The Effects of Energy Dashboards and Competition Programming on Electricity Consumption on a College Campus

Katherine Binder, M.A.

A report submitted to
Honeywell Building Solutions
in fulfillment the Sustainability Dashboard Grant
proposal number: 922-1000

Western Michigan University
Kalamazoo, Michigan
May 2015

Abstract

This report aims to explore questions pertaining to the efficacy and cost effectiveness of energy dashboards as part of a Honeywell Building Solutions funded project at Western Michigan University (WMU). Given the increasing popularity of energy dashboards along with a lack of data to support their effectiveness, more rigorous research utilizing this technology is necessary. An intervention including the installation of physical and internet based energy dashboards along with an energy reduction competition is discussed. A literature review is presented that provides arguments against the potential for long-term effectiveness of these interventions despite research claiming the opposite. Results from this study are presented and discussed and future research opportunities explored.

The Effects of Energy Dashboards and Competition Programming on Electricity Consumption on a College Campus

As building technologies become increasingly efficient, energy-related behavior change strategies have been dubbed the “last frontier” for public building energy use reduction. As an attempt to induce behavior changes that reduce energy consumption, many college campuses have installed real-time electricity displays (energy dashboards). Energy dashboards monitor the energy consumption of a facility and present the data to building occupants in an interactive way either on touchscreen television kiosks or on a website. Data displayed are typically aggregated for an entire building and may show electricity data alone or in combination with water and natural gas usage. The Association for the Advancement of Sustainability in Higher Education (AASHE) reports that 70 of its member universities and colleges have installed energy dashboards in at least one of their campus buildings (AASHE, 2015).

Companies that create and sell energy dashboards and the associated software suggest anecdotally that building occupants will change their behavior as a result of receiving feedback showing the amount of energy being utilized in that building along with access to the educational components of the dashboards designed to give occupants instructions about how to conserve energy (Lucid Design Group, 2015). Previous research, however, has found feedback alone to be ineffective in changing resource use behavior in residential and master-metered settings (Geller, Erickson, & Buttram, 1983; Winett, Kagel, Battalio, & Winkler, 1978). Similarly, information likely plays an important role in interventions where participants are required to use it in order to gain access to other components such as rewards. However, when relied upon alone, this information has been found to have little or no effect on conservation behavior

(Abrahamse, Steg, Vlek, & Rothengatter, 2005; Geller, 1981; Geller et al, 1983). A popular argument supporting the use of feedback and information includes the notion that attitude change is a necessary precursor to behavior change (Lehman & Geller, 2004). This assumption has also been disproven in numerous research studies (Werner, Turner, Shipman, Twitchell, Dickson, Bruschke, & Bismarck, 1995; Geller, 1992).

Feedback and information have been successfully leveraged to create behavior change, when they are linked to other consequences. For homeowners, these consequences can come in the form of utility bills. Behaviors that result in more electricity use also result in a higher bill and vice versa. For the occupants of non-residential buildings, or residents living in master-metered apartments, other consequences must be programmed in order for feedback or information to have behavioral impact. Rewards are commonly used in this context, in the form of group electricity reduction programs or competitions. Following a 1975 report by the Midwest Research Institute finding that master-metered apartments used 10-25% more electricity than individually metered residences, a number of research studies focused on addressing this issue through group contingencies.

The dependent variable used in the majority of these studies was a measurement of the electricity used by the group over a period of time which was then used as a prediction of future use. Calculations were made between the predicted and actual consumption to obtain a percentage of reduction. The reduction percentages were used as performance feedback for building occupants during the interventions (Bekker, Cumming, Osborne, Bruining, McClean, & Leland, 2010; Petersen, Vladislav, Janda, Platt & Weinberger, 2007; Slavin, Wodarski & Blackburn, 1981; Walker, 1979;

McClelland & Cook, 1980; Winett, Kagel, Battalio, & Winkler, 1978). One study used an additional measure that included compliance with a provided checklist that included ideal thermostat settings and window and door status. Compliance was checked at random (Walker, 1979).

A number of studies provided individual rewards for group electricity reductions. These rewards came in the form of monetary rebates or cash payments that were either presented in predetermined amounts or were based on the amount of money saved through conservation (Slavin, et al., 1981; Winett, et al., 1978; Walker, 1979). Other studies pitted groups against each other in competitions to achieve the highest conservation rates. These rewards were distributed to the entire winning group and consisted of sums of money, prizes such as building embellishments, or funds for group parties (Bekker, Cumming, Osborne, Bruining, McClean & Leland, 2010; Petersen, et al., 2007; McClelland & Cook, 1980).

