

Date: December 8, 2010

To: Student Sustainability Committee

Cc: Michael Smith

From: Jeremy Neighbors

Topic: Shut the Sash Completion Report

Executive Summary

Lowering the sashes on chemical fume hoods when not in use has been shown to significantly reduce building energy consumption. During late 2009 and early 2010 the Division of Safety and Compliance with a grant from the Student Sustainability Committee conducted a Shut the Sash Pilot Program at the Beckman Institute. The purpose was to determine the resources and procedures required to develop a model Shut the Sash Program that could be implemented campus-wide for reducing energy consumption on variable air volume chemical fume hoods.

Various forms of information about the program were distributed prior to initiating the program. Total building energy use (electricity, chilled water, and steam) and sash heights for hoods not in use were measured to determine the effectiveness of the informational program.

A total of 53 chemical fume hoods at the Beckman Institute were included in the pilot program. Operator-place sash height decreased from the initial baseline measurement of 11.97 inches above the working surface to as low as 1.93 inches above the working surface. The final average sash height was 3.13 inches above the working surface. Based on these readings the program was successful in changing chemical fume hoods user behaviors by encouraging the closing of chemical fume hood sashes when not in use.

In general, energy usage during the pilot program was greater than the baseline use. Not enough is known about overall building energy consumption and the interrelationships between various contributing factors to develop metrics for measuring success in reducing energy costs. Further studies need to be conducted to determine why the anticipated reduction in energy consumption did not occur.

It is recommended that before any action is taken to educate users, background studies should be done to allow more effective control of CFH systems and to more accurately measure the effectiveness of interventions. Funding to conduct the additional studies has been requested as part of the Illinois Climate Action Plan (iCAP). If additional studies indicate that a Shut the Sash program is feasible, additional funding will be sought through the iCAP.

Introduction

The Division of Safety and Compliance (S&C), with a grant from the Student Sustainability Committee (SSC), conducted a Shut the Sash Pilot Study for variable air volume chemical (VAV) chemical fume hoods (CFH) at the Beckman Institute from October 27, 2009 through March 16, 2010. The purpose of the shut the sash pilot study was to evaluate the resources, components, and best practices required to develop a model shut the sash program and implement it campus-wide for variable air volume (VAV) CFHs. Shutting the sash on VAV CFH systems has been shown to significantly reduce energy consumption, reduce carbon dioxide emissions, and improve laboratory safety.

Summary of Activities

On October 14, 2009 an email was sent to all of the occupants of the Beckman Institute that described the purpose of the shut the sash pilot program and activities that would take place during the program. A copy of the informational email is included as Attachment A. Posters were also hung in public spaces and posted on the internal television monitors in the Beckman Institute. A copy of the poster is included as Attachment B. Based on recommendations from the Beckman Institute administration, in-person informational briefings were not conducted due to the unusual hours of the researchers and belief that attendance to the briefings would be very low.

Baseline measurements of sash openings were collected from each of the study CFHs on August 19-20, 2009 and again on October 2, October 16, and October 20, 2009. Posting of the three different shut the sash placards was completed on October 23, 2009. If the labs were occupied during the placard posting process, the student worker spoke briefly with the occupants about the purpose and benefits of the program. A copy of each of the shut the sash placards is included as Attachment C.

Collection of sash opening measurements occurred on a twice-weekly basis beginning on October 27, 2009 through December 14, 2009 and approximately bi-weekly from January 13, 2010 until the end of the study on March 16, 2010. Data collection was limited during breaks such as winter vacation.

Beginning with the November 13, 2009 sash opening measurement event, reminder signs were posted on CFHs that were left open in unoccupied labs. A copy of the reminder sign is included as Attachment D. Vacation reminder signs were placed on all of the CFHs prior to winter vacation and spring break on December 14, 2009 and March 16, 2010, respectively. A copy of the vacation reminder sign is included as Attachment E.

Results

Sash Measurements

Average sash height results by survey date are summarized in the table below. A table containing the sash measurement data is included as Attachment F.

