pay off but this will take awhile and is not easy to see with our current data. "Do it in the Dark" is one of the ways that the College can work towards its goals of reducing energy consumption and as such, should be supported by administration and students each year.

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