Only one published study utilized real-time energy dashboards as part of a competition. The study took place on a college campus and the buildings included in the competition were dormitories. A 55% reduction in electricity use was documented (Petersen, Shunturov, Janda, Platt, & Weinberger, 2007). While this seems like a significant decrease in electricity consumption, it should be noted that the dataset is quite small, comprised of only seven weeks. A three-week baseline period was used to calculate electricity reductions during a two-week period where dormitories competed against each other to reduce energy use. A discontinuous two-week follow-up period was used to determine treatment maintenance effects. The authors report a continued decrease in electricity use during follow up, a possible indication of a downward trend throughout the entire data collection period.

These data are equivocal, however, because no statistical analysis of the results is presented and energy use is known to vary widely over short durations (Johnson, Xu, Brewer, Lee, Katchuck, & Moore, 2012). No trend data are presented and no references are made to previous years for trend comparison. Furthermore, this research design makes it impossible to tease out the effects of the dashboard aside from the competition. All of these factors make it difficult to conclude that the findings presented in this study are significant.

Of further concern is the use of a follow up survey seeking to document and detail students' resource use behavior. Many answered that they engaged in behaviors such as unplugging vending machines and turning off hallway lights. They acknowledged that these practices were not maintainable after the competition ended, but also stated that they were already engaging in many of the more individually impactful behaviors such as turning off room lights and computer monitors before the competition started. This provides further evidence of the potential that extraneous variables could have contributed to the large reductions in electricity use.

A major issue with this entire body of research is the longevity of the results. Slavin et al. (1981), reported a diminishing treatment effect during the intervention. Winett et al. (1978) questioned the existence of any durable changes following the conclusion of programming. Only one study reported reliable levels of behavioral maintenance in the weeks following the intervention, but did not continue follow-up after five weeks (Walker, 1979). All the studies discussed the costs and benefits of long-term programming, seemingly under the assumption that the majority of the effects would diminish with time. However, no known research has attempted a permanent or long-term consequence based behavioral program using incentives.

A final concern addresses the implementation of programming based on reduction percentages and the problems that arise when making these calculations. These calculations are particularly important because they are used not only to assess the success of the intervention, but also to calculate pay offs and reward distributions for participants. All interventions were reported to be effective with energy reductions of 6-20% and 50% in the case of the Petersen et al. (2007) study. However, concerns have been raised with the accuracy of these calculations given the need for weather normalization along with their fairness based on their dependence on baseline periods that dictate results (McClelland & Cook, 1980; Winett, Kagel, Battalio & Winkler, 1978). Johnson, et al. (2012) have discussed these issues in depth and call for a reevaluation of all findings presented using the baseline to treatment reduction comparison.

A cost-benefit approach is also missing from previous research. Energy dashboard touchscreens can cost between $5000 and $9000 per building to install. They may also necessitate the installation of additional electricity metering technology. There are also yearly fees for software and data management subscriptions along with a dedicated staff member who may need to be assigned to run dashboard programming components and to function as a liaison between the organization and energy dashboard software company. If the electricity cost-savings from occupant behavior change can be calculated, then a pay off period can be estimated, a calculation commonly required for other energy saving projects.

This report aims to explore these questions pertaining to efficacy and cost effectiveness of energy dashboards as part of a Honeywell funded project at Western Michigan University. Given the increasing popularity of energy dashboards along with the lack of data to support their effectiveness, more rigorous research utilizing this technology is necessary. The purpose of this study is to break down and compare the effects of energy dashboards and competition programming separately and in combination. Research in a university setting can be challenging and the associated successes and setbacks will also be discussed.

Method

Setting

The research took place on Western Michigan University's main campus. It included buildings in four usage categories: apartments, residence halls, academic and classroom buildings, and specialized use buildings.

Materials and equipment

For measurement and data collection, the study utilized digital electricity meters that report data to a central campus server. The energy dashboards consisted of an internet dashboard website and in some buildings, an interactive touchscreen kiosk developed and maintained remotely by Lucid Design Group.

Dependent variables

Building electricity consumption data were collected from two sources. One source is the WMU energy system, which holds energy data from the previous eight years for all campus meters. This system automatically reports monthly electricity information for each meter and these reports can be pulled individually to collect electricity consumption data. Many buildings contain more than one meter, so post processing is necessary to determine building-wide consumption. These data are only available from the university on a monthly timescale.

The second source is through Lucid Designs' BuildingOS website, a back-end tool for the energy dashboard requiring a username and password. Through BuildingOS, meter-level data can be queried and automatically calculated to provide reports for entire buildings on timescales as small as 15 minutes. These data are available for the previous two years in 22 buildings, including all the buildings involved in the study.