Table 1: Summary of Sash Height Measurements

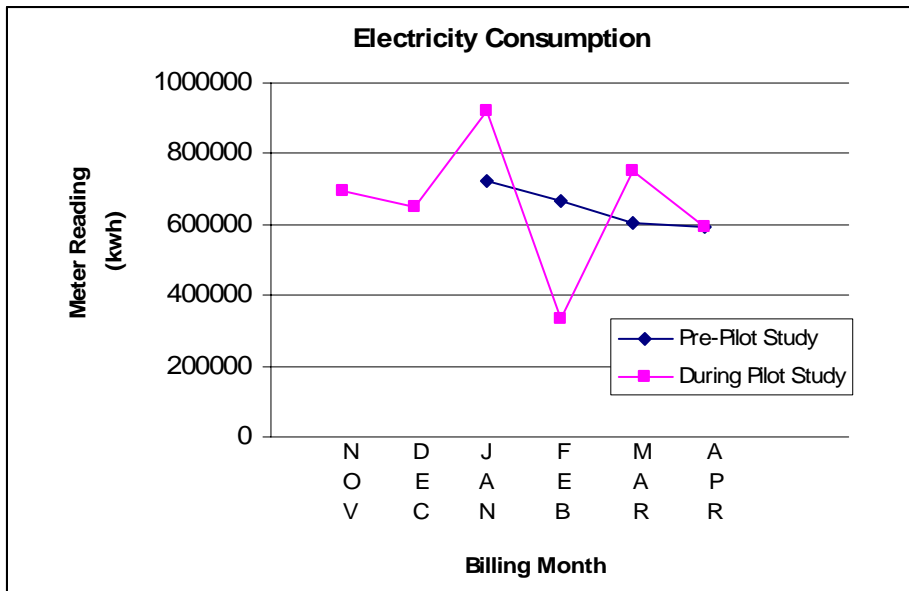
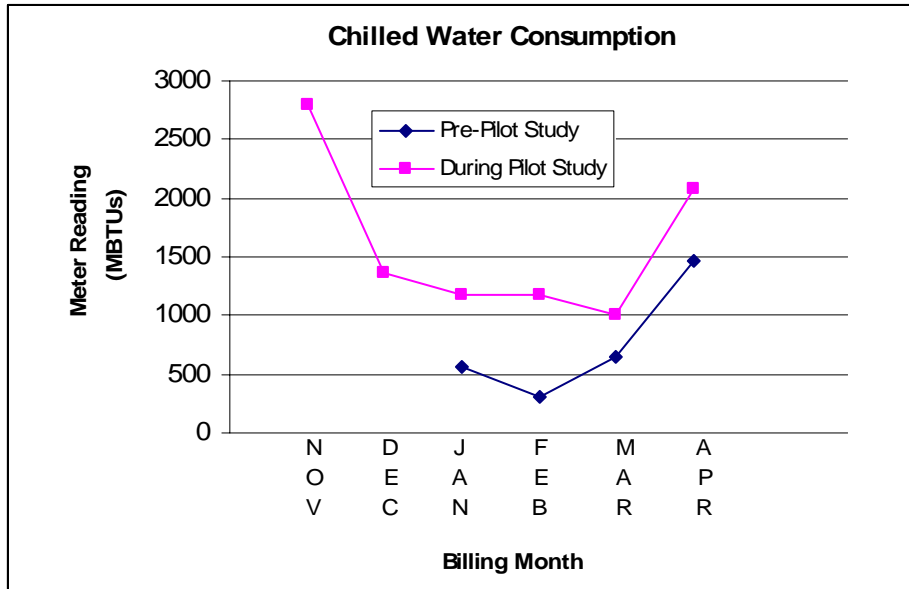
Date/Event Description	Average Sash Height (inches)
August 19-20, 2009/Initial Baseline Measurements	11.97
October 16, 2009/First Measurements Following Email	7.80
October 20, 2009	7.44
October 23, 2009	6.31
October 27, 2009/First Measurements Following Placard Postings	6.02
October 30, 2009	4.33
November 3, 2009	6.37
November 6, 2009	4.92
November 10, 2009	3.92
November 13, 2009/Begin Posting Reminders Signs	4.88
November 17, 2009	3.46
November 20, 2009	3.77
November 23, 2009	3.89
December 1, 2009	2.15
December 4, 2009/Last Reading Before Finals	3.38
December 14, 2009/Last Reading Before Winter Vacation, Vacation Signs	3.09
January 13, 2010	3.35
January 20, 2010/First Reading Following Winter Vacation	4.45
February 3, 2010	3.24
February 17, 2010	2.94
February 27, 2010	1.93
March 16, 2010/Last Reading of Study and Before Spring Break, Vacation Signs	3.13