Dashboard interaction data were also collected for the internet-based dashboard website. The information reported includes the number of page views, individual users, and website sessions totaled since August 2013 and sorted by date. These data were collected and reported by Lucid using Google Analytics. Additionally, in an effort to assess the dissemination of information about the website dashboard, a survey was sent to residents of the dormitories that included questions about how they used the physical and internet based dashboards during the Eco-Thon competition. The survey also assessed their knowledge about the competition itself.

Independent variables

Three independent variables were included in the study. The first was the addition of the Lucid Designs Kiosk touchscreen. The touchscreens displayed a rotating screen with electricity consumption data for all buildings included in the study. Building occupants could interact with the screen to create graphs comparing buildings, explore usage patterns in individual buildings, get information about campus "Green Features" including solar panels and electric vehicle charging stations, get tips about how to conserve resources, and look at the current and predicted weather for Kalamazoo.

All of these features were also made available on the website version of the dashboard, which served as the second variable. The dashboard website was available from both on and off campus and showed the same information as the kiosk, but in a format created for personal computers. Both the physical and internet based dashboards functioned identically to the one used in the previous study that utilized energy dashboards in a dormitory.

The third variable consisted of a resource use reduction competition, called Eco-Thon, which takes place every February in WMU's residence halls and apartments. Eco-Thon is organized by WMU's Residence Life Department and is run by the resident staff in each hall. Events and information sessions are organized encouraging students to reduce electricity and water use and increase recycling rates. Winners were chosen from three campus "neighborhoods" and prizes included a pizza and ice cream party or money to fund small projects such as the installation of bottle filling stations. For the 2015 Eco-Thon competition, real-time standings were displayed on the dashboards under tabs labeled for the competition and reflected on each participating building's "homepage."

Research design

Interventions were implemented in an approximate multiple baseline design, with rollouts occurring periodically over time. Reference Appendix A for the full schedule. All buildings began in a baseline phase with no intervention. For the dataset from the WMU system, this baseline period begins in January, 2006. For the dataset from BuildingOS, the baseline period begins in April, 2013. The dashboard website was also activated beginning in April, 2013, but was not advertised widely until February, 2015. Dashboard touchscreen installation began in September, 2014 and continued through March, 2015.

Results

Figures 1 and 2 show results for a sample of buildings included in the study. These sample buildings were chosen because they have the most complete dataset. Other buildings were removed from the analysis because significant portions of data were missing or rates of consumption fell radically outside what is to be expected, indicating issues with the metering system. The monthly data reports from WMU's system were utilized because they were found to be the most reliable. These decisions are discussed in greater detail in the following section.

The sample buildings all show a somewhat similar pattern of monthly consumption, with higher rates during the academic year than during the summer months. The Bernhard Center is the only exception, with higher rates during summer months in every year except 2008. It is hypothesized that the higher rates are a result of the air conditioning system along with traffic patterns. The Bernhard Center is the student union and the only sample building that utilized central air conditioning throughout the summer months. It was open year-round and houses a number of staff and administrative offices along with student group spaces, a cafeteria, and a number of shops. It is also used during summer months for campus tours for prospective students.

A physical dashboard was installed in the Bernhard center at the beginning of September, 2014. The internet dashboard was available starting in April, 2013, but not advertised. In Figure 1, energy use shows a dramatic drop after the installation of the physical dashboard. This reduction appears to be part of a trend that began in the midsummer 2014. This downward trend from June or July through December is reflected in multiple other years, most particularly 2010, 2011, 2012, and 2013. This reoccurring pattern of consumption indicates that the reduction following dashboard installation is most likely a result of variables other than the dashboard itself. Additionally, the reduction does not fall below levels of previous years, suggesting that there were no significant electricity savings. Using Figure 2 for a direct comparison of each month, with the exception of 2013, each treatment month falls within or slightly above historical rates of electricity consumption, again suggesting no significant effect from dashboard installation.

Eicher/LeFevre is a residence hall used primarily during the school semesters and is shut down during the summer months. This usage pattern is reflected in the dips in electricity usage during the summer months. Data are missing for a portion of 2013. 2014 does not reflect the same trends as previous years, including a data point in August 2014 that was near zero, an impossible rate of consumption for this building. Additionally, data are missing from September 2014 and January 2015. These clues indicate potential metering system issues, calling into question the accuracy of the remaining data recorded during the interventions. However, Eicher/LeFevre is the only building where a dashboard was installed separately from the Eco-Thon competition, and therefore was still included in this analysis.

Eicher/LeFevre received a physical dashboard at the beginning of September 2014 and participated in Eco-Thon during February 2015. The continuous monthly data in Figure 1 show relatively high, but variable rates of electricity use following dashboard installation. Relatively low rates are seen during and after the Eco-Thon competition.

However, when referenced against the monthly comparisons in Figure 2, it is hypothesized that these data are part of an overall downward trend during the months of February and March beginning in 2011. Figure 2 also shows that in the months leading up to Eco-Thon, the dashboard alone created no change in electricity consumption.

Henry and Draper/Siedschlag Halls are also residence halls and show patterns of electricity consumption similar to Eicher/LeFevre. A dashboard was installed in Henry at the same time the Eco-Thon competition began on February 1st, 2015. Draper/Siedschlag participated in Eco-Thon, but did not receive a physical dashboard. Both halls show no change in electricity consumption during treatment months as shown in Figure 1 or Figure 2. Figure 2 shows that both may be experiencing a slight downward trend over the past ten years. It is possible that this trend is a reflection of the increasingly efficient technologies utilized in dorm rooms such as compact fluorescent light bulbs and low energy televisions and electronics.

The Dalton Center and Moore Hall both served as control buildings. Moore Hall received a dashboard that was not activated. Both buildings had dashboard websites that were made available beginning in April 2013, but were never advertised to building occupants. Visual inspection of the data for both buildings in Figure 1 and 2 show relatively stable patterns of electricity consumption, indicating that there are likely no extraneous variables impacting the data during treatment periods in the other buildings.

The dashboard website was advertised to occupants of dormitories during the Eco-Thon competition. The competition tabs showed results for all 12 dormitories on campus, with real-time data for buildings connected through Lucid and manually entered data for the remaining buildings. The website address was shared by residence life staff through hall meetings and posted signage. Interaction data from Google Analytics showed a total of 533 page views by 284 users. This represents only 6.7% of the 4,239 students living in dormitories. Figure 3 depicts the number of page sessions over time and shows the highest rates of daily page interactions happening during the first two weeks of the Eco-Thon competition at 19 sessions per day.

Results from the survey indicated low levels of awareness about the Eco-Thon competition and both versions of the dashboard. 69 of the 135 students who responded to the question "Did a sustainability competition take place on campus?" answered, "I don't know." Only 9 out of 40 correctly answered when the competition took place and 14 could name it. In response to a question asking how they viewed results during competition, 23 students out of 37 indicated that they used methods other than the touchscreens or internet dashboards to check results. These methods included written communications posted by their resident assistants, hallway posters, word of mouth, and Facebook updates. A number of students indicated that they were not aware of any methods for tracking results.

Discussion

Data and data collection

The data presented here are a much more complete representation of building electricity use patterns than the data used in previous research studies. These data show that many yearly trends span several months and could account for some of the effects seen in studies with short treatment periods. Large portions of the reductions in electricity use could easily have been a result of typical data trends for that time of year rather than the implementation of dashboard technology and competition programming. This dataset shows the installation of physical dashboards, competition programming, and online dashboard websites to have very little to no effect on building electricity consumption.

These data are not without flaws, however. An ideal analysis would include data for smaller segments of time in addition to the monthly consumption rates presented here. This would enable a deeper understanding of what happens to electricity use immediately following treatment implementation. Hypothetically, it is possible that small reductions may have been apparent following installation of dashboards or the beginning of the competition, but that the novelty of these interventions caused those reductions to diminish over the month and result in data points that look similar to historical data. An analysis of this sort was attempted utilizing data downloaded through Lucid's BuildingOS system. However, due to unresolved software issues, these data were found to be inaccurate. Reference Figure 3 for a comparison of these data to data pulled directly from WMU's central data server.

This issue raises an additional concern. The real-time data that Lucid displayed on the physical and internet based dashboards utilizes these more granular data, meaning that potentially all of the data used to provide feedback to building occupants was not accurate. This hypothesis is untestable because of the difficulty of pulling granular data from WMU's system, however, for the few buildings that were cross-referenced, large discrepancies were apparent. There is a chance that this issue may have contributed to the failure of the dashboards and programming to elicit electricity reductions.

The monthly data reported from WMU's server was also not without fault. The server is set up to automatically run and archive monthly reports for each meter. Many buildings have multiple meters that need to be added or subtracted in order to calculate the entire building's electricity use. In many cases, reports were missing for one or more meters or indicated that some data may be missing from the month. Months with missing meter data were not included in the results. Because of the high rate of missing data reported, in some cases as much as 75% of all data for entire buildings, reports with missing data were included in the results. Missing data could have comprised a time period as short as a 15-second increment or as large as multiple days. The reports do not provide this information, only a notice of missing data.