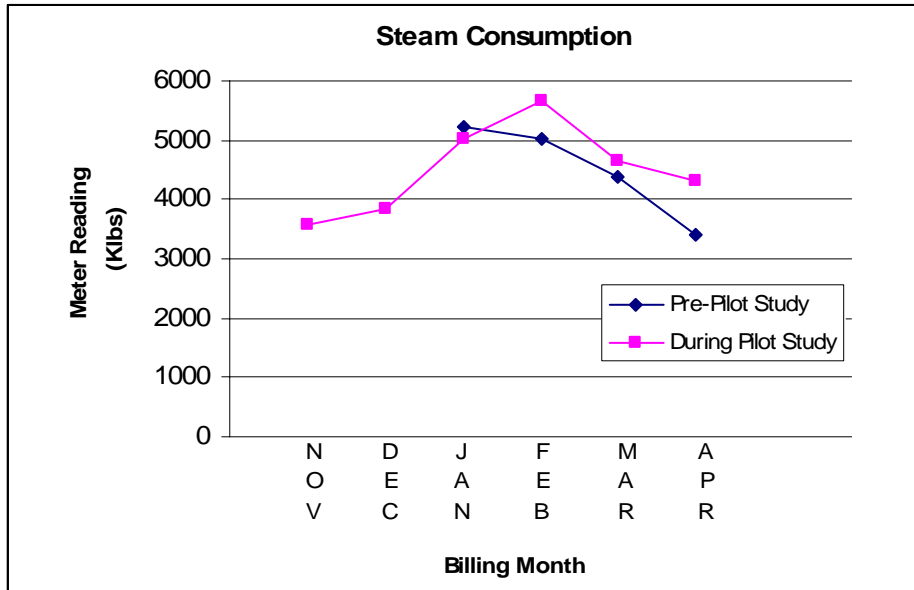
Average sash heights for each sash placard over the entire study period are as follows: arrow placard = 3.47"; 4 reasons placard = 3.37"; and window in winter placard = 3.97". A limitation of the study was that the arrow placards were difficult to install and prone to falling off due to the presence of electrical outlets and service valves on the CFHs. Average sash heights by placard are included in the table in Attachment F.

Energy Consumption

The following charts compare energy consumption prior to beginning the Shut the Sash Pilot Study with energy consumption data during the pilot study. The data are provided based on billing period. Energy consumption shown for the billing period corresponds to the energy consumed during the prior month.

Pre-pilot study data are from billing period January 2009 through April 2009 while the pilot study data are from billing period November 2009 through April 2010. A limitation of the study is that a month-to-month comparison of pre-pilot study data can not be made to data acquired during the pilot study for the month of November and December. Energy data for billing periods January 2009 through April 2010 are included as Attachment G.





Survey

The response rate of the online survey was very low with only six individuals responding. In general, the respondents indicated that the program increased their likelihood of shutting their sash when they are not using their hood. Five of the six respondents believed that the program should be expanded to the rest of the campus. A copy of the survey summary is included as Attachment H.

Three of the six respondents provided write-in comments. Generally speaking, the comments show that there needs to be a local presence to the Shut the Sash Program to be able to work directly with the researchers to promote and implement the program. A summary of the write-in comments is included as Attachment I.

Conclusions

No reduction in energy consumption was observed during the study period compared to energy usage during the same period the prior year. Among the factors that may have contributed to this scenario include a lack of baseline data, faulty VAV controls and sensors, or an increase in building energy loads not associated with the CFH system.

Even though the energy consumption data gathered during the study did not show the desired energy use reduction, the sash location measurements indicate that the pilot program was successful in one of its goals of changing the behaviors of the CFH users. Lowering CFH sashes when not in use creates safer laboratories by preventing chemical vapors from escaping through the sash and protecting the building and building occupants in the event of a fire or explosion in the CFH.

The post study survey suggests that most of the tactics used were beneficial in promoting proper use of the CFH sashes and the 4 reasons placard resulted in the lowest average sash height over the course of the study.

Contrary to a survey respondent's comment in question 14 of the survey, threats of fines were not part of the pilot program. To the knowledge of S&C, these were not promoted by anyone associated with the pilot program, and are not a focus of this study. Any penalty for excessive energy consumption would have to be implemented and enforced by individual campus units at either the departmental or college level.

Recommendations

A thorough investigation of the VAV control and sensor system at Beckman is needed to determine why the anticipated energy reduction did not occur, what repairs or modifications would be required to achieve the savings, and the feasibility of the repairs or modifications. If it is not feasible to repair or modify the Beckman system and others on campus, then creating and distributing a campus-wide Shut the Sash Program is not feasible. Other VAV systems throughout campus should also be evaluated to determine if an energy reduction can be realized through a Shut the Sash Program.

Further investigation is recommended to determine the appropriate course of action needed to design an education program. This investigation should focus on establishing a clear baseline so that reliable performance metrics may be determined and used to assess the program's effectiveness. The study should focus on:

1. Evaluating the VAV control and sensor system at buildings like Beckman to determine why anticipated energy reductions were not seen.
2. Assessing the total energy consumption rates at these same buildings to determine all of the factors that affect usage.
3. Developing tested and reliable metrics from the above data that can be used to evaluate the effectiveness of any later interventions.

A Shut the Sash education program for VAV CFH users has been shown to reduce carbon emissions and related energy costs. A well-designed educational program at this campus would require gaining a full understanding of how campus systems function, developing performance metrics for those systems, and using these data to evaluate the program's effectiveness. Funding for these recommendations has been requested through the iCAP. If development of a Shut the Sash program is determined to be feasible, funding for development and implementation will be requested through the iCAP.

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Attachments