Eliminated buildings

In some cases, monthly reports indicated no electricity use. None of the buildings reporting no electricity use were completely shut down at any point during the past 10 years, meaning that these readings must be false. Zeros occurred frequently in the buildings removed from the results analysis. These buildings included Haenicke, and French Halls, the Lee Honors College, and Seibert Hall. Schneider Hall, Wood Hall, and the College of Health and Human Services Building were removed because of significant amounts of missing data coupled with extremely varying, unrealistic data. Sangren Hall, Western View Apartments, Elmwood Apartments, and the Office for Sustainability building were removed because these buildings were added to the metering system within the past year and have no historical data, making it impossible to decipher yearly trends from treatment effects.

Project implementation

Because of the slow progression of this project and delays with implementation of interventions, a discussion of the barriers to progress is warranted. The research project began in 2012 with the understanding that upgrades to WMU's central server would need to take place. These upgrades were necessary before integration with Lucid could happen. The server was upgraded in February 2013. However, new software still remains to be installed on the system as of May 2015. Touchscreen installation protocol was initiated in December 2014, immediately following full Lucid integration and installation of new meters in multiple buildings. Touchscreen installation commenced in September 2014 but was halted after campus authorities determined they had been installed contrary to Americans with Disabilities Act (ADA) guidelines. A solution was fashioned, which included the installation of wooden boxes below each touchscreen. While all touchscreens were installed by March 2015, currently, no touchscreens have been made ADA compliant. All upgrades and installations mentioned were and continue to be performed at the sole discretion of WMU's Facilities Management Department's Construction Services.

The issues that arose throughout the implementation of this project should be considered in the planning of future projects. This project was developed as a collaboration primarily between Honeywell Building Solutions and WMU's Office for Sustainability. While WMU's Facilities Management department was involved from the development stages, a subsector of this department, Construction Services, was relied upon for much of the implementation of interventions. Future projects should address this necessary relationship during the planning process.

Future research

The interaction data and results from student surveys indicate that the Eco-Thon competition programming was weak, especially when compared to the strong results documented in previous studies (Petersen et al., 2007). In order to directly compare our findings to those of previous research, a similar model must be adopted with higher levels of publicity and communications with students about the dashboards and the competition. Beyond the competition, further publication of the dashboard websites is necessary. Within the timeframe of the current study, websites were not advertised prior to Eco-Thon in an effort to increase the potential for effects to be seen from the competition. Further promotion of the dashboard to the entire university is the next logical step.

A resolution to the electricity metering issues will result in a wealth of additional data and potential for analysis. It is currently believed that the issue lies within the connection between Lucid and the WMU server and involves the Siemens software that is installed on the server computer. This issue will take time to resolve, but has the potential to provide retrospective data in 15-minute increments for all buildings involved in the study. The ability to measure data on this timescale will also open the possibility of additional control measures. Implementing a reversal design would be the most effective method for measuring effects of the dashboard alone. With data available for increments throughout each day, reversal conditions could be implemented. A reversal condition could include covering select dashboards short periods of time and then reintroducing them after a number of days or weeks. This would help to elucidate the impact of the dashboard on electricity use by further eliminating extraneous variables.

In the absence of additional retrospective data, the continuation of monthly data collection may also prove to be fruitful. Utilizing the monthly data alone means that currently no building has more than 7 months of treatment data and some only have two. This simply is not enough data to make finite conclusions. Continuing this system of data collection into the future would provide enough data to compare against historical yearly trends and make it possible to draw further conclusions about the existence or absence of electricity use reductions. This additional data would also allow for a cost-benefit analysis, an aspect of this research that is still missing from the literature.

Conclusion

This study presents the most comprehensive dataset found in the literature. It addresses the concerns of Johnson et al. (2012) while calling into question the results from other studies with very short data collection periods. While it is apparent that our attempts to incite electricity reduction through dashboard feedback and competition programming were not effective, this research project sets the stage for further analysis.

References

Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2005). A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology, 25*(3), 273-291. doi: 10.1016/j.jenvp.2005.08.002

The Association for the Advancement of Sustainability in Higher Education (AASHE) (2015). *Campus Building Energy Dashboards*. http://www.aashe.org/resources/campus-building-energy-dashboards

Bekker, M. J., Cumming, T. D., Osborne, N. K. P., Bruining, A. M., McClean, J. I., & Leland, L. S. Jr. (2010). Encouraging electricity savings in a university residential hall through a combination of feedback, visual prompts, and incentives. *Journal of Applied Behavior Analysis, 43*(2), 327-331.

Geller, E. S. (1981). Water reduction and resource recovery: Strategies for energy conservation. In A. Baum & J. E. Singer (Eds.), *Advances in environmental psychology, Vol. III: Energy conservation: Psychological perspectives* (pp. 115-154). Hillsdale, NJ: Erlbaum.

Geller, E. S. (1992). It takes more than information to save energy. *American Psychologist, 47*(6), 814-815.

Geller, E. S., Erickson, J. B., & Buttram, B. A. (1983). Attempts to promote residential water conservation with educational, behavioral and engineering strategies. *Population and Environment, 6*(2), 96-112.

Johnson, P. M., Xu, Y., Brewer, R. S., Lee, G. E., Katchuck, M., Moore, C. A. (2012). Proceedings from International Academic Conference on Meaningful Play: *Beyond kWh: Myths and fixes for energy competition game design*. Lansing, MI

Lehman, P. K. & Geller, E. S. (2004) Behavior analysis and environmental protection: Accomplishments and potential for more. *Behavior and Social Issues, 13*(1), 13-32.

Lucid Design Group (2015). *What is Building Dashboard*. http://luciddesigngroup.com/buildingdashboard/index.html

McClelland, L. & Cook, S. W. (1980). Promoting energy conservation in master-metered apartments through group financial incentives. *Journal of Applied Social Psychology, 10*(1), 20-31.

Petersen, J. E., Vladislav, S., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. *International Journal of Sustainability in Higher Education, 8(*1), 16-33.

Slavin, R. E., Wodarski, J. S., & Blackburn, B. L. (1981). A group contingency for electricity conservation in master-metered apartments. *Journal of Applied Behavior Analysis, 14,* 357-363.

Walker, J. M. (1979). Energy demand behavior in a master-metered apartment complex: An experimental analysis. *Journal of Applied Psychology, 64*(2), 190-196.

Werner, C. M., Turner, J., Shipman, K., Twitchell, F. S., Dickson, B. R., Bruschke, G. V., & Bismarck, W. B. (1995). Commitment, behavior, and attitude change: An analysis of voluntary recycling. *Journal of Environmental Psychology, 15,* 197-208.

Winett, R. A., Kagel, J. H., Battalio, R. C., & Winkler, R. C. (1978). Effects of monetary rebates, feedback, and information on residential electricity conservation. *Journal of Applied Psychology, 63*(1), 73-80. doi: http://dx.doi.org/10.1037/0021-9010.63.1.73

Appendix A

		13		2014												2015				
	Month:	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M
Experimental Condition:		Baseline										Dashboard					Eco-Thon			
Bernhard Center	Mixed Use																			
Valley 2	Residence Hall																			
Henry	Residence Hall																			
French	Residence Hall																			
Draper/Sied	Residence Hall																			
Office for Sustainability	Mixed Use																			
Moore Hall	Academic/Classroom																			
Sangren Hall	Academic/Classroom																			
Seibert	Mixed Use																			
Western View	Apartment																			
Elmwood	Apartment																			
Elmwood	Apartment																			
Faunce	Mixed Use																			
Haenicke	Academic/Classroom																			
Health & Human Services	Academic/Classroom																			
Lee Honors College	Mixed Use																			
Schneider	Academic/Classroom																			
Western View	Apartment																			
Western View	Apartment																			
Wood Hall	Academic/Classroom																			
Dalton	Academic/Classroom																			

Figure 1

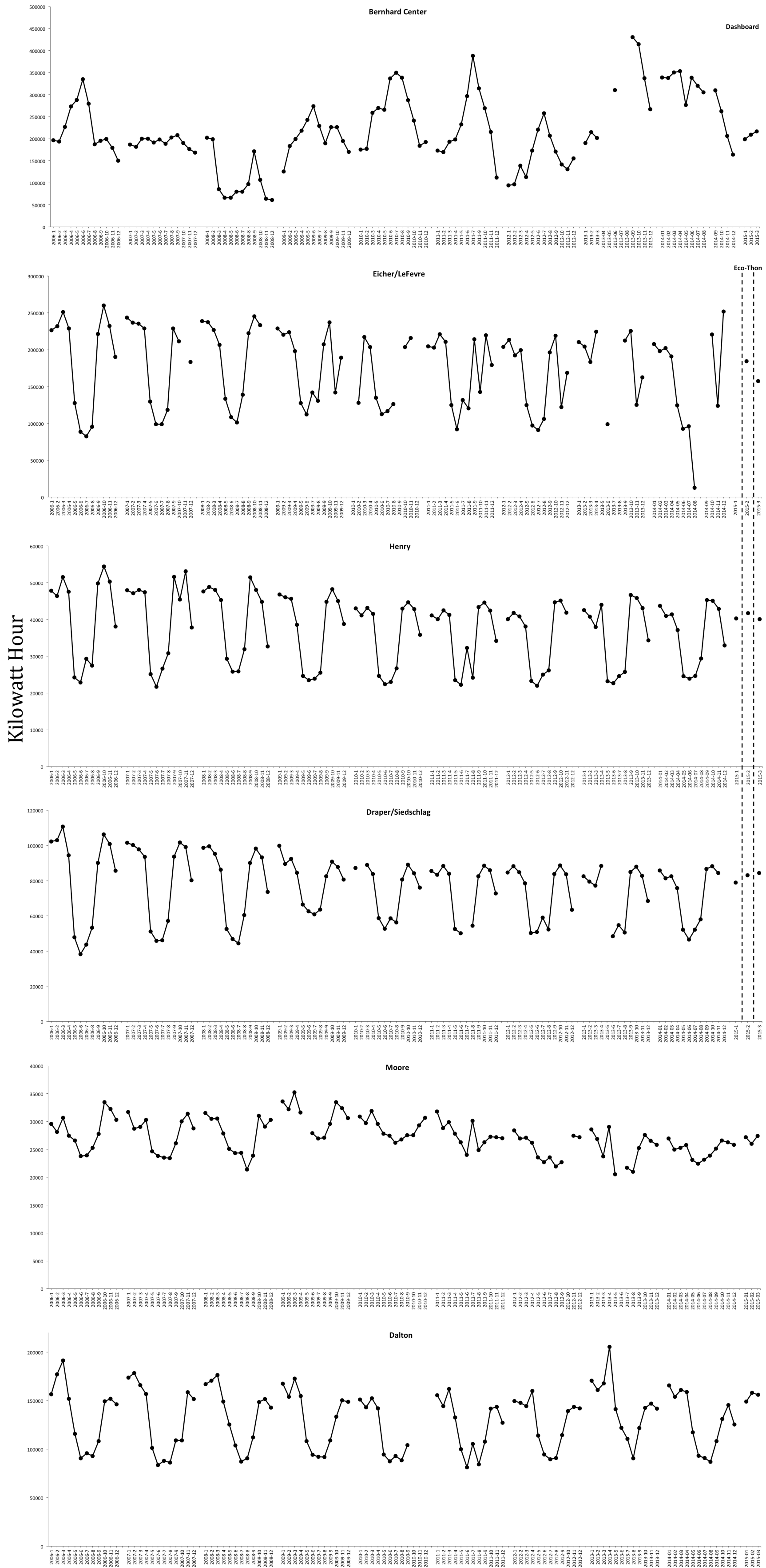

Kilowatt Hour
Bernhard Center
Dashboard
Eicher/LeFevre
Eco-Thon
Henry
Draper/Siedschlag
Moore
Dalton

Figure 2

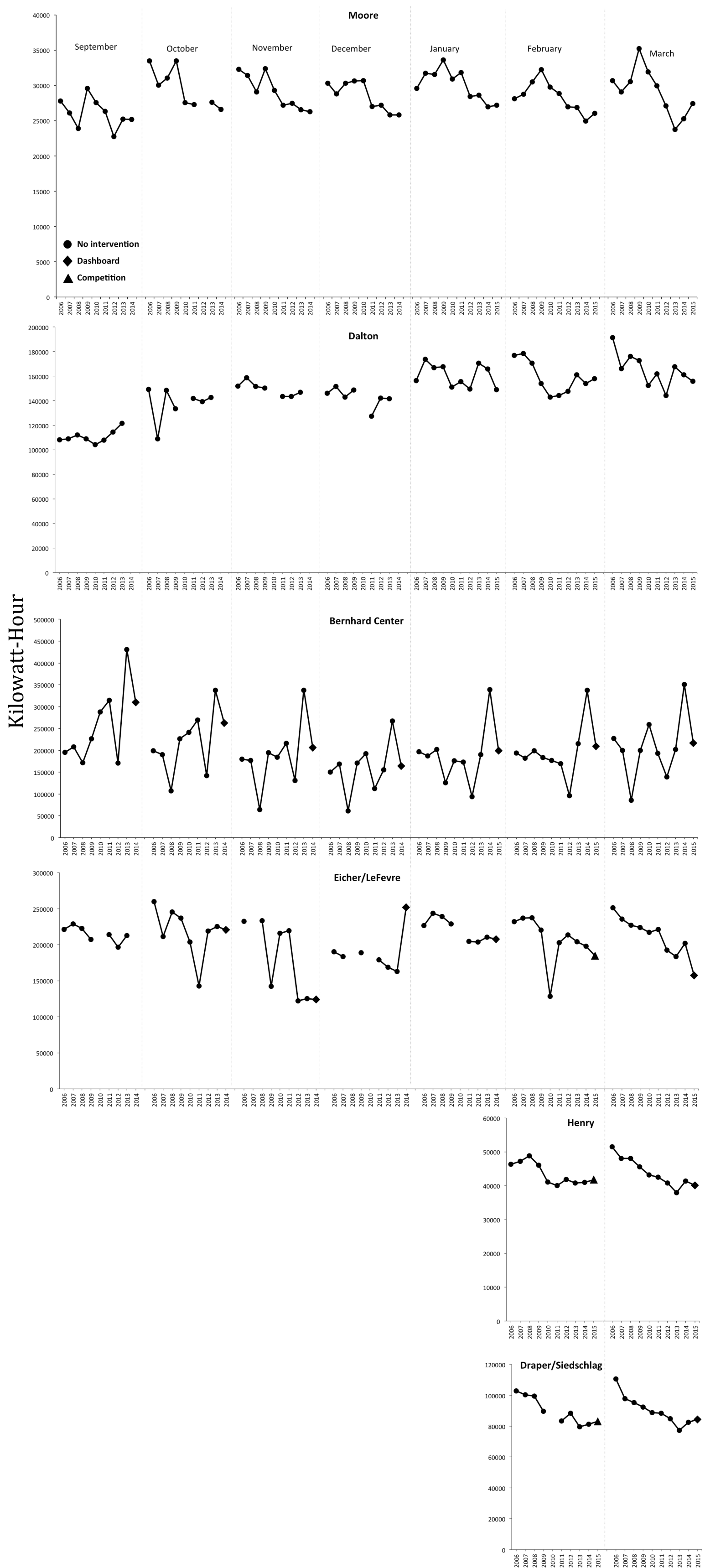
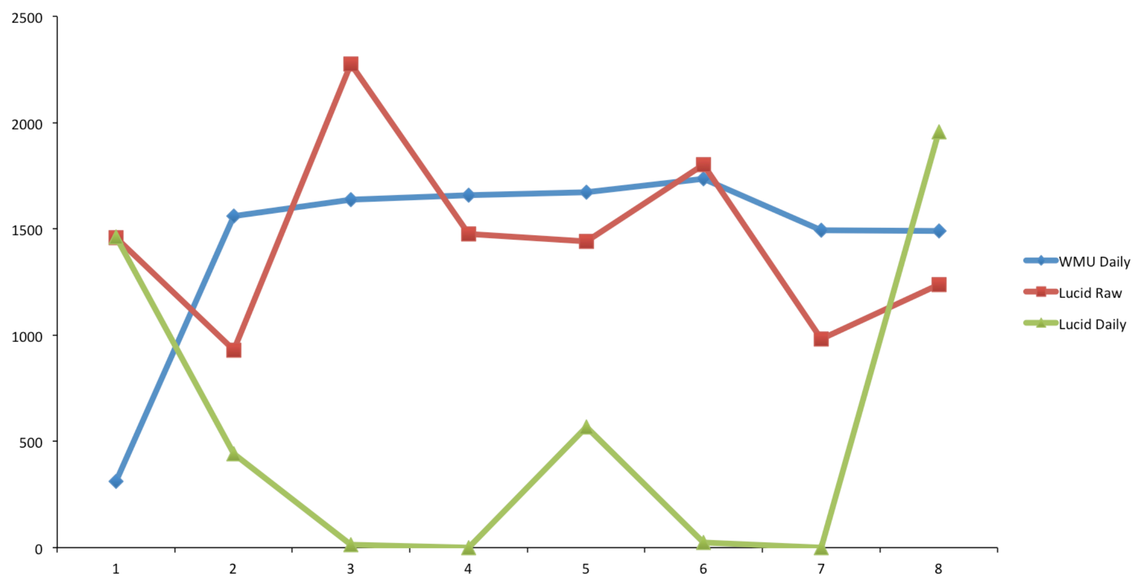

Kilowatt-Hour
Moore
Dalton
Bernhard Center
Eicher/LeFevre
Henry
Draper/Siedschlag
September
October
November
December
January
February
March
No intervention
Dashboard
Competition

Figure 3


2500
2000
1500
1000
500
0
1
2
3
4
5
6
7
8
WMU Daily
Lucid Raw
Lucid Daily